EFFECT OF MACROECONOMIC FACTORS ON AGRICULTURAL PRODUCTIVITY IN KENYA

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A Research Thesis submitted to the School of Business and Economics in Partial Fulfillment of the Requirements for the Award of the Degree of Masters of Science Economics of, Masinde Muliro University of Science and Technology

OCTOBER, 2024

DECLARATION

I declare that thesis is my original work and has not been presented for a degree or any other award in any other university.

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CERTIFICATION

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DEDICATION

This thesis is lovingly dedicated to my father Joash Sirengo, my mother Irene Sirengo, and my devoted sisters Eddah, Lilian, Pauline Sirengo. Brothers: Bethwel, Caleb and Victor for their patience while I was in school finishing my studies. I wouldn't be who I am now without your prayers, your sacrifices, parental guidance, and your unwavering support.

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ABSTRACT

Agriculture is the key driver of Kenya's economic growth and will continue to play a significant role for many years to come. In addition to accounting for 30% of the nation's GDP, the agriculture sector generates over 60% of export revenue, 18% of formal employment, and 60% of informal employment. Furthermore, the sector provides around 65% of the revenues of rural families in the country and 75% of the raw materials used in manufacturing. The Kenyan government has been enacting important macroeconomic policies to boost economic performance through higher agricultural productivity, particularly from 1993 to 2022. This may have contributed to the country's GDP increasing despite low agricultural productivity and rising unemployment. The general objective of this study was to establish the effect of macroeconomic factors on the agricultural productivity in Kenya. Specifically this study sought to: examine the effect of Unemployment on agricultural Productivity in Kenya, determine the effect of Foreign Direct Investment on agricultural Productivity in Kenya and finally to establish the effect of public debt on Agricultural productivity in Kenya. This study was anchored on the Malthusian theory ,Coub Douglas theory, and Keynesian theory. This study adopted a causal research design and used time series data from Kenya National Bureau of Statistics and World Bank spanning from years 1993 to 2022. This study employed E-VIEWS software version 10 to analyse the data both descriptively and by inferential statistics.Correlational analysis indicated a very weak negative relationship (r = -0.0479) between the agricultural productivity and Unemployment; a moderate positive relationships (r= 0.3213) between Foreign direct investment and agricultural productivity and there was also a strong positive relationship (r = 0.65907) between Public debt and agricultural productivity. Augmented Dickey –Fuller test for unit root revealed presence of unit at integrated levels I (0) and I (1), but on first difference the variable was stationary showed, while F-Bound tests revealed no cointergration among variables. Multiple regression analysis confirmed the significant negative effect of unemployment with a coefficient -0.5805 and p value 0.000<0.05. Findings also revealed a positive significant effect of foreign direct investment on agricultural productivity with a coefficient of 0.3661 and p value 0.0014<0.05 Further, public debt equally had a positive and significant effect on agricultural productivity with a regression coefficient 0.1038 and p value 0.0072<0.05. The post-estimation diagnostics test indicated that the regression residuals data was normally distributed, independent variables were not correlated and the regression residuals were homoscedastic and not serially auto correlated. The CUSUM test demonstrated that the model was fit for policy making. This study concluded unemployment had negative significant effect while foreign direct investment and public debt had positive significant effect on agricultural productivity in Kenya. This study recommends that government should; develop and implement sustainable subsidy programs to curb unemployment rates, Access and use of modern agricultural technologies and mechanization to increase productivity along selected value chains, external loans for agricultural productivity must be monitored to ensure that they are appropriately channeled into productive agricultural usage for the Kenyan economy.

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LIST OF ABBREVIATION AND ACRONYMS

AATF	African Agricultural Technology Foundation
ADF	Augmented Dickey fuller
AGRA	Alliance for Green Revolution in Africa
ASK	Agricultural Society of Kenya
ASPS	Agricultural Sector Programme Support
ATAAS	Agricultural Technology and Agribusiness Advisory Services Project
ASALs	Arid and semi-arid lands
ASDS	Agricultural Sector Development Strategy
FAO	Food and Agriculture Organization
FD1	Foreign direct investment
GAP	Global Agricultural productivity.
GDP	Global Domestic product
IFS	International Financial Statistic
IMF	International monetary fund
KALRO	Kenya Agricultural and Livestock Research Organisation
KAPP	Kenya Agricultural Productivity Project
KARI	Kenya Agricultural Research Institute
KNBS	Kenya National bureau of statistics
MDG	Millennium Development Goal
NAAIAP	National Accelerated Agricultural Inputs Access Programme
NALEP	National Agriculture and Livestock Extension Programme
OLS	Ordinary Least Squares
UNCTAD	United Nations Conference on Trade and Development
SRA	Strategy for Revitalizing Agriculture

SDGs	Sustainable development goals
TFP	Total Factor Productivity
WDI	World Development Indicators
WFP	World Food Programme

OPERATIONAL DEFINITION OF KEY TERMS

Agricultural productivity	The final product of the industry after deducting direct inputs and incorporating all outcomes. This ratio, which is determined by calculating the total factor productivity of the food supply (TFP), is also known as the agricultural output-to-input ratio.
Foreign Direct Investment	An investment in a foreign corporation or enterprise by a domestic entity or individual.
Macroeconomic Factors	A major fiscal, environmental, or geopolitical event that has far-reaching consequences for national or regional economy.
Unemployment	This represents the proportion of the Kenyan labor force that is not currently working in an occupation that generates income.
Public debt	The outstanding debts incurred by several tiers of government to fund public deficits arising from increased program expenditures.
Total factor Productivity	defines the link between the actual output and the resources used to generate it.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Agriculture is a vital industry in any nation, serving as a crucial source of food, employment, and economic advancement.Loizou and Mattas (2019).Enhancing agricultural productivity has been humanity's main strategy to address the periodic Malthusian catastrophe, in which the demands of a growing population surpass our capacity to provide sufficient food. Agricultural total factor productivity (TFP) growth has the potential to create returns to farmers—at all scales of production, society, the environment, and the economy. However, since 2011, average annual TFP growth has consistently fallen below the target growth rate whereby 2011–2021, global TFP grew at an average of just 1.14 percent annually below 1.91 percent average annual TFP growth to sustainably meet the agricultural output of a growing global population by 2050.

The main force for expansion in global agriculture has been the increase in productivity, which involves obtaining greater output from existing resources..Fuglie, and Wang. (2012).According to the Food Agriculture Organization FAO (2023), the global population has tripled in the past 50 years, while the food supply has doubled. This increase in food production has been achieved despite a decrease in the amount of land being used for cultivation, which has only decreased by 12% due to human activity and industrialization.

The world aims at achieving the Sustainable Development Goals by 2030 and agriculture is a key sector to achieving these goals for instance Goal 1 - Ending

poverty in all its forms and Goal 2 - Ending hunger to ensure food and nutrition security (United Nations. 2020). To achieve the Sustainable Development Goals by 2030 globally, Sustainable development goals recognizes the inter linkages among supporting sustainable agriculture, empowering small farmers, ending rural poverty, ensuring healthy lifestyles, tackling climate change, and other issues addressed within the set of 17 Sustainable Development Goals in the Post-2015 Development Agenda. (Abraham, & Pingali, 2020) .

The new GAP report (2023) indicates that global agricultural productivity is failing to keep up with the increasing demand for food, primarily due to the influence of climate change. The 2023 Global Agricultural Productivity Report indicates that the annual growth rate of total factor productivity is 1.36 per cent (2021-2022). However, this falls short of the annual target of 1.73 per cent set by the Global Agricultural Productivity Index to meet the future demands of food and bioenergy sustainably by 2050.

Africa is yet a net importer of food. Despite its vast agricultural potential, the abundant land, fisheries, natural resources, and biocultural environment of the area haven't, however, been able to advance the food system. (Oluwole and Olagunju (2022). With the rapidly increasing population, there is an increase in the demand for foodstuffs in an already food insecure world , especially in developing countries. (Shebanina & Lunkina, 2023) .Nevertheless, in economically disadvantaged nations, virtually all increases in agricultural production stem from alterations in land use and the destruction of forests and grasslands for the purpose of cultivation and grazing.

Policy reforms in the 1980s and 1990s generated respectable Total factor productivity growth in sub-Saharan Africa , (GAP 2023).But the region had been unable to sustain

or improve total factor productivity growth due to minimal investments in agricultural research and development. (Oluoko-Odingo, 2018).Developing countries are currently approaching levels of productivity that were achieved by industrialized nations in the 1960s. This indicates that significant global productivity gaps still exist between countries..It is necessary to reconsider the agricultural policies and methods that have been implemented in the past and redirect our focus towards sustainable production. (Ibrahim, 2021)

Establishing robust food supply networks in agriculture may serve as a crucial factor in enhancing the value-added activities and income of those involved in the chains. This objective is to integrate African food systems into the global food chains (Ron Vida,2022).Agriculture systems worldwide must become more productive and less wasteful. (Atukunda, Eide, Kardel, Iversen, 2021). Sustainable agricultural practices and food systems, including both production and consumption, must be pursued from a holistic and integrated perspective .Agricultural growth plays a crucial role in driving the economies of several African countries, and this relationship is mutually beneficial. Kamara, & Cooke, 2019). Kenya relies heavily on agriculture as its primary source of employment. Nevertheless, there has been a decline in the involvement of workers in agricultural operations inside the nation. In 2020, agriculture accounted for 53.8 percent of overall employment in Kenya. (Kosgei and Agwata, 2021) By contrast, the percentage stood at 59.8 percent in 2010. In contrast, employment in the manufacturing and services industries has been steadily increasing.

More than 80% of Kenya's agricultural land is classified as arid and semi-arid, which means it is at risk of being affected by changes in climate conditions. Therefore, it becomes challenging to attain desirable output when rainfall patterns become increasingly unpredictable and only a small number of farmers practice irrigation on their farms. Therefore, the allocation of resources in agricultural production systems necessitates the implementation of precise and focused regulations and actions. (Hemathilake & Gunathilake, 2022). Birch (2018) reviewed the literature on agricultural productivity in Kenya and noted several obstacles to increased agricultural output, including Reduced use of sustainable land management techniques increases land degradation, and variations in rainfall and temperature become a greater danger to agricultural productivity. Low public spending on agriculture has been continuously dropping over the past ten years, (Beintema et al. 2018). Inadequate funding has also led to a shortage of skilled workers inn extension services.(De Groote and Omondi 2021).

Following the structural adjustment programs (SAPs) introduced by the International Monetary Fund (IMF) and the World Bank in the late 1980s, Kenya embarked on liberalizing its economy through the removal of price controls, exchange rate controls, and trade barriers, all of which had a profound impact on the agricultural sector. (Görgen,2019). Over the period between 1993 and 2023, the Kenyan government introduced several key policies aimed at improving agricultural productivity and sustainability, such as:Strategy for Revitalizing Agriculture (SRA) (2004-2014), which aimed to modernize agriculture and enhance food security. Kenya Vision 2030 (launched in 2008), which prioritized agricultural development as a key driver for economic growth. (KNBS ,2023).

In response to agriculture's poor outcomes in terms of productivity, value addition, the Kenyan government developed its most recent strategies, the National Agricultural Investment Plan (NAIP) and the Agricultural Sector Transformation and Growth Strategy (ASTGS, Kenya, Ministry of Agriculture 2018). The premise behind the new approach was that in order to ensure food security, the agriculture sector needed to be dynamic, commercial, and modern in order to sustainably support national priorities, economic growth, and commitments to the UN Sustainable Development Goals. Gollin, (2021).

According to World Bank (2022) after 2015, the nation's economic performance began to reflect decades of policy changes. Kenya's economy saw broad-based development between 2015 and 2019, with GDP growth averaging 4.9 percent year, The COVID-19 pandemic of 2020 had a severe negative impact on the econom. Luckily, the economy's pillar of agriculture held strong, allowing the pandemic-caused GDP decline to be contained to just 0.3 percent (World Bank, 2023).

1.1 Agricultural Productivity Trend



Figure 1.1: Trend of Agriculturl productivity from 1993 to 2022

Source; World bank indicators 2022

Acording to figure 1.1 ,Kenyan agriculture has experienced significant changes between the years 1994-2000 and 2009-2020 which have experienced growth where as the years 2000-2008 have experience diminishing agricultural productivity. There is debate over how these policies and programs affect the productivity of agriculture. Nyoro, & Jayne, (2019). Africa's economy is broadly turning around and support higher growth rates in agricultural productivity, contrary to the more pessimistic image of stagnating African agriculture that is often presented. (World Bank 2023). The rise in productivity growth is attributed primarily to sectoral changes in agriculture and macroeconomics factors . (Waaswa, Mwangi & Ngeno , 2022).

According to the Economic Survey (2022), the agriculture sector had a decline in growth from 5.2 percent in 2020 to a contraction of 0.1 percent in 2021 due to adverse

weather conditions, which resulted in decreased productivity in both crops and animals. Kenya, a developing nation, aims to achieve industrialization by 2030.To realize the goal,Economic development must pick up through downward trend in unemployment rates in order to achieve high agricultural productivity by 2030. Despite progress made, there are still signs that Kenya's agricultural productivity is not yet on a sustainable path of fast growth driven by total productivity factor.(De Groote ,2022).

1.2 Statement of the problem

Agriculture is crucial for Kenya's economic growth and poverty reduction as it plays a major role in generating jobs, facilitating investment creation, managing public debt, and fostering sustainable development. In 2021, it directly contributed 22.7 percent of GDP, accounted for 20.9 percent of total exports, and generated 43.3 percent of employment.(KNBS 2023). The Agricultural sector is thus not only an important driver of Kenya's economy but also the means of livelihood for many Kenyan people.

Agricultural productivity has been inconsistent. since 1993 to 2022, there were periods of growth, but also significant contractions, especially from 2000 to 2008.due toHigh input costs, climate variability, and land use change have hindered productivity.Most Kenyan agriculture is rain-dependent, making it vulnerable to unpredictable weather patterns and climate change, which has led to periods of low productivity.

Kenya is still struggling to meet the global targets for agricultural productivity. The Global Agricultural Productivity Index (GAP) sets an annual growth target of 1.73%

to meet future food demands sustainably by 2050. However, Kenya's productivity growth has been slower than this, which is a concern given the rapid population growth and increasing demand for food.(World Bank ,2023)

Kenya remains a net food importer despite having vast agricultural potential, and productivity is hindered by high unemployment, insufficient investment, and reliance on traditional farming methods. Muyanga, and Jayne (2019).In order to meet the global and regional standards, Kenya needs to Increase investment in agricultural technology and infrastructure,expand irrigation systems to reduce dependence on rain-fed farming.Improve labor participation in agriculture to address unemployment and boost output.Achieving sustainable productivity by 2030 requires that Kenya address these gaps to align with global agricultural productivity growth rates. De Groote, Marangu and Gitonga, (2020).

In this context, Despite agriculture's importance to Kenya's economy, the country has not fully realized its potential for agricultural productivity, largely due to structural and macroeconomic challenges. This necessitates the need for this study to examine the contribution of various macroeconomic factors (unemployment, public debt and foreign direct investment in examining its effects to agricultural productivity in Kenya.

1.3 Objectives of the Study

1.3.1 General Objectives of the Study

The purpose of the study was to establish the effect of Macroeconomic factors on Agricultural productivity in Kenya.

1.3.2 Specific objectives

The study sought to address the following specific objectives;

i. To examine the effect of Unemployment on agricultural productivity in Kenya
ii. To analyse the effect of Foreign direct investment on Agricultural productivity in Kenya
iii. To examine the effect of Public debt on agricultural Productivity in Kenya

1.4 Hypothesis of the study

This study sought to answer the following research hypothesis;

Ho_1: There is no statistically significant Unemployment agricultural productivity in Kenya

Ho_2: There is no statistically significant effect of foreign direct investment on agricultural Productivity in Kenya

Ho_3: There is no statistically significant effect of public debt on agricultural Productivity in Kenya.

1.5 Significance of the Study

Policymakers: Kenyan and regional policy makers will benefit from evidence-based studies on the impact of macroeconomic factors on agricultural productivity. A significant obstacle in Kenya is enhancing the food security of its population, which involves, among other things, augmenting the accessibility of food products and improving the nutritious composition of the food supply.

The findings of the study informs the design and implementation of agricultural policies, economic reforms, and development strategies aimed at promoting sustainable agricultural growth, poverty reduction, and food security. Policymakers can use the insights from the study to formulate targeted interventions, allocate resources effectively, and address macroeconomic challenges affecting the agricultural sector.

Agricultural Industry Stakeholders: The findings of this study are valuable to stakeholders as they provide an analytical foundation for designing institutional, macroeconomic, and agricultural policy strategies. These strategies aim to address the obstacles faced by smallholders in the commercialization and investment in the Kenyan agricultural sector. The ultimate goal is to achieve sustained economic growth, improved food and nutrition security, and reduced poverty.

Farmers: Farmers in Kenya, especially smallholder farmers, benefit from understanding how macroeconomic factors such as unemployment, FDI and public debt affect their agricultural productivity. By gaining insights into these relationships, farmers would make informed decisions regarding crop selection, input usage, investment in technology, and risk management strategies.

This knowledge helps farmers enhance their productivity, profitability, and resilience to economic fluctuations.

Academic and Research Advancements: The study contributes to the academic understanding of the interplay between macroeconomic factors and agricultural productivity, providing a basis for further research.It can serve as a benchmark for

comparing Kenya’s agricultural productivity dynamics with other countries or regions facing similar macroeconomic conditions.

1.6 Scope of the Study

The geographical scope of a study on the effect of macroeconomic factors on agricultural productivity in Kenya was delineated to the entire Country Kenya as developing nation in East Africa.This study mainly utilized the Malthusian population theory,the Cobb douglas production function and the Keynesian theory .

This research work was limited to the effect of macroeconomic factors on Agricultural productivity in Kenya from 1993 to 2022 a span of 30 years. These variables were chosen due to their direct correlation with productivity and the government's ability to influence them through policy interventions. The study narrowed down to a quarterly data for a period from 1993 – 2022. The period of 1993 to 2022 provides a crucial backdrop to Kenya Vision 2030, the country’s long-term development plan aimed at transforming Kenya into a middle-income country. The choice of 1993 to 2023 provides context for evaluating the effectiveness of policies and reforms aimed at achieving the goals of Vision 2030, especially in terms of agricultural productivity and economic stability.

1.7 Limitations of the study.

The secondary data was collected from World Bank Development Indicators,the Central Bank of Kenya (CBK), Economic surveys, Kenya National Bank (KNBS). Data was collected from 1993-2022 covering the period of 30 years.

Multiple sources may provide contrasting data on the same variable. This could make it difficult for locating all the relevant information. The researcher used triangulation of internationally known sources in comparing if the collected data agreed.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter outlines the reviewed literature. Section 2.2 present theoretical literatures, sections 2.3 presents conceptual literature review, 2.4 present's empirical literature review and final 2.5 presents the conceptual framework.

2.2 Theoretical literature review

This section presents the Malthusian theory,Coub Douglas function theory and the Keynesian Theory.

2.2.1 The Malthusian theory

According to Thomas Malthus, who put forth the Malthusianism theory in the late 1700s, population size increases geometrically and uncontrollably while food production increases only arithmetically. The discrepancy in growth patterns inevitably led to a situation where the population would surpass the capacity of food production. This required the implementation of what he called preventive measures (such as celibacy and delayed marriages) and positive measures (such as war, disease, floods, and famine) to control the population and maintain a balance with the existing subsistence levels. The assertion that famine, war, and disease served as inherent mechanisms to regulate unrestricted population expansion resulted in him being characterized as a pessimist (Sen, 1982).

The Malthusian theory directly relates to agricultural productivity by focusing on the ability of the land and available technology to meet the food demands of a growing population. In the study, agricultural productivity is the dependent variable, and its changes can be explained through the application of modern technology in agriculture.

High unemployment, especially in rural areas, could be a modern “Malthusian check” on productivity, as it may signal an inability to employ labour efficiently in agriculture, thus reducing overall output as per the findings Ogato and Mbataru (2023).From a Malthusian perspective, public debt used to fund agricultural reforms or modernization efforts (e.g., irrigation or technology) can be seen as a preventive measure to avoid scarcity and improve productivity.

The new agricultural development trajectory should incorporate the principles of sustainable development in all countries, with particular attention given to emerging nations. Undoubtedly, certain transitional phases, such as the substitution of human labor with mechanical power (agricultural mechanization), cannot be entirely disregarded. Nevertheless, it is important to acknowledge that during the initial phases of agricultural production in many African nations, there may arise certain environmental limitations. The theory is relevant contextualizing the role of public investment (through debt) and technological innovation (enabled by FDI) as responses to population pressure on agricultural productivity.

This study examined the impact of macroeconomic factors on Kenya's agricultural sector, as the country is one of several developing nations facing the formidable challenge of feeding a rapidly expanding global population in the face of a steadily worsening global productivity situation.

2.2.2 Cobb-Douglas Production Function Theory

The study utilized the Cobb-Douglas production function, as suggested by Solow (1961), Barro (1992), and Lyashenko (2013), which is the most suitable model for identifying potential sources of growth while considering the potential for substitution and its constraints. In order to determine the specific or combined impact of inputs on output, it is essential to build a production function.
The Cobb-Douglas production function utilizes two inputs, namely capital and labor,

($Yt = AKt$ and Kt = $sYtKt$,) (1)

Where S is an exogenous and constant investment rate, while A is an exogenous and constant efficiency parameter. In this configuration, the variable K represents physical capital. Solow's model considers saving rates, population growth, and technological advancement as exogenous variables. At a given moment, labor and capital are considered as inputs with their respective marginal products in the production function, assuming a Cobb-Douglas model.

Production functions, is:

$[Yt = AtKt\alpha Lt1-], \theta < \alpha < 1$ (2)

In the given context, Y represents production, K represents physical capital, L represents the labor force, a represents the elasticity of physical capital, and A represents the technological level. The number of effective labor units increases at a rate of (n + g) at Atlt. As per the model, a fixed quantity of production is consistently allocated for investment. The calculation of k, which represents the stock of capital per unit of labor, may be determined by the equation k = KAL. Similarly, the quantity of output per effective unit of activity, denoted as Y, can be calculated using the equation Y = YAL.

The study used the Solow (1956) growth model, which breaks down economic development into fundamentals in the production function, to recognize the link between Macroeconomic factors and agricultural productivity.

$Y = (K, L)$ (3)

Accepting the Cobb Douglas model (1928), Mankiw, Romer, (Koutsoyiannis, 2006), stipulated that agricultural productivity would be the output of a function of capital

(K), labour (L), and human capital (H),agricultural productivity at the time (t). As states the following equation:

$$Yt = At + Kt\alpha + Ht\lambda + Lt\gamma \quad (4)$$

Here Y represents output growth, A is “total factor productivity”, K is capital, L is labor, and His human capital. Agriculture productivity (AGR) is defined as a “function of Unemployment (UNP), FDI, Public Debt (PDT). As a result the general production Function is.

$$\text{AGR} = At\text{UNP}t\beta 1 + \text{FDI}t\beta 2 + \text{PDT}t\beta 3 \quad (5)$$

This theory treats agricultural productivity as the output of a production function where the inputs include capital, labour, and technology.Unemployment affects the labour input in the Cobb-Douglas model. A high unemployment rate suggests that a significant portion of labour is unused, reducing the productivity of the economy, including the agricultural sector FDI introduces capital, technology, and expertise to the agricultural sector. In the Cobb-Douglas framework, an increase in capital (such as from FDI) can directly boost productivity, assuming the labor force (which may also be influenced by FDI) is efficiently utilized.Public debt, when used to invest in infrastructure or technology (e.g., irrigation, farm mechanization), increases capital in the production function. This can enhance productivity, as public debt-financed investments contribute to the efficiency of inputs in agriculture.

Cobb-Douglas function is relevant as it highlights how agricultural productivity can be optimized by balancing these inputs.This theory is relevant in explaining the relationship between agricultural output and inputs such as capital and labor. It was

used to model how changes in these inputs, such as FDI (capital) and labor (affected by unemployment), impact productivity.

2.2.3 The Keynesian theory

The Keynesian theory' was first suggested by British economist John Maynard Keynes who was the founder of Keynesian economics. 1953; 1964. The Keynesian theory emphasizes the role of government intervention in stabilizing and stimulating the economy through fiscal policies. According to Mankiw Gregory (2013), Keynesian economics argues that in periods of underemployment, government borrowing can boost aggregate demand and stimulate economic activity, including in the agricultural sector. Keynesian theory implies that agricultural productivity can be enhanced by increasing aggregate demand through government investment funded by public debt in the sector. Public spending could also reduce unemployment, allowing for better utilization of labour in agriculture, thus raising productivity. (Omodero, & Alpheaus, 2019).

The Keynesian perspective also highlights the role of government spending in reducing unemployment. When unemployment is high, Keynesian policies advocate for government intervention to boost job creation in sectors like agriculture, which can then improve overall productivity. (Omodero, & Alpheaus, 2019).

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According to the Keynesian theory economists , public debt and Agricultural growth are positively correlated, an increase in government spending funded by borrowing and other sources boosts domestic economic activity, which at any given interest rate level increases aggregate demand, savings, and private investment, thereby crowding in private investment. The theory promotes the utilization of proactive government policies to regulate overall demand in order to tackle or avert economic recessions. The Keynesian perspective proposed a direct correlation between public debt and economic expansion. Eligayehu (2013). The Keynesian framework suggests that public debt, when used for productive investments such as in infrastructure, education, or agricultural technology, can stimulate economic growth. Ogunnoiki (2016) notes that , public debt can be seen as a tool used by the government to increase agricultural productivity through investments in agricultural inputs and service. (Sogah, E., Tuffour, J. K., Mawutor, J. K. M., & Gborse, F. C. (2024). This theory justifies the inclusion of public debt as an independent variable, as it shows how government borrowing can enhance productivity in agriculture, reduce unemployment, and stimulate broader economic growth.

2.3 Conceptual Literature Review

2.3.1 Agricultural productivity

Agriculture is a crucial tool for promoting sustainable development, reducing poverty, and improving food security in emerging nations. In Sub-Sahara Africa (SSA),

productivity in agriculture lags behind globally, and is below the required standards of achieving food security, poverty goals and food sufficiency (Fuglie, 2023).

However, it is important to note that the rate of agricultural productivity development in certain African nations, such as Kenya, has been remarkably high since the early 2000s. Nevertheless, it is crucial not to become complacent with this achievement. The authors of the study are Mekonnen, Tessema, Ganewo, and Haile (2021). In order to achieve sustained and fast growth, it is imperative to significantly enhance the productivity of smallholder farmers.

The Strategy to Revitalize Agriculture (SRA), Kenya Vision 2030, Comprehensive African Agricultural Development Program (CAADP), and Alliance for Green Revolution in Africa (AGRA) have emphasized the significance of enhancing agricultural productivity in combating poverty. Historically, agricultural production was mostly influenced by the amount of land available, but future increases in production will depend on improvements in productivity.

The agricultural sector for every country is the basic catalyst and accelerator of growth (Patrick, 2013). Agriculture sector plays a decisive role in economic growth and development, especially for developing countries (Sharif & Noor, 2015).

The sector has a potential in reducing poverty and creating employment for a large number of people in developing countries (Ukpe et al., 2018). Productivity in agricultural is also important for spurring economic growth in other sectors.World Bank (2023).Hence, the country's aspiration for achieving overall economic growth largely depends on the performance of the agriculture sector (FAO, 2020). In spite of

huge agricultural potential, the growth in agricultural production has not been able to keep pace with that of the demand which has compelled the country to depend on foreign food. (Khatri, Joshi, & Vyas, 2017).

Moreover the current Kenyan development policy stresses on development push from agriculture to industry based on use of all means of increasing productivity and production of the sector (Dagninet & Wolelaw, 2016). Due to such importance of agricultural sector, the Kenyan government gives high priority to the sector by planning and implementing different strategies (Moa, 2015).

Agricultural Development Led Industrialization (ADLI) is the central pillar of the economic strategy of the country (Mohammed, 2018) whose prime objective is to strengthen the linkage between agricultural and industrial sectors (Fantu, 2016). The government also has been implementing the Agricultural Growth Program I and II (AGP-I and II) to increase agricultural productivity and commercialization via addressing some of the key constraints to agricultural growth (Moa, 2015).

The production of food has a profound influence on land and resources. Among all the activities we engage in, this is the one that we must diligently protect and conserve in order to perpetuate our species. Therefore, it is imperative to prioritize agricultural productivity in order to make significant progress in terms of sustainable development. An increase in agricultural productivity may have positive effects on Kenya's food security (Yudelman, 2020), hence the need to embrace agricultural technology in an effort to spur growth and development.

2.3.2 Unemployment and Agricultural productivity

Unemployment is widely seen as a great problem to global economic development. Both developed and developing countries, in recent years, have witnessed different degrees of this problem, with the latter witnessing the most shock. (Kamau & Atela, 2022). The global population growth is not proportional to the employment and entrepreneurship opportunities available, especially for young people living in developing countries (Yami et al., 2019).

The youth unemployment rate in most African countries is said to be more than twice as high as the adult jobless rate. (World Bank, 2023). Africa's economic growth and social development heavily rely on the agriculture sector. The agricultural sector employs the largest proportion of the overall population, particularly in Africa (Africa Agricultural Situation Report, 2019). The economic and rural development greatly depend on the dynamics of the rural population, young individuals, and employment. The departure or waning enthusiasm of young individuals from the agricultural sector can lead to a depletion of the labor force, so negatively impacting the productivity of the rural economy (Başaranoglu and Yılmaz, 2020). Furthermore, the younger generation possesses the ability to introduce fresh expertise and vitality, as well as implement a higher level of professionalism in the agricultural industry. In light of an aging agricultural workforce, it is imperative to secure the future of the farmers' profession (Redigor, 2012).

Kenya is a developing country with a GDP of $95.5 billion. The agricultural sector plays a key role in the Kenyan economy, contributing 51 percent to the total GDP (World Bank, 2019). 60% of the total workforce in Kenya is employed in the

agricultural sector. The average unemployment rate in Kenya from 1991 to 2022 was 8.98 percent. It reached its highest point of 12.20 percent in the fourth quarter of 2009 and its lowest point of 4.70 percent in the second quarter of 2019.

Kenya unemployment rate for 2022 was 5.64%, a 0.05% decline from 2021. (KNBS, 2023). However In 2023 Kenyan Unemployment rate is 6.19% and has been identified as one of the major causes of poverty (World Bank 2024). In most developing countries like Kenya, governments and policy makers are finding it increasingly difficult to deal successfully with the problem of unemployment which has risen continuously culminating in reduction of household income and living standards and concomitant rise in the level and incidence of poverty (Ude, 2020).

In urban areas, there are limited job opportunities for the youths thus rural-to-urban migration has increased the unemployment rate in Kenya. (Katumo, 2019). The shifting of young people from the agricultural sector to other sectors is largely attributed to the strength of various push and pull factors based on global economic trends that favor the non-agricultural sector over the agricultural sector, thus shifting the workforce from agriculture (Njeru, 2017).

To solve unemployment in Kenya, the agricultural sector possess the highest potential, and unemployed youths need to be productively involved and be made part of the food systems. (Kamau & Atela, 2022).

Given its labor intensive nature, agriculture sector act as a means through which the unemployed youths in Kenya may be absorbed towards contributing towards increased productivity in the Kenyan economy hence achieve food security by 2030 (Himaja, 2020).

2.3.3 Foreign direct investment and Agricultural productivity

According to the World Bank (2023) and the UNCTAD (2023) statistics, FDI is a type of international investment in which a resident of one economy (the direct investor) acquires a long-term stake via an enterprise in another economy (the direct investment enterprise).

Foreign direct investment (FDI) fell 7% to USD 1,364 billion in 2023, continuing a downward trend and remained below pre-pandemic levels for the second year in a row. In 2022, FDI flows into the country reached USD 759 million, an increase of over 64% from the levels reported prior to the epidemic. FDI totaled $11.2 billion at the end of the same period, which was just 9.7 percent of the country's GDP. If you believe the National Bank of Kenya's Foreign Investment Survey, the top five countries sending money to Kenya are: the UK(13.5%), the US(10.3%), South Africa(9.8%), and France (5.2%). Bringing in capital from outside investors is a key strategy for developing nations like Kenya to boost their economies. FDI has the potential to drive growth in economies. According to Bouchoucha and Ali (2019), this boosts a country's chances of becoming more integrated into international financial flows, increasing its exports and employment base, and creating technical spillovers that enhance local enterprises' efficiency and capacity.

The link between technology and farming is longstanding. Agriculture is a technological advancement that emerged as a creative solution to the increasing population of our hunter-gatherer ancestors. Modern society has become significantly dependent on technology to address the ongoing challenge of providing sustenance to a continuously growing global population. (Degu, 2019).

The advent of novel plant varieties, advancements in chemical fertilizers and pesticides, and innovative approaches to large-scale crop production and processing have brought about a period of immense agricultural output. (Sikandar, F., Erokhin, Wang ,& Ivolga, (2021). FDI enhances agricultural growth productivity by injecting substantial money and incorporating novel inputs and foreign technologies into the production processes of local firms. Enhancing access to agricultural inputs, such as the enhancement of crop varieties, adoption of advanced farming practices, utilization of fertilizers, and technology advancements, can significantly boost farmland and labor productivity. These improvements will lead to increased crop yields and overall output (Almfraji & Almsafir, 2017).

Today, FDI affects a country in numerous ways. FDI is crucial for emerging nations like Kenya (Kumar & Gopalsamy, 2020). For many developing nations, especially those with high rates of poverty, savings, and unemployment, it provides a crucial source of income and may even be their lifeline (Hasan, 2017). For the fiscal year of 2022–2023, the Kenyan government estimates that over 25.3% of the population will remain poor (World Bank 2023). Investment from outside the country can strengthen many industries, including agriculture. Investment in agriculture needs to be increased by developing nations (Robin, 2017). Food shortages and insecurity have been problems across Africa, including in Kenya, despite the country's abundant arable land. Kenya must increase its investment and open up new markets. Agriculture is the main industry in Kenya.

Forty percent of the population works in agriculture. Agriculture contributes over 20% to the GDP. Subsectoral breakdowns within this sector indicate that 55% of its agricultural economy is devoted to crops, 14% to livestock, 22% to fisheries, and 9%

to forests (CBK 2023). Agriculture has long played a significant role in Kenya's economy. Agriculture is the main source of income for most people who live in rural areas. Every single economic advancement that the country has made has its roots in agricultural development. According to Lowder and Skoet (2022), 20% of GDP comes from the agricultural sector.

The Kenya Investment Authority reports that the agricultural sector generates approximately 70 million metric tons of output, with maize, tea, wheat, rice, green grams, and beans being the primary commodities. FDI is responsible for the supervision and promotion of private investment. Kenya exports a variety of items to more than 140 countries, including cut flowers, roses, coffee, tea, palm oil nuts, tobacco, cut flowers, and processed agricultural products including feed for cattle, chicken, and fish (Kenya Trade Agency report 2023) among the top ten. Whether it's via the transfer of technology and experience or the augmentation of local capital to encourage expansion, many researchers have stressed the importance of FDI for the growth of the host nations' economies. Many countries, especially developing ones, have passed legislation or instituted incentives to attract FDI because of these benefits (Iddrisu, & Halidu, 2015).

Whether or not host economies gain from FDI has been the subject of a great deal of empirical study (Kumar, & Gopalsamy, 2020). There has been research on the potential for FDI to spur domestic capital development and on the potential for FDI to have spillover effects. Many studies have looked at how FDI impacts GDP growth in the host country. There will be more economic development if FDI in the agricultural industry is increased. FDI and agriculture are intricately related to one other.

Agriculture continues to play a significant role in Kenya's economy. Improving a developing nation's financial development requires investment in numerous sectors of the country. The chance for developing nations to attain speedier monetary development presented by FDI is immense in current era of globalization (Dhungana, & Ghimire, 2013).

2.3.4 Public debt and Agricultural productivity

Borrowing made by the government form the debt owed by the government of the country. Such borrowings either external or internal are meant to supplement domestic savings and allow such countries to carry out productive activities, (Getinet, & Ersumo, 2020). Borrowed funds from third parties, such as private companies like Chartered Bank UK or international organizations like the IMF, are known as "external" creditors. Countries like as the United States, Germany, Japan, France, and Italy are examples of bilateral creditors. According to World Bank (2023), multilateral creditors include the following: IDA, IFAD, EC, World Bank, IMF, and European Investment Bank.

Domestic debt is amounts borrowed from government instruments like Treasury bills, bonds, and others (UNCTAD, 2023).Murungi and Okiro (2018) affirm that internal borrowing is a form of fiscal financing, where the government raises funds through floating loans within the country.When a country is unable to generate enough domestic savings to carry out their productive activities, they opt for borrowing, such borrowings are termed as public debt which is a major source of public revenue (Omodero, & Alpheaus, 2019).

Countries incurs debts for two broad macroeconomic reasons; either to circumvent hard budget constraints or finance higher investments such as the agricultural sector. This implies that an economy indulges in borrowing to stimulate economic activities like in the agricultural sector and enhance standard of living of people, (Guei, 2019).

The East African Community (EAC) is one of Sub-Saharan Africa's fastest-growing regions, averaging 6.2 percent GDP growth in 2022(EAC Development Strategy). However, the IMF has raised an alarm on the high debt accumulation of the EAC countries that has resulted to a revision of debt stress levels. Kenya’s public debt was 61.1% of GDP in 2023 largely on account of heavy commercial borrowing and exchange rate depreciation (PDMR, 2022/2023.

Kenya's gross state debt rose by Ksh1.93 trillion to Ksh11.1397 trillion on December 31, 2023, up from Ksh9.2 trillion ($63.45 billion) at the end of December 2022. Published by the Treasury, the October-December 2023 quarterly economic and budget review report showed that the gross public debt constituted 45.3% domestic debt and 54.7% external debt. Variations in the currency rate, the distribution of external loans, and the growth in domestic debt over the designated time help to explain the rise in the national debt.

Nevertheless, enhancing agricultural production continues to have a prominent position in the hierarchy of sectors that receive significant government attention and support. The sector is widely regarded as a catalyst for economic growth, generator of wealth, and contributor to poverty reduction for a significant portion of the population in Kenya. As an economic activity agriculture contributed about 20% of GDP and provided 60% of employment in recent year (KNBS 2023).

Output from agriculture in the Economic Survey (2022) reported a deceleration in the growth of the agriculture sector from 5.2% in 2020 to a contraction of 0.1 % in 2021 on account of unfavorable weather conditions that led to a reduction in both crops and livestock performance. The decrease in productivity was ascribed to the increasing expenses of agricultural inputs, infestation of leaf lust, and the transition of land usage from agriculture to real estate construction.

The sector experienced a contraction of 0.7%, 1.4%, and 0.6% in the first, second, and third quarters of 2022, respectively. It is crucial to comprehend the patterns in the prices of agricultural commodities and the sector's production, considering the substantial influence of food in the CPI basket and the considerable importance of agriculture in the economy. Moreover, given the high reliance on rain-fed farming, farmers are increasingly vulnerable to drought and unpredictable weather patterns due to climate change. (CBK report 2023).With the fluctuations in the real sector particularly the agricultural sector output and the rising food insecurity, it is pertinent that a lot of borrowings and public debt is incurred. The past couple of decades have witnessed rising concern on the increase in Kenya’s public debt. (KNBS 2023)

Research on the connection between agricultural productivity and public debt debt has been conducted in Sub-Saharan countries like Ethiopia and Nigeria, (Sogah, Tuffour, Mawutor, & Gborse, 2023).

There is a dearth of such literature about Kenya, which leaves a knowledge vacuum in this particular context Kenya, a developing nation, has been promoting the growth of the agricultural sector through initiatives like Agricultural Sector Growth and Transformation Strategy (ASTGS) that draws on the status of our agriculture today to

address challenges and informs the food systems transformation agenda and propel us towards our vision of attaining 100% food and nutrition security by 2030, despite having a high debt to GDP ratio of more than 55.1% (World Bank,2022).

Despite this, a key question remains: does public debt significantly impact the growth of agricultural GDP? Thus, the study looked into the relationship between the rise of agricultural GDP and public debt which makes the examination in the context of Kenya extremely important.

2.4 Empirical Literature

2.4.1 Unemployment

Enilolobo and Ohalete (2017) examined the impact of inclusive growth determinants on agricultural output in Nigeria over the period of 1981 to 2015 employing four macroeconomic variables: Agric GDP, Per Capita Income, Unemployment and Poverty Rates . The model was analyzed using the Augmented Dickey Fuller (ADF) unit root test, Johansen co-integration test, and Error correction model (ECM) procedures.

The ECM analysis showed that there is a positive relationship between agricultural output and factors such as lower unemployment and poverty rates, as well as higher per-capita income. This suggests that agriculture can be an effective way to achieve inclusive growth.

Ogbalubi and Wokocha (2013) conducted a study on the progress of agriculture and its impact on job creation in Nigeria from 1973 to 2002. The study uncovered that Nigeria's agriculture sector is significantly underdeveloped, unable to harness the full potential of the country's climate, land, and human resources.

Shakira (2018) examined the factors that influence agricultural productivity in Malawi. The study utilized time series data spanning from 1980 to 2015 and employed the autoregressive distributed lag (ARDL) model. The findings indicate that there is a positive long-term relationship between agricultural expenditure and agricultural production, suggesting that an increase in agricultural spending leads to an increase in productivity. In the near term, a rise in inflation will lead to a boost in agricultural productivity. However, there is no substantial correlation in the long term. Bernard and Adenuga (2017) utilized the Error Correction and Granger Causality tests to examine the impact of the agriculture sector, along with other explanatory factors such as GDP, foreign private capital, and federal government expenditure on employment generation in Nigeria.

The study unveiled a direct correlation between agricultural production and the creation of jobs in Nigeria. Thus, Bernard and Adenuga (2017) supported the Keynesian view that increase in aggregate supply will increase employment generation of a country.

2.4.2 Foreign Direct Investment

Oboyede (2014) did research on how FDI affects the growth of Nigeria's agricultural industry. The research used the Ordinary Least Square (OLS) method of estimate on

time series data spanning 1981–2012. Agriculture benefits from FDI, according to the author. The author further notes that the agricultural sector feels the effects of political unrest.The present analysis used time series data spanning from 1993 to 2023 and was carried out in Kenya, which creates a contextual gap.

Edeh et al. (2020) examined the relationship between Nigeria's agricultural productivity and FDI.The ADF, ARDL, FMOLS, and DOLS techniques were used to conduct the unit root tests and estimate the regression parameters. The research shows that agricultural productivity is positively affected by net FDI.

Ogbanje (2010) looked at how FDI and agricultural production in Nigeria were related.With the help of the OLS method, this research estimated variables using FDI as a diagnostic tool. Foreign investment in Nigeria's manufacturing sector was highest, while that in the country's agricultural sector was lowest, according to the study's results. Even more encouraging for the agricultural sector was the finding that GDP and FDI investment both positively affect it. Indicating that an increase in agricultural output is associated with a link between GDP and FDI.

Khalil (2012) investigated what drives increases in Pakistan's agricultural output. He applied the autoregressive distributive lag model on yearly data spanning 1965–2009. The results indicate that both the application of fertilizer and the level of human knowledge and skills are essential factors in influencing the increase in agricultural production, both in the immediate and extended periods. Agricultural financing has a

modest effect on both immediate and prolonged productivity increases. Djokoto (2011) undertook a study to investigate the causal connection between the increase in FDI in agriculture and the growth of agricultural production. The Granger causality test was performed using data from 1966 to 2008.

Djokoto (2013) conducted a study that aimed to investigate the correlation between the level of openness in the agriculture sector and its overall performance. The study employed FDI and trade openness as metrics to gauge the level of openness. The study included data spanning from 1995 to 2009. After analyzing data from 1995 to 2009, the author determined that there is no substantial and enduring relationship between FDI and trade openness in Ghana and the performance of its agriculture sector. The author found that both openness and FDI have a negative and significant impact on agricultural performance in the short run.

A research study by Rahman (2015) looked at how FDI affected Bangladesh's GDP, inflation rate, and trade balance. The study employed time series data spanning from 1999 to 2013. The results indicated that FDI had a negative impact on the economic development of Bangladesh. The study recommended that the government give priority to implementing reforms and conducting policy reviews to ensure that FDI positively influences the economic growth of Bangladesh. This should be done while considering the potential concerns that these findings may raise among international organizations.

Owu and Ying (2013) conducted a study examining the correlation between FDI and its impact on the agricultural industry. The study variables were identified through the utilization of a Vector Autoregression (VAR) model. According to the research

findings, there is no substantial correlation between FDI and agricultural productivity. Nevertheless, it exerts a beneficial impact on the job market. Gachunga (2019) conducted a distinct investigation to analyze the impact of FDI inflows on Kenya's infrastructure, industry, and agriculture, and their role in fostering the country's economic progress. The study utilized the Ordinary Least Squares (OLS) method to analyze the correlation between FDI and Gross Domestic Product (GDP). The study revealed that FDI in infrastructure has significantly stimulated economic growth, as seen by the rise in gross domestic product (GDP). Nevertheless, FDI has had a limited but positive effect on the manufacturing and agricultural sectors.

Msuya (2017) conducted a study to analyze the influence of FDI on agricultural production and poverty reduction in Tanzania. The study also identified the variables that impede the flow of FDI to the agricultural sector. This study examines the impact of FDI on enhancing the operational efficiency of agricultural firms in Tanzania, as well as the necessary reforms needed to promote investment in agriculture more effectively.

FDI has been found to have a beneficial effect on production, particularly for smallholder farmers that are involved in integrated producer schemes. The report suggests reconsidering the current structure of smallholder institutions in order to enhance productivity and attract foreign direct investment to the agriculture industry. A significant consequence of the findings is that FDI in Tanzania, particularly in the agricultural sector, has a more extensive economic and social influence compared to other industries.

The quantity of net FDI has a substantial impact on agricultural productivity. Prior

research (Ogbanje, Djokoto, 2013; Msuya, 2017; Oloyede, 2014; Edeh et al., 2020) has established a significant and favorable correlation between external investment and agriculture sector output.

2.4.3 Public Debt

Wilson Ebhotemhen and David Umoru (2019) conducted a study to evaluate the influence of external debt on the increase of agricultural production in Nigeria. They used time series data from 1980 and employed co-integration as a testing instrument, as well as the ECM (Error Correction Model) to examine the relationship between the variables.

The empirical findings indicate that there was no gain in agricultural production as a result of external debt, due to its negative correlation with agricultural output. This suggests that the external loans obtained for agricultural purposes during the study period were not effectively utilized for the intended purpose.

Ukpe et al. (2019) The study evaluated the role of public external debt and private investment on agriculture in Nigeria which covered a period of thirty seven years (1980-2016) using annual time series data. The empirical result corroborated the Keynesian hypothesis. The findings of the study supported the Keynesian theory, which holds that government borrowing is required to maintain the economy, by demonstrating that increasing public external debt and decreasing gross domestic private investment resulted in a higher level of agricultural output than increasing gross domestic private investment and decreasing public external debt.

Adetula's (2019) study, the investigation of the effects of external debt service payment habits on agricultural output in Nigeria revealed a substantial correlation between debt services and agricultural productivity. The report therefore suggests obtaining additional foreign loans to support the expansion of the agriculture sector. There is a contextual disparity due to the fact that the current study was conducted in Kenya.

Mohamed (2005) investigated the impact of the amount of money owed to external creditors on the efficiency and output of agricultural activities in Sudan. The study found that export revenues had a beneficial impact on agricultural production, but the combination of external debt stock and inflation had a negative effect on agricultural productivity.

The utilization of external loan resources is anticipated to bolster domestic revenue by facilitating investment in crucial sectors of the economy, hence stimulating growth. Nevertheless, significant levels of debt or loans above a specific limit and the need to make regular payments could adversely impact agricultural production (Ayadi & Ayadi,2008).

In addition, Hameed et al. (2008) investigated the correlation between the amount of external debt and agricultural productivity in Pakistan, both in the short and long term. The findings indicate that limited ability to repay external debt has a detrimental impact on the productivity of each worker, hence negatively affecting agricultural productivity in the nation.

Matthew and Mordecai (2016) analyze the influence of household debt on agricultural production. The findings of the co-integration test suggest that there is a long-term relationship between agriculture productivity, domestic debt, government expenditure

on agriculture, and interest rates. The findings derived from the parsimonious ECM model demonstrate a significant and positive influence of domestic debt on agricultural productivity. However, the interest rate has an indirect but significant effect on agricultural productivity. The Granger causality test revealed a causal relationship between domestic debt, government expenditure on agriculture, and agricultural productivity. Thus, agricultural productivity in Nigeria is profoundly impacted by factors such as domestic debt, government expenditure on agriculture, interest and interest rates.

Ramakrishna (2015) examined the influence of external debt on the service and agriculture sectors in Ethiopia. The data clearly demonstrate that foreign debt has a significant and beneficial influence on the service and agriculture sectors. These findings contradict the conclusions of Brown et al. (2020) and Bezlepkina and Lansink (2016), who both found that external debt negatively impacted agricultural production.

Ramakrishna (2012). After conducting an analysis of the influence of external debt on the service sector and agricultural growth of Ethiopia's economy from 1981 to 2012, it was found that both sectors made positive contributions to the overall economic growth of Ethiopia. Multiple authors have recorded that the total external debt has an adverse effect on the expansion of the agricultural economy. The relationship between debt load and agricultural output is one-way, with the debt burden negatively impacting the growth of agricultural output.

Studies examining the connection between agricultural productivity and foreign debt have produced inconsistent findings. Nevertheless, several studies have indicated a positive link between the variables being investigated. Contrary to Ramakrishna's (2012) viewpoint, other researchers such as Wilson Ebhotemhen, David Umoru (2019), Matthew and Mordecai (2016), and Ukpe et al. (2019) held the belief that there existed an indirect association between the factors examined in the study.

Table 2.1: Summary Empirical Literature review and Gaps

Author(s)	Focus of the study	Methodology	Findings	Research Gaps & how it will be filled
Muraya and Beth (2017)	A study by George and Beth (2017) in Kenya, Determinants of agricultural productivity in Kenya using secondary data from the period 1980 - 2013	employed Johansen-Granger Cointegration procedures and Error Correction Model (ECM)	Found that increase of one percent in labour force caused an increase in agricultural productivity by 0.198%.	Adopted Error Correction Model (ECM) while the study used the ARDL model It explored variables like inflation, real exchange rate, labour force, government expenditure and climate/rainfall as the factors while this study focused on unemployment ,FDI,public debt as macroeconomic variables
Shariff and Noor (2014)	Investigated the impact of macroeconomic variables on agricultural productivity in Malaysia.	Using time series data covering from 1980 to 2014 and Autoregressive-Distributed Lag approach,	The findings confirmed a long- run relationship between variables used nominal exchange rate, net export, inflation rate, interest rate, government expenditure and money supply.	Variables of unemployment ,FDI and public debt will be addressed in this study
Ayinde (2008)	Examined agricultural	The study employed t-	The Granger Causality test	While the prior study investigated the link

	growth and unemployment in Nigeria.	test, Duncan Multiple Range test, and Granger Causality test and regression analysis.	showed that there is unidirectional causation between agricultural growth and national unemployment and between urban unemployment and agricultural growth	between agricultural growth and urban unemployment, this study delved into the connection unemployment rate and agricultural productivity Additionally, the former study was conducted in Nigeria, whereas the present study took place in Kenya.
Enilolobo and Ohalete [2017]	examined the impact of inclusive growth determinants on agricultural output in Nigeria over the period of 1981 to 2015, on Education, Labour Force and Government	Applied. Augmented Dickey fuller (ADF) unit root test, Johansen co-integration test and Error correction model (ECM) techniques of analysis	The ECM result revealed that Agricultural output increases as unemployment and poverty rates fall and when per-capita income rises	Adopted Error correction model (ECM) while the study used the ARDL model Study was conducted in Nigeria, whereas the present study took place in Kenya. Macroeconomic variables: Agric GDP, Per Capita Income Unemployment and Poverty Rates while this study used unemployment ,foreign direct invest and public debt Government Expenditure variables
Bernard and Adenuga	Analyzed the contribution of	Employed the Error Correction (ECM) and	The study revealed that there is a positive relationship	The study concentrated explanatory variables such as GDP, foreign private

[2017]	agricultural sector alongside other in Nigeria.	the Granger Causality test.	between agricultural output and employment generation in Nigeria	capital, federal government expenditure on employment generation The study adopted both the Granger Causality test and ECM while this study adopted the Bounds cointegration and OLS.
Djokoto (2013	Studied the causal link or direction of movements between growth of FDI to agriculture and the growth of agricultural productivity by performing 1995 and 2009.	granger causality test using data covering the period	The author found no causal link between the variables. The author rather found openness and FDI to have negative and significant impact on agricultural performance over the short run.	The study was executed in Ghana, whereas the present study took place in Kenya The study adopted the Granger Causality test while this study used ARDL model
Msuya (2017),	Examined the impact of FDI on agricultural productivity and poverty reduction as	employed Johansen-Granger Cointegration procedures and Error Correction Model	that FDI has a positive impact on productivity especially to smallholder farmers who are linked in	Other variables like unemployment ,and public debt were addressed in the study

	well as factors that hinder FDI flow to agriculture in Tanzania.	(ECM)	integrated producer schemes	
Ramakrishna (2015)	Examined the effect of external debt on service and agriculture sectors in Ethiopia.	used a time series data over a period from 1999 to 2013	The results found external debt has a significant and positive effect on service and agriculture sectors.	The study was executed in Nigeria , whereas present took place in Kenya
Oloyede (2014)	Studied the impact of FDI on the development of the Agricultural sector in Nigeria.	Used time series data covering the period 1981 and 2012 and employing the Ordinary Least Square (OLS) estimation technique.	Findings showed FDI to positively impact agriculture. The author also finds instability of the political environment to inversely affect the agricultural sector	The study was executed in Nigeria , whereas present took place in Kenya
Mwangi (2017)	Studied how each type of debt, that is, internal and foreign Borrowing impacts individually on growth	Cointegration analysis was employed	. Research revealed that in the case of domestic debt, it has an insignificant but positive effect on growth of an	The study focuses on the Agricultural productivity in Kenya

	of Kenya's economy.		economy.	
Ogwuche &Mohammed	Examined the effect of public debt on agricultural output in Nigeria using time series data from 1981 to 2022	The study adopted the Augmented Dickey Fuller (ADF) unit root test, the Bound test for long run equilibrium relationship and the Autoregressive Distributed Lag Model (ARDL).	The findings The ARDL result estimated that public debt has no significant impact on agricultural output .Public debt has a negative relationship with agricultural output in Nigeria	The study was executed in Nigeria, the current was done in Kenya

Source: from empirical literatures reviewed

2.5 Conceptual Framework

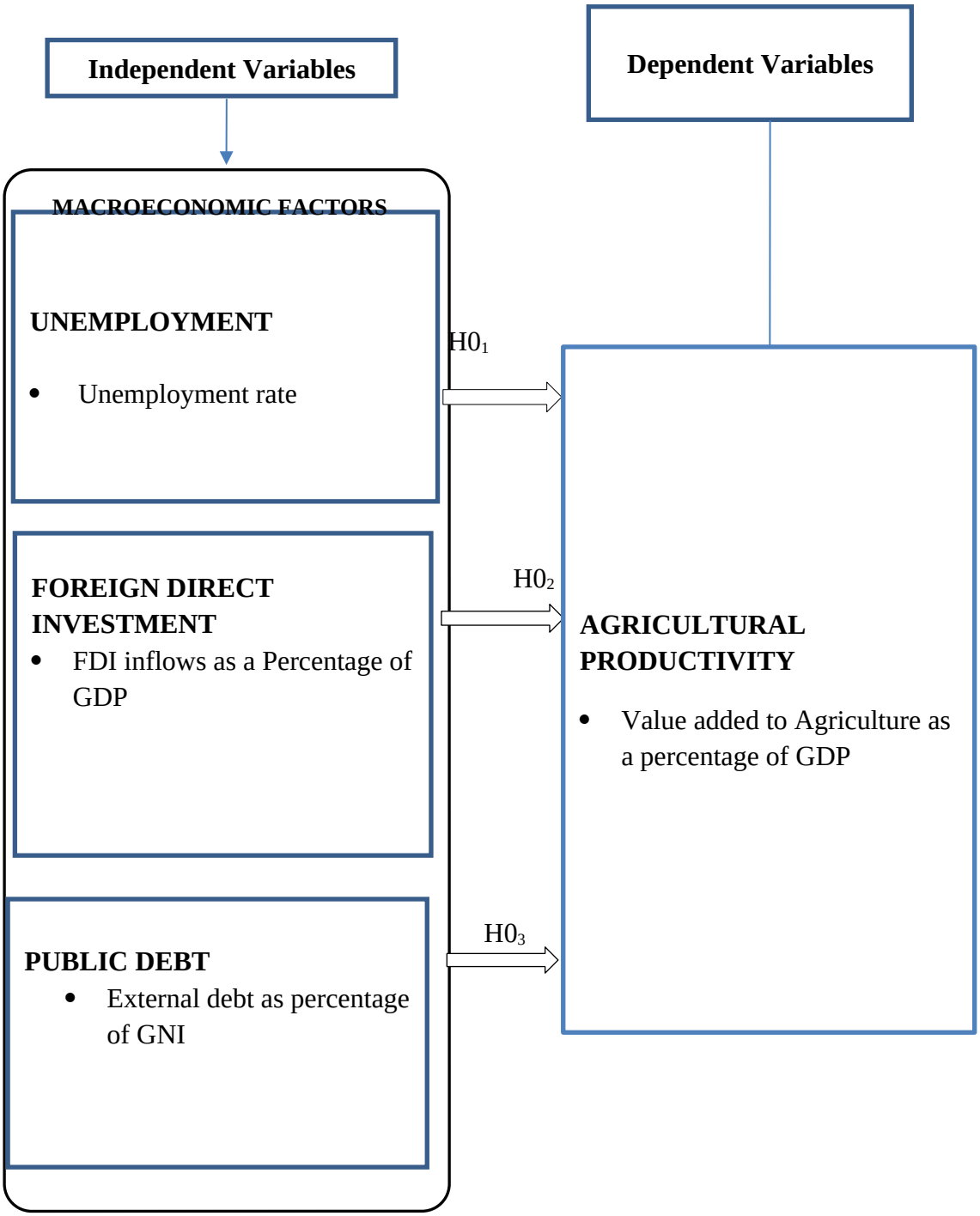

Figure 2.3: Conceptual Framework

Source: adapted from Oloyede (2014)

Agricultural productivity was the dependent variable. The three independent variables were public debt, foreign direct investment, and the unemployment rate. Unemployment measured as a percentage of unemployment rate .There may be an excess of labor in the economy if unemployment is high. This might imply a greater pool of workers accessible for farming activities in the agriculture industry. Nevertheless, the overall output might not rise in proportion if these jobless people lack the education or training required for agricultural labor.

Foreign direct investment measured in terms of inflows as a percentage of Gross domestic product can have both positive and negative impacts on agricultural productivity in Kenya. Public debt also affects, the Agricultural productivity that High levels of public debt can potentially lead to reduced government spending on the agricultural practices , which may negatively impact investments in agricultural infrastructure, research, and development (Ibrahim , 2021).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section provides the research design, study area, data collection methods and data analysis and model specification.

3.2 Research Design

According to Kothari (2021), research design is defined as the plan, structure, and strategy of investigation conceived to obtain answers to research questions or problems. It constitutes the blueprint for the collection, measurement, and analysis of data.In essence, Kothari emphasizes that a research design is a comprehensive plan that outlines how the research will be conducted.

This study adopted a causal research design to analyze the effect of macroeconomic factors on agricultural productivity in Kenya for the period 1993 - 2022. In a causal study identifies the extent and nature of cause-and-effect relationships between two or more variables(Lauren Thomas, 2020). This study adopted causal research design as its primary strength is its ability to establish causal relationships between variables. By manipulating an independent variable and observing the effect on a dependent variable, researchers can infer causation more confidently.

3.3 Study Area

This study was conducted in Kenya, a country generally located between latitudes 5oN and 4o40'S, with a population of 55,920,673 (UN DATAs 2023) and an

estimated geographical area of 580,367 km2. . The Equator almost cuts this country in half horizontally, whereas 38oE longitude almost cuts it in half vertically.

It extends longitudinally from longitude 33o53' East of the Greenwich Meridian to longitude 41o55.5' East, i.e., from Suba, Mfangano, Ilemba, and the pyramid islands on Lake Victoria. It has a total area of 580,367Km2, of which 2.3 percent is water surface, making it the largest economy in East Africa (GOK, 2022).

The importance of agriculture to Kenya's economy cannot be gainsaid. A third of the country's GDP comes from agriculture, which also generates 60% of export revenue, 18% of formal employment, and roughly 60% of informal employment. In addition, the industry provides over 75% of the nation's raw materials for manufacturing and 65% of the incomes earned by rural households.Kenya has also ratified a treaty requiring its members to set aside at least 10% of their annual budgets for the advancement of agriculture.

According to Grow Africa Partnership forecasts (2023), more than 300 foreign companies have committed to investing over ten billion US dollars across 12 African nations. According to the World Bank (2023), the continent of Africa's agricultural output is currently valued at US$ 280 billion, but due to increased domestic and During 2011–2021, global TFP grew at an average of just 1.14 percent annually. To sustainably meet the agricultural needs of a growing global population by 2050, we must now aim for 1.91 percent average annual TFP growth global food demand that amount might treble to almost US$ 800 billion by 2030.

3.4. Data types and collection method

The study relied on secondary data sourced from the statistical summaries ,economic reports and economic indicators provided by World bank and Kenya National Bureau of statistics.

Data collected encompassed various variables including Unemployment as a pecentge of unemployment rate ,Foreign direct investment as a percentage of gross domestic product and public debt as a percentage of GNI , and Agricultural productivity as value added to agriculture as percentage of GDP. Utilizing a quarterly time series framework, the study employed data spanning from the year 1993-2022. The choice of 1993 to 2023 provides context for evaluating the effectiveness of policies and reforms aimed at achieving the goals of Vision 2030, especially in terms of agricultural productivity and economic stability.

3.5 Data sources and analysis

The study relied on secondary data sourced from the economic reports, statistical summaries, and economic indicators provided by the Kenya National Bureau of Statistics. The collected data encompassed several variables, including unemployment as a percentage of gross domestic product, foreign direct investment as a percentage of gross domestic product, public debt as a percentage of gross domestic product and agricultural productivity. Utilizing a quarterly time series framework, the study employed data spanning from the year 1993 to 2022.

3.5.1 Description and Measurement of variables

Table 3.1: Description of variables, how they were measured and the predicted signs.

Variable	Description	Measurement	Prior-Expected Sign
Unemployment	The annual proportion (as a %) of the total labour force (total labour force measures .	As percentage of unemployment rate	+/-
Foreign direct investment	An ownership stake in a foreign company or project made by an investor, company, or government from another	As percentage of Gross Domestic product	+/-
Public Debt	The percentage of a country's debt that it has borrowed from international financial institutions, commercial banks, or governments.	As a percentage of Gross National Incomf	+/-
Agricultural productivity	It represents the agricultural ratio of agricultural outputs to inputs.	As percentage of value added yearly on agriculture	+/-

S**ourc**e (author 2024)

3.5.2 Econometric Model Specifications

Data was analyzed in the following steps:

Steps 1: The study employed a multivariate linear regression analysis in checking the hypothesized relationship between agricultural productivity, and the regressors (Unemployment, foreign direct investment and public debt).

The following model was employed:

$Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \mu$

$\mathbf{Y_t}$ = Criterion variable, which is the growth Agricultural productivity measured in percentage value added to agriculture

$\boldsymbol{\beta_0}$ = constants.

$\boldsymbol{\beta_1 ..... \beta_3}$ = the slope representing the extent to which agricultural productivity changes as the regressor changes by a unit.

$\mathbf{X_{1t}}$ = unemployment

$\mathbf{X_{2t}}$ = FDI (inflow)

$\mathbf{X_{3t}}$ = Public debt

t= time index

μ= error term

The coefficient of determination (R^2) was applied in showing variation Yt (agricultural productivity changes over time) explained by the variation in Unemployment ($\mathbf{X_{1t}}$), foreign direct investment ($\mathbf{X_{2t}}$), and public debt ($\mathbf{X_{3t}}$) over time.

The following model was applied

$\mathbf{Y_t = \beta_0 + \beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t} + \mu_t}$

Where; $\mathbf{Y_t}$ = Criterion variable.

β_0 = constants.

$\beta_1 X_{1t} + \beta_2 X_{2t} + \beta_3 X_{3t}$ = interaction terms.

The F-test was used to determine if the difference in R^2 was statistically significant. If the change exhibited statistical significance, it indicated its impact on the regression model.

3.6 Pre estimation Diagnostic test Pre- Estimation Diagnostic tests

The researcher conducted a series of diagnostic tests, including descriptive statistics, inferential statistics, correlation analysis, unit root test, calculation of optimum lag duration, and boundaries cointegration test.

3.6.1 Descriptive statistics

Descriptive statistics are indices that describe a specific representative. (Kothari, 2022). They enable the researcher to use specific indices or statistics to show how the variables are distributed. (Leavy, 2017).

3.6.2 Inferential statistics

Inferential statistics inferential statistics generalize the findings from a sample to a larger population with a certain level of confidence. They are vital for assessing the hypotheses of the study and determining the population parameters.(Kothari 2022) .

3.6.3 Correlational

A linear association between two variables is frequently quantified using correlation coefficients. An increase in the linear correlation coefficient that is greater than zero indicates a positive correlation. A relationship that is negative is indicated by a value that is less than zero. In contrast, a score of zero suggests that there is no correlation between the variables.

Gujarati (2009) asserted that when the correlation coefficient is below 0.9, it is necessary to avoid multicollinearity among independent variables. A correlation between two variables is considered significant and indicates a pattern of dependency when the significance level is below 0.05. Nevertheless, when the significance threshold is sufficiently elevated, such as 0.50 or higher, the correlation loses its significance and suggests the absence of a linear association between the variables.

3.6.4 Unit root test

Unit root testing was used to assess the stationarity of the data at different levels. A dataset is considered stationary when its mean and variance remain consistent over time (Gujarat, 2022). An analysis was conducted using the Augmented Dickey-Fuller (ADF) test to determine whether the time series data was stationary. A probability value of less than 0.05 indicates that there isn't a unit root (Gujarat, 2022). If a unit root is present, it can be eliminated by differencing the data.

3.6.5 Optimal Lag Length Determination

To avoid serial correlation, it is necessary to determine the ideal lag length prior to model estimation (Thoma, 2008). According to Koutsoyiannis (2021), the approach with the lowest rank value was chosen. To determine the optimal lag length, the researcher employed the Akaike Information Criterion.

3.6.6 F-Bounds Cointergration Test

According to Pesaran, Shin, and Smith (2001), cointegration occurs when two or more time series variables show mutual movement across time and a long-term relationship, even in the face of short-term divergences.

To examine potential cointegration relationships between the independent and dependent variables in this study, the F-Bounds test was utilized. This test is still appropriate whether the series is of order (1) or (0).

3.7. Post Diagnostic test

After a regression model has been fitted, possible issues with the model can be found using post-estimation diagnostic tests. They support the process of verifying the validity of a model's underlying assumptions and the accuracy of study results. There will be tests of the following kinds:

3.7.1 Heteroscedasticity Test

Heteroscedasticity refers to the situation in a regression model where the variance of the error component is not constant across observations (Gujarat, 2022). The study employed the Breusch-Pagan Test, which is specifically developed to evaluate the null hypothesis regarding the lack of heteroscedasticity in the errors of a regression

model. The null hypothesis of homoscedasticity is rejected when the p-value from the Breusch-Pagan test is less than 0.05. Therefore, this situation suggests that there is heteroscedasticity in the data.

3.7.2 Autocorrelation test

Auto-correlation arises when there is a strong correlation among the residuals obtained from the regression analysis (Gujarat, 2022). The Breusch-Godfrey LM test was utilized in this study to examine the presence of autocorrelation. Autocorrelation is absent when the probability value exceeds 0.05 (Aljandali & Tatahi, 2018).

3.7.3 Model Stability Test

The Cumulative sum test was used to ensure that the regression model was stable and appropriate for policy formulation. The model was first suggested by Brown, Durbin, and Evans in mid 1970s, later refined by Kramer (1992). Zeileis (2004) asserts that a model is stable if all the variables are contained inside the 5% range.

3. 8. Ethical Consideration

When conducting secondary data research on the effect of macroeconomic factors on agricultural productivity in Kenya, ethical principles were essential to ensure the integrity of the research process and the responsible use of data was upheld.The researcher got permission from Masinde Muliro University of science and Technology school of Business and Economics,the Universities post graduate Studies directorate and finally from Kenya, National Commission for Science, Technology and Innovation (NACOSTI).The researcher ensured the highest standards of data accuracy, transparency and intergrityduring entire process of data collection, analysis and presentation of the results.

CHAPTER FOUR

DATA ANALYSIS PRESENTATIONS AND DISCUSIONS

4.1. Introduction

This chapter displays the findings of the data analysis and discusses them. It presents both descriptive and inferential statistical findings. The analysis is based on examining the connection existing between unemployment , foreign direct investment and public debt and Agricultural productivity

4.2 Descriptive statistics

An analysis of descriptive statistics was performed on the raw data, including measures such as the mean, standard deviation, minimum and maximum values, as well as tests for skewness, kurtosis, and Jarque-Berra. The mean, a fundamental measure of central tendency (Kothari, 2021), represents the average value of a distribution. Moreover, the standard deviation precisely measures the degree of scattering within the distribution, revealing the range of observations from the average. Skewness, kurtosis, and Jarque-Berra tests assess the degree to which the source distribution of the sample data deviates from normality.

Table 4.1 indicated that there were 30 observations with four variables. The Agricultural productivity was the dependent variable and denoted as (AGR), unemployment was the first independent variable and denoted as (UNP), foreign direct investment was the second independent variable and denoted as (FDI), public debt level was the third independent variable and denoted as (PDT),

Table 4.1: Descriptive Statistics

	AGR	UNP	FDI	PDT
Mean	22.96923	3.384400	0.825234	42.84303
Median	21.83671	3.080000	0.467822	36.31028
Maximum	28.74408	5. 644000	3.094711	131. 8997
Minimum	16.25498	2. 760000	0.040833	21.44737
Std. Dev.	3.864413	0.871929	0.825340	24.7666
Skewness	0.103851	1.857519	1.407681	1.203518
Kurtosis	1. 611653	4.907940	3.822904	5.7913331
Jarque-Berra	2.463310	21.80218	10.75430	52.97984
Probability	0.291809	0.815009	0.360831	0.130207
Sum	689.0768	101. 5320	24.75703	1285.291
Sum Sq. Dev	433. 0769	22.04754	19.75438	17759. 51
Observations	30	30	30	30

Source (author 2024)

From Table 4.1, The agricultural productivity which was measured with an average of 22.969%., the minimum value of 16.255%, the maximum value of 28.744 showing the maximum production for the period under study and standard deviation of 3.844. The average unemployment rate was 3.384, with a minimum value of 2.767 and a maximum value of 5.64. The standard deviation was 0.871929. The average value of foreign direct investment was 0.82, with a minimum value of 0.0408, a highest value

of 3.09471, and a standard deviation of 0.825. The public debt level had an average value of 42.843, with a minimum value of 21.447 and a maximum value of 131.8997. The standard deviation was 21.447.Skewness, kurtosis, and Jarque-Bera test are used to assess the normalcy of a distribution. Skewness quantifies the degree of asymmetry exhibited by a distribution. When the skewness value is less than two, the kurtosis value is less than six, and the Jarque-Bera probability is more than 0.05, then it may be concluded that the dataset should be deemed normally distributed (Gujarati, 2022). Positive skewness indicates that the mean of a dataset is higher than the median value, whereas negative skewness suggests that the median value is higher than the mean value (Odour, 2021). According to the data in Table 4.1, the agricultural productivity showed a moderate positive skewness with a value of 0.10385. The kurtosis value was 1.611, indicating a relatively high peakness in the distribution. The Jarque-Berra probability was 0.2918. The aforementioned three tests demonstrated that the distribution of agricultural productivity followed a normal distribution. The unemployment rate exhibited a positive skewness of 1.8575, a kurtosis of 4.9079, and a Jarque-Berra probability of 0.815, suggesting that it followed a normal distribution. The foreign direct investment had a positive skewness of 1.4706 and a kurtosis of 3.822. The Jarque-Berra p-value of 0.3608 suggests that the distribution of the data is about normal. The public debt exhibited a positive skewness of 1.2035, a kurtosis of 5.7918, and a Jarque-Berra p-value of 0.130207, indicating that it followed a normal distribution.

4.3 Correlational Analysis

Correlational analysis measures the extent to which variables associate with each other (Gujarat, 2022). The fundamental aim of correlational analysis is to show if a positive or negative association exists between variables and how strongly they relate (Gogtay & Thattle, 2017). Correlational analysis was conducted to examine the relationship between variables in this study. The study utilized pairwise correlational analysis to assess the magnitude and nature of the associations between the variables being investigated, as presented in the Table.

Table 4.2: Correlation Analysis

	AGR	UNP	FDI	PDT
AGR	1.000000			
UNP	-0.047949	1.000000		
	[-2.54015]			
	(0.0133)			
FD1	0.321274	0.210499	1.000000	
	[2.79193]	[2.139388]		
	(0.0034)	(0.0141)		
PDT	0.0659073	0.011870	0.012205	1.000000
	[0.1459]	[0.62812]	[0.64589]	
	(0.001)	(0.9504)	(0.9490)	

Values in parenthesis [ ] indicate t- statistic and values in brackets ( ) indicate p-values

Source :(author, 2024)

From Table 4.2, Unemployment (UNP) had a weak, significant negative correlation with the Agricultural productivity (AGR), =- 0.0479 (p = 0.0133); FDI had a positive significant connection with the Agricultural productivity (AGR), R = 0.321274 (p = 0.0034); and Public debt (PDT) had a strong positive significant correlation with the Agricultural productivity (AGR), R = 0.65907 (p = 0.0001).The coefficients of associations between explanatory variables indicated that there was no multicollinearity among them, as the values were below 0.9 (Gogtay and Thattle, 2017)

4.4 Augmented Dickey-Fuller Unit Root Test

Several time series data sets have non-stationarity, indicating that both their variance and mean change over time (Gujarat, 2022). Performing a unit root test is an essential first step before conducting statistical analysis, as it prevents erroneous results by accounting for the assumption of data stationarity made by many statistical models and procedures.The Augmented Dickey-Fuller (ADF) test was conducted to assess the presence of a unit root. This test includes delayed values to account for any serial correlation within the error term. According to Aljandali and Tatahi (2018), the null hypothesis of this test assumes the presence of a unit root. According to the ADF test, in order to accept the null hypothesis, the T-statistic must be higher than both the crucial values of 5% and 1%, regardless of its sign. Additionally, the p-value must be greater than 0.05. The following table displays the results of the Augmented Dickey-Fuller (ADF) test at different levels.

Table 4.3: ADF Results at levels

Number of observations = 30

At Levels

Variables	ADF T-statistic	Prob	Critical values			Conclusion
			1%	5%	10%	
(AGR)	-2.806265	0.2085	-4.3943	-3. 61219	-3.24307	Unit root
(UNP)	-4.9709	0.0237	-4.34307	-3. 6032	-3.2380	Stationary
FDI)	-4.3629	0.0018	-3.6793	-2.963972	-2. 622298	Stationary
(PDT)	-9.0033	0.0000	-3.6793	-2.9676	-2.62298	Stationary

Source (Author computation using Eviews version 10, 2024**)**

Table 4.3 shows that the Agricultural productivity (AGR) was not stable at its initial level since it had a unit root with a p-value of 0.2085, which is larger than the significance level of 0.05. Additionally, the ADF T-statistic for AGR was (-2.806265), which exceeded the crucial values of -4.3943 (at 1% significance level), -3.61219 (at 5% significance level), and -3.24307 (at 10% significance level). The unemployment rate (UNP) remained constant at a level with a p-value of 0.0237, which is less than the significance level of 0.05. Additionally, the ADF T-statistic of -4.9709 is greater than the crucial values of 1% (-4.34307), 5% (-3.6032), and 10% (-3.2380). FDI remained constant at a level that is statistically significant (p-value 0.0018>0.05). Additionally, the ADF T-statistic (-4.3629) was lower than the critical values of 1% (-3.6793), 5% (-2.9677), and 10% (-2.622298). The public debt (PDT) remained constant at a specific level, as indicated by the p-value of 0.0000.05. Additionally, the ADF T-statistic of -9.0033 was higher than the crucial values of 1% (-3.6793), 5% (-2.9676),and 10%(-2.62298). The agricultural productivity was

subjected to first differencing and found to be stationary. The p-values for the test were 0.0000, indicating a high level of significance. The ADF T-statistic of -6.516957 was greater than the critical values of -3.6891 (at the 1% level), -2.9718 (at the 5% level), and -2.6251 (at the 10% level), as shown in Table 4.4.

Table 4.4: ADF Results at 1st Difference

Variables	**Adj T-statistic**	**Prob**	**Critical Values**			**Conclusion**
			1%	**5%**	**10%**	
D(AGR)	-6. 516957	0.0000	-3.6891	-2.9718	-2.6251	Stationary

Source (Author computation using Eviews version 10, 2024)

4.5 Optimum Lag Length Determination

A lag is a period it takes the dependent variable to be affected by an independent time (Thoma, 2008). The table below presents the results of lag duration determination using several criteria. In this work, the Akaike Information Criterion (AIC) was employed to ascertain the lag order.

Table 4.5: Determination of Optimal Lag Length

Lag	logL	LR	FPE	AIC	SC	HQ
0	-203.1892	NA	98.12805	15.93763	16.13118	15.99337
1	-130.2140	117.8830	1.249585	11.5592	12.52269*	11.83360
2	-104.1881	34.03385*	0.6385863	10.78370	12. 52568	11.28533
3	-84.33912	19.84899	0. 625356	10.48762	13.00382	11.21220
4	-58.91142	17. 60380	0. 568952*	9.762417*	13.05282	10.70993*

Source (Author computation using Eviews version 10, 2024)

Table 4.5 had an asterisk on lag 4, indicating that it had the lowest value across all the ranks according to the AIC. Therefore, lag 4 was the most appropriate choice for the model.

4.6 ARDL Bounds Cointegration Test

The study utilized the ARDL Bounds test due to the mixed integrated order of the variables (Tursoy and Faisal, 2018). The Bounds test checked to see if there was a cointegrating equation between the factors. According to the rules for the Bounds cointegration test, we reject the null hypothesis if the F-statistic is greater than the lower limit I(0) and the upper bound I(1) at a significance level of 5%. This indicates the existence of cointegration and a persistent long-term connection between the series (Sam, McNown, and Goh, 2019). This suggests that the series are interrelated and capable of undergoing a linear combination. Furthermore, it suggests that a specific series will eventually converge if short-term disturbances have an impact on it (Sam et al., 2019). To estimate both short-run and long-run models, it is advisable to use either the Vector Error Correction Model (VECM) or the Autoregressive Distributed Lag (ARDL) model.

Adom, Bekoe, and Akoena (2012) state that if the F-statistic is lower than the 5% critical values of I (0) and I (1), the null hypothesis is not rejected, indicating the absence of cointegration. Consequently, the researcher should just estimate short-run models due to the implicit presence of only short-run correlations in the series. Therefore, the researcher has the option to choose between using a vector autoregressive (VAR) model or regression analysis. Adom, Bekoe, and Akoena (2012) state that if the F-statistic is lower than the 5% critical values of I (0) and I (1), the null hypothesis is not rejected, indicating that there is no cointegration. Consequently, the researcher should exclusively estimate short-run models due to the implicit presence of short-run connections in the series. Therefore, the researcher has the option to choose between using a vector autoregressive (VAR) model or regression analysis.

Table 4.6: F-Bounds Test

F-Bounds Test		**Null Hypothesis: No level relationship**		
Test Statistic	**Value**	**Signif.**	**I(0)**	**I(1)**
			Asymptotic: n = 1000	
F-statistic	8.734147	10%	3.47	4.45
k	3	5%	4.01	5.07
		2.5 %	4.52	6.62
		1%	5.17	6.36
Actual Sample Size	26		Finite Sample: n = 35	
		10%	3.8	4.888
		5%	4.568	5.795
		1%	6.38	7.73
			Finite Sample: n = 30	
		10%	3.868	4.965
		5%	4.683	5.98
		1%	6.643	8.313

Source (Author computation using Eviews version 10, 2024)

Table 4. 6, shows the F-statistic was 8.734147 which is more than the critical values of me (0) and me (1) at 5%, which are 4.01 and 5.07, respectively. As a result, the

researcher rejected the null hypothesis at the 5% level of significance, demonstrating that there is no long-term link between the study's variables.

4.7 Multivariate Regression analysis

The Bounds cointegration test revealed that there was no long-term relationship among the variables under investigation. As a result, the researcher turned to regression analysis to investigate a possible short-term relationship between the explanatory variables and Kenya's Agricultural productivity. In order to make the model feasible, the agricultural productivity was included as a dependent variable. The results of the regression analysis were presented in Table 4.7.1.

Table 4.7.1: Multiple Regression Analysis Results for effect of Unemployment, Foreign direct investment, and Public debt on agricultural productivity

Dependent Variable: DAGR

Method: Least Squares

Sample (adjusted): 1993 2022

Included observations: 30

Variable	Coefficient	Std. Error	t-statistic	Prob
UNP	-0. 580519	0.194586	-2.983352	0.0000
FDI	0.366138	0.623673	2.679886	0.0014
PDT	0.103843	0.020336	5 .106416	0.0072
C	21. 86425	2.372538	9.215552	0.0000

R- squared	0. 559237	Mean dependent var	22.96923
Adjusted R- squared	0.508380	S.D. dependent var	3.864413
S.E. of regression	2.709557	Akaike info criterion	4.9955013
Sum squared resid	190.8842	Schwarz criterion	5.141840
Log likelihood	-70.32520	Hannan- Quinn criter.	5.014781
F- statistic	10.9962	Durbin- Watson stat	2.782076
Prob (F-statistic)	0.000076		

Source (author, 2024)

The regression model was fitted and found to be statistically significant at the 5% level of significance, as indicated by the p-value for the F-statistic being less than 0.05. The measure of goodness of fit, R2, was calculated to be 0.559237. Moreover, the R2 value of 0.559237 indicates that the regressor accounts for 55.9237% of the variation in the dependent variable. Hence, the analysis did not include other macroeconomic variables that contributed to 44.0673% of the variation in agricultural production in Kenya. The data presented in Table 4.7.1 indicates that AGR had a statistically significant influence on UNP, FD1, and PDT.

$$Y_t = \beta_0+\beta_1X_{1t}+\beta_2X_{2t}+\beta_3X_{3t}+\mu \ldots\ldots\ldots\

The fitted regression is shown in the equation below;

$AGR_t = 21.86425 - 0.5805UNP_t + 0.3661FDI_t + 0.10385PDT_t + \mu$

Where; AGR=Agricultural productivity

UNP_t = Unemployment rate (measure for unemployment in the study)

FDI_{2t} = Foreign direct investment inflow as a proportion of GDP (measure for Foreign direct investment in the study)

PDT_{3t} = public debt as a proportion of GNI (measure for public debt in the study)

μ= the error term

t = quarterly time series

4.8 Results and Discussion as Per the Study Objectives

The study's overall objective was to establish how Unemployment (UNP), FDI and Public debt (PDT) affected the Agricultural productivity (AGR).

4.8.1 The effect of unemployment on Agricultural productivity in Kenya

The initial null hypothesis (HO1) in this study, which stated that the unemployment rate had no significant effect on agricultural output in Kenya, was rejected based on the regression results presented in Table 4.7. The p-value for unemployment (UNP) was precisely measured at 0.0000, indicating that it is lower than the significance level of 0.05. The data suggests that the unemployment has a notable impact on agricultural productivity in Kenya.

Moreover, the coefficient (β1) linked to this variable was found to be -0.5805. Unemployment exerted a substantial adverse impact on the agricultural production of Kenya. The coefficient indicates that a 1% rise in the unemployment rate results in a 58.05% decrease in the growth rate of Agricultural productivity in the short term. This The study found a negative relationship between unemployment and agricultural productivity. Higher unemployment means fewer people are engaged in farming, reducing labor availability and thus productivity.

This finding aligns with the research conducted by Enilolobo and Ohalete (2017), which shown that as unemployment rates decrease, agricultural output improves. This suggests that agriculture can be a reliable method for attaining inclusive growth. The government ought to enact favorable policies and laws that foster agricultural productivity and facilitate the generation of employment opportunities. These

measures may encompass initiatives such as land reforms, provision of inputs such as seeds and fertilizers, and implementation of legislation aimed at promoting sustainable agricultural practices.

In contrast to Muraya and Beth's (2017) findings, it was observed that a one percent increase in the labor force resulted in a corresponding rise in agricultural output. The findings suggest that elevated unemployment rates may be indicative of an excess supply of workers in the economy. Within the agricultural industry, this implies an expanded reservoir of accessible workers for farming operations. Nevertheless, if these jobless folks are deficient in the requisite expertise or instruction for agricultural labor, the overall efficiency may not grow in direct proportion.

4.8.2 Effect of Foreign direct investment on Agricultural productivity

The data in Table 4.7 demonstrates a noteworthy impact of FDI on Agricultural productivity, as evidenced by a p-value of 0.014, which is below the significance threshold of 0.05. Therefore, the second null hypothesis (HO2), which states that Foreign direct investment does not have a statistically significant effect on Agricultural productivity, was rejected at a significance level of 5%.

The coefficient linked to Foreign direct investment has a positive sign, indicating that it effectively promotes the growth rate of Agricultural production. Furthermore, the coefficient value (β2) was determined to be 0.366138. This indicates that, in the immediate period, a 1% augmentation in foreign direct investment leads to a 36.61% upsurge in the expansion of Agricultural production, provided all other factors remain unchanged.

Foreign direct investment would contribute essential capital to the agricultural industry in Kenya. Foreign investors have the opportunity to invest in extensive commercial farming enterprises or agribusinesses, providing financial resources for acquiring land, purchasing inputs, and carrying out expansion initiatives. Capital access facilitates farmers' ability to invest in contemporary inputs, such as fertilizers and insecticides, resulting in enhanced output. The empirical research revealed that the net inflow of FDI had a statistically significant and favorable impact on agricultural output throughout the analyzed time period. This statement is backed by empirical evidence from several previous studies (Ogbanje, Okwu & Saror, 2010; Oloyede, 2014; Edeh et al., 2020; Alvarado et al., 2017; and Effiong & Eke, 2016). These studies have demonstrated a statistically significant positive relationship between FDI and agricultural output in both developed and developing countries. This discovery is consistent with the findings of Msuya (2017), which indicate that FDI has a beneficial effect on productivity, particularly for smallholder farmers who are involved in integrated producer schemes. The study suggests that in order to promote FDI, the government should allocate additional financial resources to enhance investment in the agricultural sector. Furthermore, it is recommended to facilitate technology transfer agreements between foreign investors and local agricultural enterprises to boost productivity and attract more FDI to the agricultural sector.

The findings vary. In Djokoto's (2013) study, it was found that FDI had a detrimental and statistically significant effect on agricultural performance in the near term. The study found no significant correlation between FDI and the long-term success of agriculture in Ghana.

4.8.3 Effect of public debt on agricultural productivity in Kenya

The statistical significance of public debt (PDT) on the growth rate of agricultural productivity is demonstrated by the p-value of 0.0000<05 in table 4.7. Consequently, the third hypothesis (HO3), which posited that public debt did not have a statistically significant impact on agricultural productivity, was denied. The coefficient's positive sign indicated a positive correlation between agricultural productivity growth and public debt. The coefficient of PDT (β_3) was 0.10385 implying that an increase in public debt by a percent result in 10.385 percentage increase in growth agricultural productivity Ceteris Paribus.

The results align with Adetula's (2009) findings, which indicated a substantial influence of debt services on agricultural productivity. This suggests that public debt might be utilized to offer subsidies, grants, or incentives to farmers, enabling them to embrace advanced technology, acquire high-quality inputs like seeds and fertilizers, and enhance their production capabilities

The findings contradict the conclusions of Wilson Ebhotemhen and David Umoru (2019), who discovered that external debt does not lead to an increase in production returns in agricultural productivity due to its negative relationship with agricultural output. This suggests that the external loans obtained for agricultural purposes during the study period were not effectively utilized for the intended purpose. Therefore, Kenyan government should display a strong dedication to efficient debt management to ensure that foreign loans are appropriately directed and used for their intended purposes. This will also ensure that the resulting returns are adequate to meet debt repayment obligations and maintain a balanced and productive Kenyan

economy.Excessive public debt can lead to inflationary pressures in the economy, especially when governments rely on monetary financing or deficit spending to meet their debt commitments.

4.9 Post Estimation Diagnostic Tests

4.9.1 Heteroscedasticity Test

Heteroscedasticity in the regression residuals was assessed using the Breusch-Pagan-Godfrey test. To reject the null hypothesis, which states that heteroscedasticity does not exist, this test looks for a p-value greater than 0.05. The presence of heteroscedasticity in the regression model, leading to unequally distributed residuals for the variables being studied, is indicated by a p-value below 0.05. The Breusch-Pagan-Godfrey test is shown in Table 4.9.

Table 4.9: Breusch-Pagan- Godfrey Heteroscedasticity Test

Heteroscedasticity Test: Breusch-Pagan-Godfrey		
Null hypothesis: Heteroscedasticity		
F-statistic	1. 669151	Prob. F(3,26) 0.1981
Obs *R-squared	4.844758	Prob. Chi-Square(3) 0.1835
Scaled explained SS	2.865308	Prob. Chi-Square(3) 0.4129

Source (author 2024)

The Chi-Square probability (3) of the Obs *R-squared value was determined to be 0.1835, which is greater than the significance level of 0.05. This conclusion is based on the data presented in table 4.9. Thus, the regression model did not exhibit heteroscedasticity since the researcher failed to reject the null hypothesis at a significance level of 5%.

4.9. Breusch -Godfrey Autocorrelation Test

The study utilized the Breusch-Godfrey test to analyze the regression model for autocorrelation, which occurs when the previous values of the error term affect the current values of the error term. The null hypothesis of the Breusch-Godfrey test states that there is no autocorrelation in the regression model, with a p-value more than 0.05. The alternative hypothesis, on the other hand, suggests the presence of autocorrelation, with a p-value less than or equal to 0.05. Table 4.10 presents the outcome of the Breusch-Godfrey Test for autocorrelation.

Table 4.10: Breusch- Godfrey Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:		
Null hypothesis: No serial correlation at up to 4 lags		
F-statistic	5.033716	Prob.F(4,22)
0.0491		
Obs*R-squared	14.336601	Prob. Chi-Square(4)
0.629		

Source (author 2024**)**

Table 4.10's Breusch-Godfrey test findings show that the p-value for the Chi-square test was 0.629>0.05, indicating that the researcher accepted the null hypothesis that the model had no autocorrelation.

4.9.5 Model Stability Test

The stability of the model was evaluated using the cumulative sum (CUSUM) test. In order for the model to be deemed stable, it is imperative that the variables remain under the 5% threshold. Figure 4.2 displays the outcomes of the CUSUM test conducted to assess the stability of the model.
In this diagram, all variables are inside the 5% limits, showing that the model remains stable.

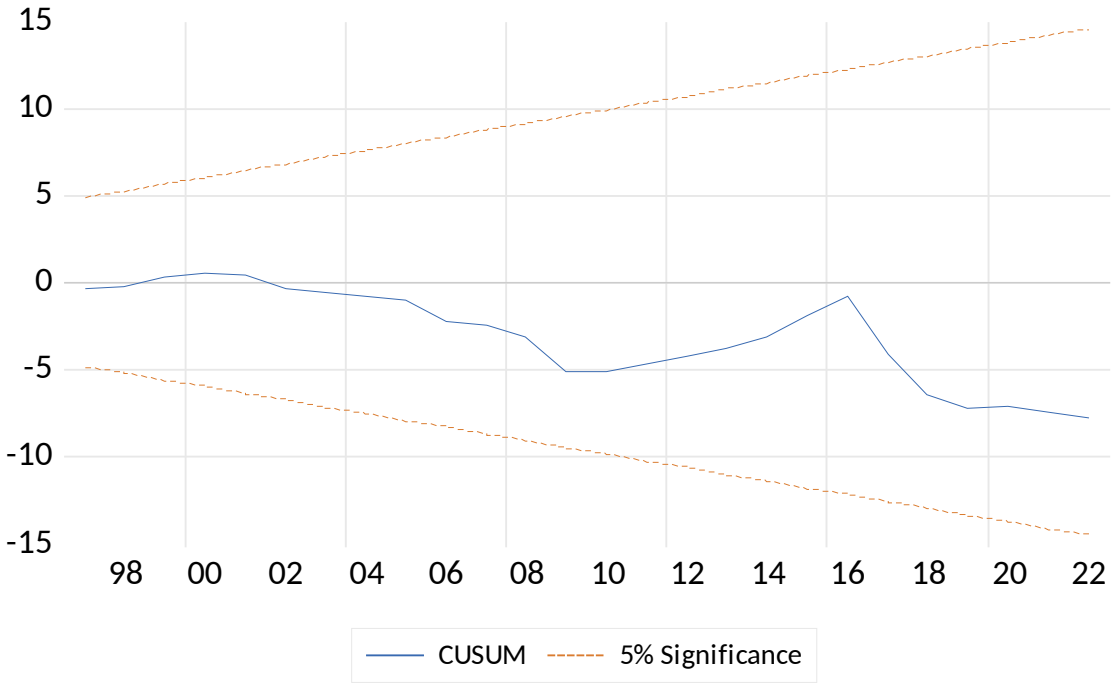

Figure 4.2: CUSUM Model Stability Test

Source: (Author, 2024)

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a comprehensive overview of the study's findings, derives conclusions on the effect of macroeconomic factors on agricultural productivity, highlights policy recommendations, and identifies avenues for further research.

5.2 Summary of the Findings

The study examined the effect of unemployment, foreign direct investment, and governmental debt on agricultural productivity in Kenya. The study employed a Causal research design, utilizing quarterly time series data obtained from the Kenya National Bureau of Statistics for the period spanning from 1993 to 2022. Variables such as unemployment, foreign direct investment, and state debt were represented as proportions of the Gross Domestic Product (GDP). The measure of Agricultural productivity was approximated by the growth rate of value added to agriculture. The data was summarized using descriptive statistics, which revealed positive means for all variables. Additionally, the Jarque-Bera test suggested a normal distribution with probabilities greater than 0.05. The correlation analysis revealed strong positive relationships between the regressors and Agricultural productivity.
The Augmented Dickey-Fuller (ADF) test determined the stationarity of variables such as unemployment, foreign direct investment, and public debt level by examining their initial differences.

The F-Bounds test did not detect any cointegration among the variables, which led to the use of a multiple regression analysis to assess the statistical relevance of the macroeconomic determinants in explaining agricultural productivity. Post-estimation diagnostics confirmed that the Ordinary Least Squares assumptions were true and that the model was suitable for policy implications.

5.3 Conclusions

The study's specific aims drove the formulation of the following conclusions based on the empirical results.

5.3.1. Effect of Unemployment rate on Agricultural productivity

Based on the findings from the first objective of the study, which focused on Effect of Unemployment on Agricultural productivity in Kenya, it was concluded that unemployment had an insignificant negative effect on the Agricultural productivity in the country. As a result, the null hypothesis (H_{O1}), stating that unemployment has no statistically significant difference on the agricultural productivity, was accepted. Thus, an increase in unemployment is associated with a decrease in the Agricultural productivity, and conversely.

5.3.2 Effect of Foreign direct investment on Agricultural productivity in Kenya

Foreign direct investment exhibited a notable and favorable correlation with agricultural productivity in Kenya. As foreign direct investment increases, agricultural productivity also increases, and vice versa. Therefore, we rejected the null hypothesis (HO2) which stated that foreign direct investment has no statistically significant impact on agricultural productivity.

5.3.3 Effect of Public debt on agricultural productivity in Kenya

The study's empirical analysis revealed a strong positive correlation between public debts and agricultural productivity in Kenya. Consequently, the null hypothesis (HO3) which states that Public debt does not have a statistically significant effect on the agricultural production sector was disproven. These findings indicate that greater levels of public debt are utilized to offer subsidies, grants, or incentives to farmers in order to encourage the adoption of contemporary technology, access to high-quality inputs like seeds and fertilizers, and the expansion of their production capacity, resulting in enhanced agricultural productivity.

5.4 Recommendations

This study's empirical findings are used to infer the following policy suggestions.

5.4.1 Unemployment and its effect on Agricultural productivity in Kenya

The research results revealed that Unemployment rate had an significant negative effect on the Agricultural productivity in a significant manner. Addressing the negative impact of unemployment on agricultural productivity in Kenya requires a comprehensive approach that focuses on creating jobs, improving skills, and supporting the agricultural sector. The Kenyan government should prioritize several policy recommendations to mitigate these negative effects.

The study recommended the government, through Skills Development, Providing training and education programs to unemployed individuals to equip them with the skills needed to work in the agricultural sector.

This could include vocational training in farming techniques, agribusiness management, and other relevant skills as supported by Adeyanju, D., Mburu, J., Gituro, W., Chumo, C., Mignouna, D., & Mulinganya, N. (2024).

The study recommends the government to Facilitate access to finance and agricultural inputs for smallholder farmers, particularly those affected by unemployment. This could involve establishing agricultural credit schemes, input subsidy programs, and farmer cooperatives to improve access to seeds, fertilizers, pesticides, and equipment. Ensuring affordable access to inputs and finance can enable unemployed individuals to engage in farming activities and enhance productivity.

It is essential to invest in rural development and infrastructure. By improving rural roads, irrigation systems, and market access, the government can create jobs in the construction and maintenance of these projects while simultaneously enhancing the agricultural productivity by providing better access to markets and reducing post-harvest losses. These investments will stimulate economic activity in rural areas, providing employment opportunities for the local population and attracting labor back to agriculture.

The government should implement comprehensive training and capacity-building programs aimed at equipping the unemployed with relevant agricultural skills. This can be achieved through agricultural extension services, vocational training centers, and partnerships with educational institutions.

By providing training in modern farming techniques, sustainable practices, and agribusiness management, the government can ensure that the labor force is better prepared to contribute to agricultural productivity.

To support smallholder farmers, the government should facilitate access to credit and financial services. High unemployment often leads to reduced household incomes, limiting farmers' ability to invest in productivity-enhancing inputs such as seeds, fertilizers, and machinery. By providing affordable credit, subsidies, and grants, the government can enable farmers to invest in the necessary resources to boost their productivity. Additionally, promoting financial inclusion initiatives will ensure that more farmers can access these financial services.

Promoting agribusiness and value addition is another critical strategy. By encouraging the development of agribusinesses that process and add value to agricultural products, the government can create jobs and increase the profitability of agriculture. This approach not only provides employment opportunities but also ensures that farmers receive better prices for their produce, further incentivizing productivity improvements.

The government should also focus on developing social safety nets and support systems to cushion the impact of unemployment on rural households. Programs such as cash transfers, food aid, and subsidized agricultural inputs can provide immediate relief to unemployed individuals and struggling farmers.

Encouraging public-private partnerships (PPPs) can leverage both public and private sector strengths in addressing unemployment and boosting agricultural productivity. The government should foster collaborations between private companies, non-governmental organizations, and international development agencies to implement joint initiatives that create jobs and support agricultural development.

Finally, monitoring and evaluating the impact of these policies is crucial to ensure their effectiveness. The government should establish robust mechanisms for tracking the progress and outcomes of various initiatives aimed at reducing unemployment and enhancing agricultural productivity.

By implementing these policy recommendations, the Kenyan government can address the negative impact of unemployment on agricultural productivity, create job opportunities, and support the sustainable growth of the agricultural sector. This comprehensive approach will not only improve the livelihoods of rural populations but also contribute to the overall economic development of the country.

5.4.2 Foreign Direct investment and its effect on Agricultural productivity in Kenya

Based on the positive impact of FDI on Kenya's agricultural productivity, several policy recommendations can be formulated to maximize these benefits.

Findings revealed that Foreign Direct investment affects Agricultural productivity significantly. The recommendation for Foreign Direct investment is that the government should allocate more budgetary resources to increase investment in the agricultural sector as argued by Mose & Kipchirchir, (2024). Governments to facilitate technology transfer agreements between foreign investors and local agricultural enterprises. This could involve providing funding for agricultural infrastructure, research and development, and training programs to enhance productivity.

The government should promote the adoption of modern agricultural technologies and innovation through research and extension services. Provide subsidies or incentives for farmers to invest in mechanization, irrigation, precision farming, and other

productivity-enhancing technologies as supported by Maiga, (2024).. Additionally, support research institutions and agricultural extension services to disseminate knowledge and best practices to rural communities.

To enhance the investment climate, the Kenyan government should streamline regulations by simplifying and clarifying the regulatory framework for FDI in agriculture. This will reduce bureaucratic hurdles and attract more investors. Additionally, offering tax incentives, subsidies, and grants to foreign investors who commit to long-term investments in the agricultural sector can further incentivize investment. Ensuring clear and enforceable land ownership and usage rights is also crucial to attract and retain foreign investors as argued by (Gibba & Amukule, (2023).

Infrastructure development is another key area. Investing in rural infrastructure, including roads, irrigation systems, storage facilities, and market access, will support efficient agricultural production and distribution. Enhancing the availability and reliability of electricity and water supply in agricultural regions is essential to support modern farming practices introduced by foreign investors.

Capacity building and training programs should be implemented to enhance the skills and knowledge of local farmers in modern agricultural techniques. Strengthening agricultural extension services can provide ongoing support and advice to farmers adopting new technologies and practices. Strenghthening agricultural research and development (R&D) through collaboration between foreign investors, local research institutions, and universities can foster innovation and development of high-yield crop varieties and sustainable farming methods. Establishing innovation hubs and

incubators focused on agricultural technology will drive local innovation and attract foreign expertise.

Sustainable practices must be prioritized by implementing and enforcing environmental regulations to ensure that agricultural practices introduced by foreign investors are sustainable and do not lead to long-term degradation of resources as supported (Elmi, 2023). by Providing incentives for foreign investors who adopt sustainable farming practices, such as organic farming, water conservation, and soil management, will further promote environmental sustainability.

To strengthen market access and value chains, the government should support the development of robust agricultural value chains to ensure that increased productivity translates into higher incomes for farmers and better market access. Export promotion policies should facilitate the export of agricultural products by reducing trade barriers, improving logistics, and negotiating favorable trade agreements.

Inclusive growth and equity are essential to ensure that the benefits of FDI are widely shared. Policies should be designed to support smallholder farmers by providing them with access to finance, inputs, and markets. Ensuring fair and transparent land acquisition processes will prevent the displacement of smallholder farmers and protect their livelihoods. Mechanisms should be developed to ensure that the benefits of FDI are equitably distributed across different regions and communities.

Public-private partnerships (PPPs) should be encouraged to leverage both public and private sector strengths in developing the agricultural sector. Collaborative projects between foreign investors, local businesses, and government agencies should be supported to drive comprehensive agricultural development.

Monitoring and evaluation are crucial for assessing the effectiveness of FDI in improving agricultural productivity. Regular impact assessments should be conducted to make data-driven policy adjustments. Ensuring transparency and accountability in FDI projects through regular reporting and public disclosure of investment activities and outcomes is essential for maintaining public trust and support.

Finally, supportive financial systems should be developed to improve access to credit for local farmers and agribusinesses, enabling them to invest in new technologies and practices introduced by foreign investors. Promoting financial inclusion initiatives will ensure that smallholder farmers can participate in and benefit from the financial opportunities created by FDI.

By implementing these policy recommendations, the Kenyan government can create a conducive environment for FDI in agriculture, thereby enhancing agricultural productivity and achieving sustainable and inclusive growth in the sector.

5.4.3 Public debt and its Effect on the Agricultural productivity

The study demonstrated a significant positive effect of Public debt on the Agricultural productivity in Kenya. To harness the potential positive impact of public debt on Kenya's agricultural productivity, several policy recommendations can be formulated to ensure that debt is managed effectively and used strategically.

The government should allocate a portion of public spending towards investment in agricultural infrastructure, such as irrigation systems, rural roads, storage facilities,

and market infrastructure. These investments can enhance productivity by improving access to markets, reducing post-harvest losses, and facilitating agricultural trade. Prioritize projects that have the potential to generate positive returns and contribute to long-term agricultural development as supported by Mohammed (2024).

It is crucial for the Kenyan government to focus on debt-financed investments that directly enhance agricultural productivity. This includes investing in critical infrastructure such as irrigation systems, rural roads, storage facilities, and market access routes. Improved infrastructure will reduce post-harvest losses, increase market access, and lower transportation costs for farmers, thereby boosting their profitability and productivity as argued by Ogwuche (2024).

Additionally, the government should allocate public debt towards agricultural research and development (R&D). By funding agricultural research institutions and universities, Kenya can foster innovation in crop varieties, pest control, and sustainable farming practices as recommended by Yerima, &Tahir (2020).

To support smallholder farmers, the government should implement capacity-building and training programs funded through public debt. These programs can enhance the skills and knowledge of farmers in modern agricultural techniques, sustainable practices, and effective resource management. Strengthening agricultural extension services is also essential to provide ongoing support and advice to farmers adopting new technologies.

According to Matthew,& Mordecai (2016).Sustainable practices must be prioritized to ensure long-term agricultural productivity. Public debt should be used to promote and incentivize sustainable farming practices, such as organic farming, water

conservation, and soil management. Implementing and enforcing environmental regulations will ensure that agricultural practices introduced through public investment are sustainable and do not lead to resource degradation.

Market access and integration are critical for maximizing the benefits of increased agricultural productivity. The government should use public debt to develop robust agricultural value chains, ensuring that productivity gains translate into higher incomes for farmers. This includes facilitating export promotion by reducing trade barriers, improving logistics, and negotiating favorable trade agreements to open up new markets for Kenyan agricultural products.

Inclusive growth and equity should be central to the government's strategy. Policies should be designed to ensure that smallholder farmers benefit from public debt investments.. Mechanisms should be developed to ensure that the benefits of public debt are equitably distributed across different regions and communities.

Public-private partnerships (PPPs) can leverage both public and private sector strengths in developing the agricultural sector. The government should encourage PPPs and support collaborative projects between foreign investors, local businesses, and government agencies. This collaboration can drive comprehensive agricultural development and ensure that public debt is used effectively.

Monitoring and evaluation are crucial for assessing the impact of public debt on agricultural productivity. The government should regularly conduct impact assessments to evaluate the effectiveness of debt-financed projects and make data-driven policy adjustments.

Finally, supportive financial systems should be developed to improve access to credit for local farmers and agribusinesses, enabling them to invest in productivity-enhancing technologies and practices. Promoting financial inclusion initiatives will ensure that smallholder farmers can participate in and benefit from the financial opportunities created by public debt investments.

By implementing these policy recommendations, the Kenyan government can create a conducive environment for using public debt to enhance agricultural productivity, achieving sustainable and inclusive growth in the sector.

5.5 Suggestions for Further Research

The study examined the effect of macroeconomic factors on agricultural productivity in Kenya. Hence, it is imperative to conduct a comparable study in other nations, particularly those with a significant reliance on agriculture, in order to enhance our understanding and establish a comprehensive basis for drawing conclusions and making policy recommendations in African countries and beyond.

Additional macroeconomic variables not included in the study such as Exchange Rate Dynamics, Inflation and Price Stability, Government Spending and Fiscal Policies Climate Change: need to be included in future research to determine how each of them affect agriculture productivity in Kenya.

By delving into these areas of further study, researchers can deepen their understanding of the complex interactions between macroeconomic factors and agricultural productivity in Kenya, and inform policy interventions aimed at promoting sustainable agricultural development, poverty reduction, and inclusive growth.

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APPENDICES

Appendix I: Data analyzed

YEAR	AGR	UNP	FDI	PDT
1993	26.80801	3.256	2.532353	131.8997
1994	28.11536	3.21	0.103977	104.9897
1995	26.34962	3.171	0.467475	83.76186
1996	27.49252	3.156	0.90216	57.64587
1997	27.69394	3.184	0.473452	49.94774
1998	27.74491	3.131	0.188366	48.8622
1999	28.74408	3.125	0.402865	51.28373
2000	28.72178	3.128	0.872896	48.88168
2001	27.84926	3.07	0.040833	42.80308
2002	25.85397	3.09	0.210062	46.79717
2003	25.80444	3.042	0.548413	45.5617
2004	24.92904	2.997	0.286194	43.35403
2005	24.23627	2.968	0.113202	34.70594
2006	20.51969	2.942	0.19622	26.09026
2007	20.58666	2.919	2.281243	23.81559
2008	22.19634	2.976	0.266291	21.44737
2009	16.25498	2.92	0.274534	23.21917
2010	17.56776	2.846	0.392164	22.29531
2011	18.89471	2.859	3.094711	23.93145

2012	18.82973	2.844	2.447259	23.57602
2013	18.61655	2.831	1.81417	25.27764
2014	18.34784	2.796	1.202208	27.91646
2015	19.46961	2.774	0.8838	31.30583
2016	20.03452	2.76	0.627591	28.53157
2017	20.89364	3.52	1.640837	33.49015
2018	20.31491	4.245	0.832686	34.61404
2019	20.86116	5.01	0.468169	35.40429
2020	22.70273	5.616	0.423521	38.4528
2021	21.47708	5.644	0.422364	38.21241
2022	21.16572	5.502	0.347014	37.21627

Source: World Development Indicators (World Bank, 2024)

Appendix II: Map of Kenya



Appendix III: Approval letter

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
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P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

21st August 2023

Wabwile Innocent
ECO/G/01-70114/2020,
P.O. Box 190-50100,
KAKAMEGA.

Dear, Mr. Wabwile,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled ***'Effect of Macroeconomic Factors on Agricultural productivity in Kenya'*** and appointed the following as supervisors:

1. Dr. Umulkher Abdillahi Ali - SOBE, MMUST
2. Dr Edwin Jairus Simiyu - SOBE, MMUST
3. Prof. John Byaruhanga - SOBE, MMUST

You are required to submit through your supervisor(s) progress reports every three months to the Director Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Business and Economics Graduate Studies Committee and Chairperson, Economics Department. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY DIRECTORATE OF POSTGRADUATE STUDIES P.O. Box 190 - 50100, KAKAMEGA (K) Date..... Sign.....

Prof. Stephen O. Odebero, PhD, FIEEP
DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

Appendix III:Research permit

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **426622**

Date of Issue: **06/September/2023**

RESEARCH LICENSE



This is to Certify that Mr.. Innocent Wabwile Sirengo of Masinde Muliro University of Science and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kakamega on the topic: EFFECT OF MACROECONOMIC FACTORS ON AGRICULTURAL PRODUCTIVITY IN KENYA for the period ending : 06/September/2024.

License No: **NACOSTI/P/23/29110**

426622

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

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