EFFECT OF MACROECONOMIC FACTORS ON PERFORMANCE OF AGRICULTURAL SECTOR IN KENYA.

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A Research Thesis Submitted in Partial Fulfilment of the Requirements for the Award of the Degree of Master of Science in Economics, Masinde Muliro University of Science and Technology.

November, 2023

DECLARATION

I hereby declare that this research thesis is my original work and has not been presented to this or any other University or Institution.

Signature ……. Date ……...

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CERTIFICATION

The undersigned hereby certify that they have read and hence recommend for acceptance of Masinde Muliro University of Science and technology of the research thesis titled '***Effect of Macroeconomic Factors on Performance of Agricultural sector in Kenya'***

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DEDICATION

This research work is dedicated to GOD, my dear parents Mr. Francis Olumo and Mrs. Colleta Olumo and to my siblings; the late Dolly, Alice, the late Fredrick, Carolyne, Jeremiah, Quinter, Lucy, Olivia and Patrick.

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ABSTRACT

Agriculture is very important to any society's future. In most developing and developed countries, it is the major backbone of the economy and its production over the last three to four decades has increased significantly. In 2018, the agricultural sector boosted the Gross Domestic Product globally by 4% and in 2020, its average contribution was 35 percent to the Gross Domestic Production (GDP) and 65 percent to foreign exchange earnings in Kenya. Agriculture provides the main source of livelihood, leading in generating of income and employment for more than 80 per cent of the Kenyan population and for the most citizens in developing countries. It's also a major source of vital raw materials for national and international industry. However, its performance has been declining over the years despite the increased Foreign Direct investment directed to agriculture. Similarly, there is dearth of information with regard to how inflation and external debt has affected the sector. The study's general objective was majorly to investigate the effect of macroeconomic factors on the performance of agricultural sector in Kenya. Consequently, the study specifically sought to: determine the effect of inflation on the performance of agricultural sector in Kenya, to assess the effect of foreign direct investment on the performance of agricultural sector in Kenya, to investigate the effect of external debt on performance of agricultural sector in Kenya and to evaluate the moderating effect of population growth on the linkage between macroeconomic factors and performance of agricultural sector in Kenya. This study was guided by the Harrod Domar growth model, the neoclassical model and the classical theory. This study adopted correlational research design. The data used was time series obtained from databases of the World Development Indicators, UNCTAD, World Bank Website, KNBS and Statista. Data was analyzed using EViews software. At level, the Augmented Dickey Fuller showed the presence of unit root but at first difference, the time series data was stationary. The Variance inflation factor (VIF) test values were less 10 showing no multi-collinearity. The study employed Descriptive and inferential statistics. Jarque-Bera test revealed a normal distribution of the series at 5 percent level of significance where the p-values > 0.05. For cointegration, Johansen test revealed presence of three cointegration equations. The LM test for Autocorrelation revealed absence of serial correlation with p-values > 0.05. The centered VIF values were lower than 10 hence showing absence of Multicollinearity. Glejser Test had probability of the F-statistics > 0.05 showing that there is no problem of Heteroscedasticity. The study also revealed that Foreign Direct investment has a positive and significant relationship on Performance of Agricultural sector with a coefficient of 0.1324 and P-value value of 0.00826 < 0.05 and External Debt has a positive and significant relationship on Performance of Agricultural sector with a coefficient of 0.5309 and a P-value of 0.00891 < 0.05 whereas Inflation negatively affect the performance of the agricultural sector with a coefficient of -0.2546 and a P-value of 0.00775 < 0.05. Population growth had a significant effect on the relationship between Macroeconomic factors and Performance of Agricultural sector shown by a change in R-squared from 0.935191 to 0.940763 with a Prob (F-statistics) of 0.0000. Therefore, from the Study, the Government of Kenya needs to attract more Foreign Direct Investment directed to the agricultural sector and also invest more External Debt in Agriculture to spur Agricultural sector Growth. Consequently, there is great need to reduce the inflation levels since it negatively affects the Agricultural sector performance.

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LIST OF ACRONYMS

AISE	Agricultural Input Supply Enterprise
AMC	Agricultural Marketing Corporation
ASTGS	Agricultural Sector Transformation and Growth strategies
CAADP	Comprehensive Africa Agricultural Development Programme
COVID -19	Corona virus Disease
COMESA	Common Market for Eastern and Southern Africa
CPI	Consumer Price Index
EAC	East African Community
ERP	Economic Recovery Program
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FSAP	Food Security Action Plan
GDP	Gross Domestic Product
KNBS	Kenya National Bureau of Standard
MoA	Ministry of Agriculture
MDTF	Multi Donor Trust Food
NAEIP	National Agricultural Extension Intervention Program

OLS	Ordinary Least Squares
PADEP	Peasant Agricultural Development Program
PRSP	Poverty Reduction Strategy Paper
SOE	State Owned Enterprise
UNCTAD	United Nations Conference on Trade and Development

OPERATIONAL DEFINITION OF KEY TERMS

Macroeconomic Factors	Are fiscal, environmental, and geopolitical events possess significant influence and exert broad-ranging effects on regional or national economies.
Agriculture	Agriculture encompasses crop and livestock production, aquaculture, fisheries and forestry for food and non-food products
Agricultural Performance	Is the assessment and evaluation of the productivity, utility, and overall efficiency of agricultural activities
Inflation	The gradual and consistent rise in average price of goods and services within an economy over time.
Foreign Direct Investment	Taking an ownership share in or gaining control of a foreign company.
External Debt	The entire amount owed by a nation to creditors, organizations, or governments abroad that must be repaid with interest or under other contractual terms over a predetermined time period.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

To achieve the goals for global development, wholesome, inclusive and sustainable food system is needed. The 2030 Sustainable Development agenda paves way to future inclusive prosperity (Struckmann, 2018).Transformative action becomes core in overcoming the complex problems the globe faces, embracing sustainable principles and addressing the core causes of hunger and poverty to ensure that no one is left behind. Food system and agriculture, plays the primary linkage between citizens of a nation and the environment hence assisting in the achievement of Sustainable Development Goals (SDGs).

The impact of FDI on agriculture can vary depending on the specific policies and regulations in place. For example, some studies suggest that FDI may lead to land grabbing and displacement of local farmers (Deininger & Byerlee, 2019).Good feeding system allows for a population to effectively learn, and even to live lives that are productive and healthy hence creating good environment for the population to contribute to the economy. Using sustainable farming practices, future generations will be able to feed a growing population by the virtue of taking care of the available land. (FAO, 2018).

According to (World Bank, 2020), by 2050, agricultural development will be among the most effective strategies to feed a population of 9.7 billion people and to increase shared prosperity .Comparing Agriculture to other sectors, its growth is nearly two to four times more successful at generating and increasing the incomes of the poorest people. In 2016,

research revealed that about 65% of working poor individuals depended greatly on agriculture for their livelihood. Agriculture is similarly deemed essential to growth of the economy; in 2018, it accounted 4% of the world's GDP, and in some emerging nations, it can even contribute more than 25% of GDP, (Liao, Wang and Huang, 2018).

Agriculture plays a crucial role in Africa's economy, providing livelihoods for a significant portion of the population. It is a key driver of food security, employment, and economic development in many African countries (Jayne, Chamberlin, and Traub, 2019). Smallholder farmers are the backbone of African agriculture. They cultivate the majority of the continent's arable land and produce a significant share of its food supply (Minten, Stifel, and Tamru, 2018). African agriculture faces numerous challenges, including limited access to modern inputs (e.g., improved seeds, fertilizers), poor infrastructure, climate change impacts, post-harvest losses, and policy and institutional constraints (Lowder, Skoet, and Raney 2016).

Youth engagement in agriculture is a critical issue. Encouraging young people to enter and remain in agriculture is essential for the sector's sustainability and the overall economic development of Africa (Nagler, Nillesen, and Voors, 2018). Effective policies and institutions are essential for promoting agricultural development in Africa. Reforms in areas like land tenure, market access, trade policies, and extension services are crucial for creating an enabling environment (Diao, Thurlow, and Benin, 2019).

FDI in Africa's agriculture has been increasing in recent years. This investment is aimed at modernizing agricultural practices, improving infrastructure, and promoting value addition in the sector. Some countries have implemented policies to attract FDI in agriculture.

However, it's important to note that the distribution of FDI in agriculture across African countries can be uneven. (Bjornlund, and Rooyen, 2020). Some regions or countries may receive more investment compared to others. Additionally, there have been discussions about ensuring that FDI in agriculture is sustainable and benefits local communities, rather than leading to issues like land grabbing or exploitation.

Inflation rates in African countries can vary widely. High inflation rates can pose challenges for agriculture by increasing the cost of inputs like seeds, fertilizers, and fuel. This can affect the profitability of farming operations. (Adenikinju, and Akinlo, 2016). Additionally, high inflation rates can sometimes erode the purchasing power of farmers, potentially reducing their capacity to invest in their farms and adopt modern agricultural technologies.

Many African countries have varying levels of external debt (Abimbola, and Mutiu, 2019). High levels of external debt can sometimes lead to constraints on government spending, potentially impacting investments in critical sectors like agriculture. Managing external debt is crucial to ensure that debt repayment does not crowd out essential investments in agriculture. Sustainable debt management policies are essential for balancing debt servicing with investments in economic development, including agriculture.

Africa's agriculture sector faces numerous challenges, including limited access to credit and finance for smallholder farmers, inadequate infrastructure, and vulnerability to climate change, (Husmann, and Kubik, 2019). Addressing these challenges requires strategic planning and targeted investments. At the same time, there are significant opportunities for growth in African agriculture. The continent has vast arable land, a young and growing

population, and potential for agribusiness expansion. Strategic investments in research, technology, and value chains can help unlock this potential. It's important for governments, policymakers, and stakeholders to adopt policies that promote sustainable agriculture, support smallholder farmers, and attract responsible foreign investment.

Considering East African Community (EAC), agriculture is crucial to employment, growth, eradication of poverty and food security. Around 70% of the region's rural population receives employment from this industry, with women making up the majority (Karugia, Massawe, Guthiga & Macharia, 2013). The EAC has relied largely on international aid for economic development (Vanheukelom, 2016).

Agriculture significantly drives growth of the economy in Kenyan, it is also the main employer, according to the 19th Kenya Economic Report. The research, in 2005 revealed that agriculture, which includes forestry and fish farming, contributed around 24% of GDP, 18 percent of the wage employment, and about 50% of the export revenue (Timothy, Mgale, and Hyandye, 2021). Similarly, the industry generated on average 21.9% of the GDP from 2013 to 2017, and at least 56% of the working force was involved in agriculture in 2017. Up to 65% of the country's exports of goods came from agriculture. As a result, the industry is crucial to the government's Big 4 development program, which relies heavily on agriculture to provide 100% nutritional security and food for all citizens in Kenya.

Similar to this, the agricultural industry has been the major employer in Kenya, contributing to 35% of the nation’s GDP in the year 2020, which is one of the highest percentages in African nations. Despite the (COVID-19) pandemic’s overall negative effects on the economy that year, the agricultural sector grew by 5.4 percent in comparison to 2019. Growing urbanization has been supported by agriculture, particularly technical

advancement and the introduction of labor-saving technologies. (Anriquez and Stloukal, 2008).

According to the economic analysis by World Bank (2018), it's established that Kenyan households who are entirely involved in agricultural activities contributed 31.4% decrease of the rural poverty. Therefore, for the non-poor and the poor citizens in most rural setups, agriculture continues to be the main source of livelihood. Increased productivity of the agricultural sector helps poor households to evade poverty (Ladisy Chengula, 2019). Kenya's most significant economic sector is agriculture, despite the fact that 20% of total land in the country suits cultivation and less than 8% of it is utilized for growing crops and animal feed. The World Bank estimated that in Kenya alone a locust plague that decimated crops in Kenya and East Africa in 2020, resulted in losses to livestock production and food production up to about $1.5 billion .(Kray and Shetty, 2020).

Understanding behind agricultural productivity remaining poor since independence and why publicly funded irrigation systems have failed to address the issue is crucial for preventing the failures of the past (Bjornlund & Rooyen, 2020). The primary emphasis on expanding the economy at the expense of economic development has neglected to take into account how complex socio-economic systems affect production of the agricultural sector. As a result, there hasn't been much consistent effort to create the infrastructure, rural financial institutions, and commercial farming skills that are necessary for most farmers to switch from commercial to subsistence farming despite the many attempts (Austin, 2004).

The adverse impacts of climate change provide a significant threat to the agricultural-dependent population of Kenya, jeopardizing both their livelihoods and food security. Furthermore, climate change also poses a substantial risk to the integrity and functionality of food production systems in the country. Kenya is currently experiencing the adverse impacts of climate change, which encompass elevated temperatures, erratic precipitation patterns, and an increased occurrence of both severe droughts and floods. As an illustration, as a result of the very prolonged periods of drought encountered during that particular period, there was a notable escalation in the population requiring food aid, with figures rising from 650,000 individuals in 2007 to over 3.8 million in the latter part of 2009 and 2010, as documented by Nyariki, and Amwata, (2019).

Based on a comprehensive examination of historical climate records, it has been determined that the mean annual temperatures have exhibited a rise of around 1.0°C since the year 1960. Projections indicate that by the 2060s and 2090s, these temperatures are anticipated to experience further increments within the ranges of 1.0-2.8°C and 1.3-4.6°C, respectively (NCCAP, 2012). In recent decades, there has been a minimal decrease in precipitation seen in Kenya, potentially associated with a decline in rainfall throughout extended periods of rainy seasons.

The agricultural sector in Kenya may benefit from foreign direct investment, particularly in the development of infrastructure like irrigation systems, storage facilities, and transportation networks. However, if FDI is not adequately targeted towards the agricultural sector, there may be a gap in essential infrastructure, (Wekesa, Wawire, and Kosimbei, 2016).FDI can have both positive and negative impacts on agriculture. On one hand, FDI can bring in much-needed capital, technology, and expertise to modernize and

improve agricultural practices (Sekabira and Qian, 2019). High levels of external debt can potentially lead to reduced government spending on the agricultural sector, which may negatively impact investments in agricultural infrastructure, research, and development (Khan, 2008). However, the relationship between external debt and agriculture can be complex and may depend on various factors, including the structure of the debt, how it is managed, and the overall economic conditions in the country.

High inflation rates can affect agriculture in several ways. One study found that inflation can erode the purchasing power of farmers, leading to reduced investment in agricultural inputs and technology (Adenikinju, and Akinlo, 2016). Inflation can also increase the costs of production for farmers, particularly if prices of inputs like fertilizers, seeds, and fuel rise faster than agricultural prices (Mujawamariya & Karugia, 2013).

1.2 Statement of the Research Problem

Agricultural development is prioritized in Kenya and selected as one of the sectors that will be essential to the accomplishment of the ambitious Vision 2030 target. By 2030, the country aims at being in middle-income status, be freshly industrializing, and have a high standard of living for all of its residents. It also aims at keeping GDP growth rates at 10% annually. Kenya has also shown an upward trend in the growth of foreign direct Investment (FDI) inflows from a low of $55787.00 million in the year 2018 to a high of $99690.00 million in 2020. However, agricultural sector performance has been declining over the years despite increased Foreign Direct Investment directed to the sector yet the Kenyan economy is closely linked to agriculture.

Similarly, there is dearth of information with regard to how inflation and external debt affected the sector. The performance of the sector has been poor hence affecting most agriculture related and farming activities revolving around crop production and livestock rearing. It's clear that the nation has the capacity to develop its agriculture industry, which will help it meet the objectives of Vision 2030. Thus, it is necessary to figure out how Kenya's agricultural output may be increased. The analysis of factors like foreign direct investment (FDI), inflation and external debt as well as how they affect the agricultural sector performance were the main goal of this study.

1.3 Objectives of the Study

1.3.1 The General objective

The study's general objective was to investigate the effect of macroeconomic factors on performance of agricultural sector in Kenya.

1.3.2 The Specific objectives

The specific objectives of the study were:

i. To examine the effect of inflation on performance of Agricultural sector in Kenya.
ii. To establish the effect of Foreign Direct Investment on performance of Agricultural sector in Kenya.
iii. To determine the effect of External Debt on performance of Agricultural sector in Kenya.

iv. To evaluate the moderating effect of population growth on the relationship between macroeconomic factors and performance of agricultural sector in Kenya.

1.4 Hypotheses of the study

H_{o1}: There is no statistically significant effect of inflation on performance of Agricultural Sector in Kenya

H_{o2}: There is no statistically significant effect of Foreign Direct Investment on performance of agricultural Sector in Kenya

H_{o3}: There is no statistically significant effect of External debt on performance of Agricultural Sector in Kenya

H_{o4}: There is no statistically significant moderating effect of population growth on the relationship between macroeconomic factors and performance of agricultural sector in Kenya.

1.5 Justification of the Study

The profound knowledge gained from this research will add flesh to the existing literature as pertains macroeconomic environment and agricultural performance issues in Kenya. Given the critical role the sector plays in providing livelihoods and a food basket for the Kenyan economy, it is increasingly important to ensure that high frequency quality data is available to inform the food supply situation in the country, the prevailing prices mostly affected by inflation and the challenges that may affect production in the sector such as capital which may be in the form of Foreign Direct Investment or even external debt invested in the Agricultural sector.

The study's findings will create a basis for formulation of policy based on the short and long-run projections for agricultural sector growth with the aim of achieving *Vision 2030* goals and the Big 4 agenda; food security. This is because the study shows how the factors studied can be adjusted to achieve the desired agricultural output. The results from this study will also provide data for reference in further research in matters pertaining economic growth and Agricultural sector performance in particular.

The research equally aims at benefiting the agricultural sector, education sector, academicians as well as other researchers interested in agriculture and economics. Tabling the effects of macroeconomic variables on Agricultural sector performance helps agricultural sector improve on its performance .Furthermore, it also prepares farmers, employers, teachers, and economists in dealing with the effects through training, education and dissemination of information in schools and social gatherings, in agricultural institutions and at the media centers.

1.6 Scope of the Study

The study majorly focused on the effect of macroeconomic factors on the performance of agricultural sector in Kenya covering a period between 2010 and 2020. The study focused on the entire agricultural sector whereby a comprehensive study of the entire agricultural sector allowed for an assessment of its long-term trends, challenges, and potential for sustainable growth. Similarly, it advocated for policy changes or interventions that have a broad impact on the agricultural sector as a whole.

The choice of the study period was informed by the fact that; In 2010, Kenya enacted a new constitution reforms and land reforms, promoted Climate-Smart Agriculture, promoted Agribusiness and Value addition, Digital Innovation and Technology was also adopted and there was a growing recognition of the need to engage youth in agriculture, leading to various initiatives and programs aimed at providing training, mentorship, and access to resources for young farmers. Between 2011 to 2013, there was Drought and Food Security Challenges, Kenya launched the National Horticulture Traceability System to enhance food safety and quality assurance in horticultural produce, there was also ban of Genetically Modified Organisms (GMOs) and Launching of the National Irrigation Acceleration Program (NIAP) took place.

In 2016, there was fall armyworm invasion which devastated crops. In 2017, there was severe droughts in the country that devastated agriculture. In 2019, the locust invasion which resulted in losses to livestock production and food production up to about $1.5 billion, (Kray and Shetty, 2020) and the COVID-19 pandemic in 2020 which prompted various interventions in the agricultural sector, including efforts to ensure continued food production, supply chain resilience, and support for vulnerable farmers. Disruptions in the agricultural supply chain were observed, including challenges related to transportation, labor shortages, and market closures. This had implications for farmers' ability to produce and sell their crops (Pitschner, 2022)

Specifically this study focused to unravel the effect of macroeconomic variables namely inflation, Foreign Direct Investment and External Debt on the agricultural sector growth. The choice of the variables was informed by the fact that Foreign direct Investment (FDI) contribute to capital formation in the agricultural sector and it leads to increased

investment in modernizing farming techniques, infrastructure, or agribusinesses (Alarcón Osuna, 2016). External Debt on the other hand affect the fiscal capacity of the government to invest in agricultural development and support programs. Inflation was equally important to be considered since it affects the purchasing power of farmers and consumers in the agricultural sector and it also lead to changes in demand for agricultural products. The research also determined the effect of population growth as the moderating factor on the linkage between the macroeconomic variables and agricultural sector performance. Population growth was used as the moderator since it can have implications for food security, as it affects the ability of the agricultural sector to produce enough food to meet the needs of the population (Asim, and Akbar, 2019).

1.7 Limitations of the Study

Secondary data used has certain limitations. Sometimes it is bias due to errors either in substitution or in arithmetic and also in definition. This therefore makes the end results not to reveal the true picture of the variables in question. Despite the aforementioned shortcomings, the used data ensured that reasonable results were attained. In order to avoid this biasness, data used was originated from different sites like the database of the World Development Indicators, the World Bank, Statista, United Nations Conference on Trade and Development (UNCTAD) and from the Kenya National Bureau of Statistics (KNBS) website. Obtaining data from these various sources helped in eliminating the errors and biasness that may have been in one source of data so as to get an accurate and a clear linkage between external debt, inflation, foreign direct investment (FDI) and population growth on the performance of the agricultural sector Kenya.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter gives broad review of the related literature to the research. It covers; the theories which are of particular relevance to the study, reviews the empirical studies to identify the knowledge gaps. Similarly, the relationships between variables studied are conceptualized.

2.2 Theoretical Literature

This segment majorly focused on the models and theories which are of significance to the study. The research was informed by Harrod-Domar Growth Theory, Neoclassical Theory, and classical theory.

2.2.1The Harrod- Domar growth Theory

Roy F. Harrod separately created the model in 1939, whereas Evsey Domar independently created it in 1946. It focuses on the relationship between investment and economic growth. It suggests that an increase in investment, particularly in the form of capital goods, can lead to an expansion in economic output. (Rajab, Bouzayani, and Zouheir, 2023). It can be applied to analyze how increased investment in agriculture might support its performance as this paradigm is predicated as one of the vital driver of expanding the economy. It targets the potential for sustained growth via adjustments to the capital supply and demand. The model focuses on the prerequisites for establishing and sustaining growth. According to Harrod and Domar, capital accumulation is essential to the growth process.

According to the Harrod-Domar model, an increase in investment leads to an increase in output. In the context of agriculture, investing in modern farming equipment, technology, irrigation systems, research and development, and infrastructure. This can lead to higher agricultural productivity and output. By 2030, it was anticipated that Kenya's infrastructure will have reached middle-income status (Omamo, Rodriguez and Muliaro, 2018), which economically, may still be on track. Similarly and in the same manner, the desired global accomplishments anticipated similar global economic trends on the physiocratic invisible economic hand of nature, which is crucial for progress along the route of economic expansion as proposed in the Harold-Domar economic model, among many others (Duong and Nguyen, 2019).

According to the Harrod-Domar model, an increase in investment leads to a multiplier effect, which means that the initial injection of investment leads to a larger increase in overall economic activity. In the context of agriculture, this means that increased investment can lead to a proportionally larger increase in agricultural output and employment, (Abimbola and Mutiu, 2019). Similarly if external debt is used to finance agricultural development projects, it's crucial to manage the debt responsibly. This includes ensuring that the returns from the agricultural investments are sufficient to service and repay the debt in the long run.

The model is not without flaws, and these includes: as a considerable amount of domestic saving may be retained in non-financial forms, which is true of many emerging nations, complicating the linkage that savings and investment have with growth element (Sohail, and Li, 2023). Harrod-Domar approach also tends to overestimate domestic saving available for investment and, as a result, underestimate the amount of foreign resources

needed to close the resource gap, oversimplifying the sources of economic growth to the extent that non-financial saving is not channeled into productive investment. It solely takes savings and capital into consideration. Moreover, it disregards other elements that contribute to economic growth, such as increased labor productivity and technology advancements.

The Domar model aids in comprehending the connection between foreign direct investment and external debt on agriculture sector performance. Foreign Direct Investment channeled to Agriculture must meet the planned investment in the agricultural sector at a specific saving rate in order for the sector to grow (Çitak, and Duffy, 2019).

2.2.2 The Neoclassical Theory

The Solow-Swan model which is basically the neoclassical growth theory, was brought forth by Trevor Swan and Robert Solow. From the year 1956, the theory has been the framework for long-term economic growth. It describes the interactions of technology, labor and capital, resulting to a stable growth of the economy. How fast the economy grows is squarely affected by the three elements. The conditions of general equilibrium permit price adjustment in the "neoclassical synthesis," which blends Keynesian macro ideas with a micro foundation, to eventually shift production and employment towards full employment levels (Alvarez, Beraja, Gonzalez-Rozada and Neumeyer, 2019).

This theory shows that economic equilibrium in the short-term results from different levels of labor and capital which are of great importance in the production process. As per the hypothesis, advancement in technology greatly affects the running of the economy. From

the outlined conditions, the theory states that an economy must always grow. However, this theory emphasizes assertion that equilibrium in the short-term, differs from equilibrium in the long-term and does not necessitate the three factors, (Hetland, Andreas, and Hetland, 2017)

The neoclassical theory postulates that for an economy to have a stable growth, it must depend highly on technology, capital and labor which is properly adjusted. However, for this to occur, temporary equilibrium is depicted necessary. Therefore for a proper operation of the economy, suitable labour, technology and good capital size needs to be in place. This however is different from a long-term equilibrium where there is the presence of one of the three elements, (Pradhan, Rudra P., *et al* 2019).

It is now widely acknowledged that a nation's capacity for growth is significantly affected by the extent of its debt (Blake, 2015). Kenya's gross state debt has reached 56 percent of GDP, fast rising due to borrowing for infrastructure-related projects. Utilization of human capital and capital accumulation of an economy are essential in stimulating economic growth. It further confirms the overall output of the economy being determined by the interaction between labour and capital. This theory also contends that advancement in technology improves labor productivity, hence increasing the overall output due to improved labor productivity. Therefore, the neoclassical growth model's production function helps in gauging equilibrium rate and economic growth.

Between June 2003 and June 2016, public debt increased five-fold in Kenya. Occasionally, due to the public debt's composition of shifting in favor of domestic debt, the private sector has been squeezed out making economic growth suffer due to rising nominal interest rates

(Mwaniki, 2016). This theory is pertinent to our study because, using the production function approach, it is possible to determine the growth of the agricultural sector through comparing the sector's growth and equilibrium condition to the amount of foreign debt that is owed to it. So, in accordance to neoclassical theory of economic growth, the agricultural sector maintains its stable rate of expansion even as the amount of foreign debt owed to it rises.

2.2.3 Classical Growth Theory

The Classical Growth Theory was developed by Adam Smith, David Ricardo, and Thomas Malthus in the late 18th century and early 19th century. It postulates that growth of the economy in any nation dwindles with population growth and the sources of resources becomes constrained, (Madiev, 2023). Such is typically a logical extension of the thought kept by the inventors of the theory, who contends that a small increase in real GDP per person invariably promotes population growth that finishes a country's resources and lowers real GDP. The growth of the economy of a nation will on the other hand start to slow down.

The capital production process begins as a result of the excess. As a result, there is a surge in the demand for labor, which raises overall salaries. Total population or total manpower will increase if overall salaries are higher than minimum wages and overall population stays constant. Surpluses may be produced due to population growth. In this way, the process continues until the economy reaches equilibrium, where wages and total output are equal and surpluses cannot be produced (Muhamad, Reza and Ilham, 2023). Yet, traditional economists assert that as technology levels advances, growth in the production function is

realized. Moreover, the Classical theory postulates that economic stagnation can only be delayed but not stopped ultimately.

The theory, however, has the following drawbacks: Lack of knowledge on technology: The efficient technical advancement that could contribute to an economy's smooth operation is ignored by the traditional paradigm of growth. Technological advancements can lower diminishing returns (Sobirov, and Eshonqulov, 2023). Total wages however are incorrectly assessed since the classical model of growth works with the assumption that they cannot rise above or reduce beyond the subsistence level which is however not true. The classical theory is very significant to the research study since it outlays how the population growth affects agricultural sector performance in Kenya by giving a clear linkage of how population growth relates to the agricultural productivity.

2.3 Empirical Literature

Vast literature as well as related studies of other researchers as pertains the effects of macroeconomic variables on growth of agricultural sector in Kenya are reviewed.

2.3.1 Foreign Direct Investment and Agriculture

According to (Tian, Dong and Ye, 2021) used quantitative data while investigating Foreign Direct Investment FDI inflows to some regions of China. They realized that places experiencing higher FDI inflows have robust growth in GDP per capita. This, was however possible by employing technology in the process. Similarly, in a research on a company level in India using panel data, (Sarkar and Lai, 2019) revealed that foreign investment (FI) in a firm positively and significantly raised the firm’s performance. Disagreeing with this

results, (Djokoto, 2018) used cointegration analysis and established that the firms with no foreign investment (FI) are less productive compared to sectors with more foreign investment. However this study focuses on the connection between foreign direct investment and agricultural sector in specific.

Chowdhury and Mavrotas (2016) studied Thailand Chile, and Malaysia, having major macroeconomic indicators and at the same time considered as major receivers of FDI, they found out that FDI could be a determining factor for quality growth through its potential features and implications that are significant in the reduction of poverty. Thus, since Foreign Direct investment is a good source for revenue generation used for enhancement of development and also for the protection of the poor citizens of a nation, both the developing and the industrialized nations have given out incentives to attract Foreign Direct Investment FDI into their countries (Klein, Esparza, DeJong, and Weinbaum, 2021).This study will therefore look at the nexus between foreign direct investment and Agricultural sector performance in Kenya.

According to Enderwick (2015), while investigating the impact of FDI on host country, realized that development processes are influenced by the most essential inputs, including rising levels of education and mobility, growing competition for foreign direct investment, and widespread deregulation. Economic growth in developing countries may be stimulated by foreign direct investment (FDI), although this is conditional on factors such as the host country's human capital, trading system, and economic openness. He argues that in order to entice FDI, the host developing country needs to assess whether or not the investment in assets and infrastructure (human capital) is appropriate. The study by Enderwick did not however reveal direct linkage to agricultural sector.

Msuya (2017) found that agriculture has a far larger economic and social impact than other sectors as a result of his study of the effect of FDI in Tanzania's agricultural sector where FDI had a positive and significant effect on agricultural sector growth. After looking at 11 countries in Latin America and East Asia, Zhang (2016) concludes that FDI has a significant granger-causal relationship with economic growth. Despite the fact that the impact on the economic growth of the host nation may differ from one country to another, this remains true. The study however does not give a clear link between agriculture and FDI.

2.3.2 Inflation and Agriculture

P. M. Jayathileke and R. M. Rathnayake (2018) explored the short-run and the long-run link between the economic growth and the inflation of three Asian nations over the period of 1980-2010. Their focus was on the relationship between these two variables in the short run. Cointegration analysis and causality testing were the methodologies applied to the research. The findings showed that there is a long run significant negative association between economic growth and inflation in Sri Lanka. This relationship exists over the long term. Although there was no statistically significant association identified between the variables in China and India, a negative and substantial short run relationship was found for China. The relationship was found to exist only in the short term. The study by Jayathileke and Rathnayake did not focus on a specific subsector of the economy whereas this study intended to give the nexus between agricultural performance and Inflation.

Mekonen, E. K. (2020) examined the effect of inflation on agriculture sector growth of Ethiopia from 1980-2018 using Autoregressive Distributed Lag model. Inflation had a

negative and significant long-run relation with agriculture sector growth suggesting that inflation is harmful to agriculture sector growth than stimulating it. Thus, to increase the growth of agriculture sector, government should moderate inflation using prudent monetary and fiscal policy. It should also monitor the efficacy and suitability of agriculture investment to countries context. As land is fixed input, intensive agriculture and productivity enhancing technologies should be applied. Increasing labour skill through training could also increase agriculture output. The study by Mekonen focused on Ethiopia's agricultural sector, whereas this study focuses on Kenya.

Olusola, Chimezie, Shuuya and Addeh (2022) estimated the influence of inflation on Ghana's private consumption spending and economic growth between 1990 and 2020 using Engle-Granger Cointegration, error correction, and granger causality. The study found a long-term negative link between inflation and private consumer expenditure in Ghana. In addition, inflation predictions hurt private consumption expenditure attitudes, especially among consumers in good financial shape. Since the global financial crisis, inflation expectations are more important.

The study recommended that the government and the Bank of Ghana develop and implement sensible fiscal and monetary policies to stabilize macroeconomic conditions and improve economic growth. Use technology. Agriculture output may rise with labor skill training. The study by Olusola *et.al* focused on the linkage between Inflation and private consumption spending and economic growth whereas this study reveals the nexus between INF and Agricultural

Asigbetse, Amoako, Marfo, and Arthur (2022) examined Ghana's sectoral structure, inflation, and exchange rates from 1980 to 2019 and how they affect economic growth using time series data. In conclusion, inflation and sectoral structure had distinct effects on economic growth in Ghana than exchange rates and sectoral structure. The study found that Ghana's economy has shifted from agriculture to services. Economic reforms and liberalization have permitted increased commerce and free markets, causing this structure change. The study recommended that the government and the Bank of Ghana develop and implement sensible fiscal and monetary policies to stabilize macroeconomic conditions and improve economic growth. Other than use of technology, agricultural output may rise with labor skill training. The study does not reveal how inflation is linked To Agriculture.

2.3.3 External Debt and Agriculture

According to Okolie, (2015), who used descriptive survey to examine the debt crisis, the debt relief as well as economic status in Nigeria, The study revealed a negative significant relationship between External debt and growth. It was concluded that slow economic rise up in Nigeria was established to be as a result of huge external debt owed by the country and hence leading to shortage of fiscal discipline brought about by over dependence on oil revenue amongst others. The study by Okolie revealed the nexus between External debt and economic growth in Nigeria whereas this study shows the nexus between external debt and agricultural sector performance in Kenya.

Rockerbie, (2018), studied 13 countries for the period of 1965-2016, he affirmed that in 1982, there was a significant effect of debt crisis with regards to slowdown of domestic investment which was considered so intense particularly on agriculture. The amount of

agricultural output that was achieved had an inverse relationship with the country's total external debt for the 13 least developed nations for the period 1982-2010. This was achieved using Ordinary Least Squares (OLS) in measuring the debt crisis size effect on agricultural output.

While conducting an investigation into the empirical evidence about the connection between Lebanon's external debt, economic expansion, and exports for the period 1970-2013, (Wadad, 2015), reported that the variables had relationships in both the short term and the long run. Insignificant effect was also revealed in the relationship between external debt and growth. He further recommended that sourcing domestic loans be considered since according to Abubakar and John (2015), returns on investment will not be subject to taxation by external creditors. The study by Wadad revealed the connection between external debt and economic expansion which does not really show the expansion in the specific sectors like the agricultural sector. This study however reveals the nexus between Inflation and agricultural sector growth.

During the period of 1975–2006, when the correlation between external debt and economic growth in Nigeria was studied, Adedoyin, Babalola. Otekunri, and Adeoti, (2016) found that external debt had a negative association with economic growth in Nigeria. From the findings, the study encourages debt accumulation in a synchronized manner for activities scheduled for repayments. The study by Adedoyin *et.al* (2016) revealed the nexus between Nigeria’s External debt and economic growth, but much is not revealed on agricultural sector.

The study by Ramakrishna (2017) that looked at the influence of external debt on the growth of Ethiopia's service sector and agricultural sector from 1981-2015 found that both the growth of Ethiopia's service sector and its agricultural sector have contributed favorably to the country's overall economic growth. In addition, aggregate levels of external debt have a negative impact on the expansion of the agricultural economy. Furthermore, the direction of causality in this relationship is unidirectional, which means that the expansion of agricultural output is adversely affected by the burden of debt (Brownson, Emmanuel, Vincent, and Etim 2014). The studies unraveled the nexus between agricultural sector and external debt in Ethiopia whereas this study focuses on Kenya’s agriculture and external debt.

According to Obadan, and Ohiorenoya, (2013) while examining the process of succession planning in small business enterprises in the hotel industry in Benin City, it was found out that the level of foreign borrowing required by a nation is contingent upon the proportion of its total domestic output allocated to overall expenditure. In order to provide a positive impact on economic growth, it is imperative for foreign borrowing to be accompanied by a rise in domestic savings and investment. Hence, in order for nations to reduce their reliance on external borrowing, they must enhance their domestic savings in order to sustain their targeted development rate. The study majorly focused on external debt and hotel industry whereas this study focuses on the nexus between external debt and agricultural sector.

A comprehensive study was carried out by Adetual, (2019) on the implications of Nigeria's processes for the payment of its external debt servicing on agricultural productivity revealed a sizable negative impact of debt services. Thus, the report urges increased foreign

lending for agricultural development. Using a co-integration test and an ECM In their study on the period from 1974 to 2017, (Safdari and Mehrizi, 2019) observed the relationship between external debt and economic growth in Iran. The findings indicated that imports and external debt exhibited a little adverse effect on the country's GDP. The study by Adetual shows the nexus between processes for the payment of its external debt servicing on agricultural productivity whereas this study reveals the nexus between external debt and agricultural sector performance in Kenya.

2.5. Research gaps

Table 2. 1 Summary of Research Gaps

Author/Year	Focus of Study	Methodology	Findings	Knowledge Gaps	Addressing the gaps
Mekonen, E. K. 2020	Investigated the effect of inflation on agriculture sector growth of Ethiopia from 1980-2018	Autoregressive Distributed Lag model	Inflation had a negative and significant long-run relation with agriculture sector growth	The study was conducted in Ethiopia	The research study focused on inflation and Agriculture in Kenya
Tian, Dong and Ye, 2021	Investigated FDI inflows to regions of China	Quantitative	Regions with higher FDI inflows experienced faster GDP per capita Growth	The theory does not reveal whether FDI spurs agricultural sector growth	The research study focused on revealing the % increase in FDI that yields a corresponding increase in the Agricultural sector performance
P. M. Jayathileke and R. M. Rathnayake 2018	short-run and the long-run link between the	Cointegration analysis and causality testing	a long run significant negative association	The study focused on effect of inflation on	This study specifically focused on inflation and

	economic growth and the inflation of three Asian nations over the period of 1980-2015		between economic growth and inflation	the general performance of the economy	agricultural sector
Olusola, Chimezie, Shuuya & Addeh 2022	influence of inflation on Ghana's private consumption spending and economic growth between 1990 and 2020	Engle-Granger Cointegration, error correction, and granger causality	negative link between inflation and economic growth in Ghana	The study focused on the economic growth of Ghana	This study focuses on agricultural sector growth.
Safdari and Mehrizi, 2019	On effect of external debt on growth in Iran (1974-2017)	co- integration test and ECM,	external debt and imports inverse impacted GDP though insignificantly	The study was on growth in Iran	The study focused on agricultural sector performance in Kenya
Ezeabasili. 2019	link between Nigeria external debt and economic growth from 1975-2016,	Quantitative	it was revealed that external debt has negative relationship with economic growth in Nigeria	The study focused on economic growth in Nigeria	The study focuses on the Agricultural sector performance in Kenya
KNBS 2018	To carry out an Economic Survey	Quantitative	There was appositive growth realized in the manufacturing of grain mill product with increase in FDI	The study does not reveal how FDI affects agricultural sector growth	The current study assessed the effects of FDI on Agricultural Sector Performance

Spar and Kou (2015)	Launched ERP-Economic Recovery Program to resuscitate the economy including the agricultural sector and its sub sectors by utilizing FDI in Ghana	Quantitative	They attracted FDI though capital transfers and non-banking entities to foreign affiliates that had recently established operations in Ghana	The study focused on Ghana	The study employed FDI in the evaluation of Kenya's Agricultural sector
Okolie,2015	examining used descriptive survey to establish external debt relief, debt crisis on growth of the economy in Nigeria,	Quantitative	huge external debt owed by Nigeria was responsible for slow economic growth	The study focused on Nigeria	The research focused on Kenya's external debt
Rockerbie, 2013	In the study of 13 countries over period of 1965-2011	Quantitative	debt crisis of 1982 had significant effects in terms of intense slowdown of domestic investment mostly on agriculture	The study does not reveal the current status of domestic investment on agriculture in relation to external debt	The current study Evaluates the relationship between external debt agricultural sector performance for the period of 2010-2020
Sarkar and Lai 2019	Effect of FDI on Firms' output	Pannel data	foreign investment in a firm significantly and positively increased the firm's output	The study focused on a firm's productivity	The study determined the effect of FDI on Agricultural sector performance

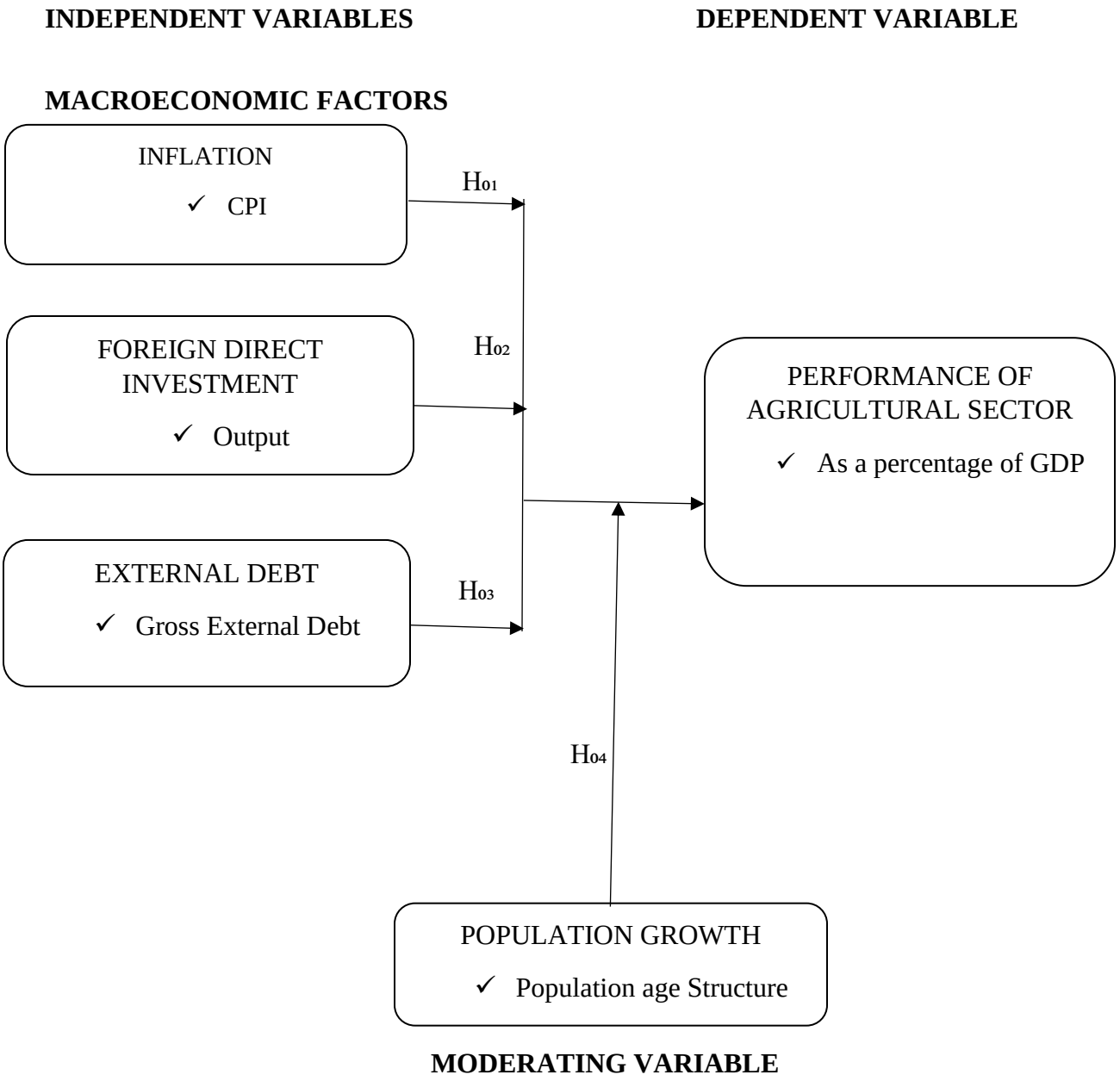
Ramakrishna, 2017)	External debt's impact on Ethiopia's service sector and agriculture growth from 1981-2015	Quantitative	it was found that service sector growth and growth in agriculture have positive impact on the economic growth of Ethiopia	The study focused in Ethiopia	The study focuses on Kenya
Wadad, 2015	The link between Lebanon's economic growth, exports, and external debt from 1970 to 2013.	Quantitative	insignificant effect of external debt on growth	External debt was not studied in relation to agricultural sector performance Also the study focused on Lebanon	The current study evaluates the relationship between external debt and agricultural sector performance in Kenya

Source: Author, 2023

2.6 Conceptual Framework

Conceptual framework is an instrument focused on assisting researchers in the development of an understanding and creating of awareness of the variables under investigation, (Grant & Osanloo, 2014). The connection between the dependent, independent as well as the moderating variable are well depicted by the conceptual framework.

Figure 2. 1 Conceptual Framework



Source: Author (2023)

Agriculture is among the most vital sectors of the economy. Its performance is influenced by a number of factors including macroeconomic variables. For adequacy in the production of good quality and sufficient food, agricultural performance takes lead. This therefore leads to rise in disposable incomes of individuals due to adequacy of food supply. In this

study, Agricultural sector performance was the dependent variable. Inflation, foreign direct investment and external debt were the independent variables whereas population growth was the moderating variable.

Foreign Direct Investment (FDI) measured in terms of its output can have both positive and negative impacts on agriculture. On the other hand, FDI can bring in much-needed capital, technology, and expertise to modernize and improve agricultural practices (Sekabira and Qian, 2019). Similarly, employing foreign direct investment (FDI) into the agricultural sector makes it easier for the sector to get financial assistance that enables for ease of access of desired equipment and even improved technology for the good performance of the agricultural sector

External debt also affects, the Agricultural sector's performance in that High levels of external debt can potentially lead to reduced government spending on the agricultural sector, which may negatively impact investments in agricultural infrastructure, research, and development (Khan, 2008). However, the relationship between external debt and agriculture can be complex and may depend on various factors, including the structure of the debt, how it is managed, and the overall economic conditions in the country.

High inflation rates can affect agriculture in several ways. One study found that inflation can erode the purchasing power of farmers, leading to reduced investment in agricultural inputs and technology (Adenikinju, and Akinlo,2016). Inflation can also increase the costs of production for farmers, particularly if prices of inputs like fertilizers, seeds, and fuel rise faster than agricultural prices (Mujawamariya & Karugia, 2013). Input price inflation affects farmers' cash flow, emphasizing the need for good operational management and financial management. Current competitive dynamics, however, may

likely lead to faster input price inflation if agriculture as a whole experiences advances in productivity and cost-cutting.

The moderating effect of population growth on the relationship between macroeconomic factors and agricultural sector performance was also determine. Population growth was used as the moderator since it can have implications for food security, as it affects the ability of the agricultural sector to produce enough food to meet the needs of the population (Asim, and Akbar, 2019).

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Substantial methodological preamble for this study is in this chapter. The chapter examines the study's research design, study area, data gathering, analysis, and presenting methods which entails, descriptive statistics, inferential statistics, correlation analysis, multiple regression analysis, analytical Model and description and measurement of variables. The chapter also covers diagnostic tests and Ethical consideration.

3.2 Research Design

Basically, research design is a plan or blueprint that directs the steps of the study investigation process including collecting, analyzing and interpreting of the made observations (Nachmias, 2005). Essentially, it gives room for inference making concerning the relations found between variables under investigation as it acts as a logical model of proof .Similarly, it forms the backbone of generalization to situations. Research design is equally termed as the research structure as it brings all of the components of a research endeavor together.

This study employed causal research design. This design is useful for studying the long-term effects of a factor on another. Causal designs are well-suited for investigating causal relationships. By observing changes in the independent variable(s) and the subsequent effects on the dependent variable(s) over time, researchers can make stronger inferences about cause and effect, (Wright, and Markon, 2016). Causal research design studies the

effect of Inflation, Foreign Direct Investment and External Debt on Performance of Agricultural Sector in Kenya.

3.3 Study Area

The research was conducted in Kenya, a country located in East Africa, which shares borders with Somalia and the Indian Ocean to the east, Ethiopia and Sudan to the north, Uganda to the west, and Tanzania to the south. Kenya is situated within the geographical coordinates of 1°00' N latitude and 38°00' E longitude. The nation's land area measures 571,466 square kilometers, while its total area encompasses 582,646 square kilometers. Kenya exhibits a diverse range of climatic conditions, characterized by annual precipitation levels that span from below 250 millimeters in arid and semi-arid regions, including over 80% of the nation's landmass, to 2,000 millimeters in regions with strong agricultural potential.

The selected nation’s agricultural sector is responsible for approximately 51% of the country's GDP, with a direct contribution of 26% and an indirect contribution of 25%. According to Agricultural Sector Transformation and Growth Strategies (ASTGS) (2018), the agricultural sector employs over 40% of the total population and over 80% of the rural population. Additionally, this sector contributes to more than 65% of the country's total exports. According to the World Bank (2015), smallholder rain-fed production farming systems, which encompass an area ranging from 0.2 to 3 hectares, account for 78% of total agricultural production and 70% of commercial production.

Despite its significant contribution to local and national economies, the agricultural sector has yet to realize its maximum potential, mostly due to a range of climatic and non-climatic factors. Inadequate land use policies, insufficient investment levels, restricted availability

of vital resources such as inputs, credit, technology, and markets for promoting fair and inclusive growth, limited value addition, and inefficient coordination among institutions are among the factors identified in the literature (Nyariki, and Amwata, (2019), GoK, 2019; AGRA, 2018). According to the National Climate Change Adaptation Plan (NCCAP, 2012), the presence of climate change exacerbates this situation.

3.4 Data Types and Data Sources

This study employed quarterly time series data from secondary sources. The data on Foreign Direct Investment were generated from the database of World Bank; World Bank Open data Platform and UNCTAD from 2010 to 2020. On inflation, data was generated from the database of KNBS as well as from World Bank. Data on External Debt was obtained from World Development Indicators, data on Agricultural sector performance was obtained from Statista and data on population growth was obtained from World Bank's official Website.

3.5 Data Collection Methods

Content analysis tool was used to acquire data in this study from secondary sources. Content analysis is the methodical reading of a collection of texts, images, and symbolic material without necessarily considering the viewpoints of the author or the intended audience in order to get a specified information. (Krippendorff, 2018). The quantitative data was also obtained through online and web survey and from financial statements and statistics.

3.6 Validity and reliability of Research Instruments

3.6.1 Validity

Validity of an instrument is a measure of how well an instrument measures what it is supposed to measure, Kombo and Tromp (2006). Validity is the accuracy and meaningfulness of inference which are based on the research results (Mugenda & Mugenda 2003). An instrument is valid when it measures what it claims to measure. Validity focuses on the much accuracy of the data obtained in the study represents the variables of the study. Much of it is determined by either the presence or absence of systematic error in data.

The study employed construct and content validity. Instrument construct validity according to Kothari (2014) is an assessment of how well the theories or ideas have been translated into actual measures. This study established construct validity of the instruments by reviewing theoretical and empirical literature.

Content validity is the extent to which data collection instruments yields expected statistical outcomes of the study, Williman (2012). This was attained through consulting with supervisors for expert advice on the content validity of the research instrument and also by measuring the content validity index. Glen (2010) opines that an instrument is declared valid if the Content Validity Index (CVI) is at least 0.7.

3.6.2 Reliability of Research Instruments

According to Mugenda and Mugenda (2014) reliability is the measurement of the degree to which a research instrument yields consistent results after repeated trials. Kombo and Tromp (2006) defines reliability as the degree to which a test consistently tests what it is designed to measure. Kothari (2014) asserts that reliability of an instrument is a priority of

the instruments to yield results when administered to a certain sample under given conditions.

3.7 Data Analysis and Presentation Techniques

Data analysis refers to the systematic procedure of acquiring, modeling, and scrutinizing data in order to derive meaningful insights that inform decision-making (Calzon, 2022). The analysis of data plays a crucial role in research, since it facilitates a more comprehensive and accurate comprehension of the data. The utilization of this approach allows researchers to effectively assess the data, so assuring the absence of any omissions that may impede their ability to derive meaningful conclusions from it.

In this study EViews software was used for analyzing data. Descriptive statistics gave values of the mean, minimum, standard deviation, maximum, skewness and kurtosis. The inferential statistics tested the assumption of hypotheses in the study. Data was analyzed where regression model was formulated in order to establish the link between dependent and independent variables. A multivariate model showed how changes in the selected macroeconomic factors affect agricultural sector performance. Correlational analysis was done to indicate statistical significance and direction between macroeconomic factors affecting agricultural sector performance.

Data presentation is key in presenting the study findings since with pertinent evidence, the aims are made obvious. For the study to convince a reader, the effective presentation has to be done .Data presentation offers conclusions in a methodical way. Regardless of how many different types of data were gathered for the study, all of them were structured, presented, and evaluated well in the presentation (Creswell, 2014). Data was presented in tables.

3.7.1 Descriptive Statistics

In this study, the maximum, the mean, the standard deviation, the minimum, and the Jarque-Bera test was used to establish whether the variables were normal.

3.7.2 Inferential statistics

Data which is originated from a sample is used in making inferences to form conclusions covering the wider population where the sample was collected. By examining a smaller sample of a population, this method aims to produce measurements that can characterize the population as a whole. To investigate the null hypotheses, the study employed inferential statistics like the multiple regression and correlation analysis. Similarly, data obtained was entered into the excel sheet. After which it was analyzed quantitatively. EVIEWS Software was also used in the analysis process and then the results were displayed using tables in the form of descriptive statistics.

3.7.2.1 Correlation Analysis

Correlation coefficients are commonly employed to quantify the degree of linear association between two variables. A linear correlation coefficient greater than zero indicates a positive association. A value less than zero signifies a negative relationship. Conversely, a value of zero indicates an absence of connection between the variables. As stated by Gujarati (2009), it is recommended to avoid Multicollinearity among independent variables by ensuring that the correlation coefficient does not exceed 0.9. When the significance level is below 0.05, the correlation between the two variables is deemed significant, indicating a linear relationship. Conversely, if the significance level is

relatively high, such as 0.50 or greater, the correlation is not significant, suggesting that there is no linear relationship between the variables (Ngumi, 2013).

3.8 Stationarity Test

Prior to the commencement of the investigation, a Unit-root test was conducted on both the dependent and independent variables in order to assess their time series properties. In order to mitigate the potential for misleading statistical regression outcomes, it was imperative to ensure that the series maintained a consistent mean and variance. The Augmented Dickey Fuller (ADF) test was used to test for presence of unit roots. This was done to ensure the integrity of the test. In order to attain the desired level of Stationarity, the identification of non-stationary variables was conducted. According to Gujarati (2009), if a series does not exhibit Stationarity at a specific level of significance, it is transformed once in order to achieve Stationarity.

3.9. Cointegration test and error correction model

Using the Johansen cointegration test, it was determined whether the variables under consideration had an equilibrium connection over the long run. The cointegration test was used in this investigation. This test is always employed to determine whether there is a significant relationship between variables that are distinguished by distinct orders. As a result, a stationary model is best suited to describe the long-term relationship between time series variables.

The first stage involves doing an Ordinary Least Squares (OLS) regression on the series based on levels, followed by the generation of residuals. In the second step of the analysis, it is recommended to store the residuals obtained from the unit root test. If the residuals

exhibit Stationarity, it can be inferred that the two series are cointegrated. In order to establish a systematic approach for adjusting disequilibrium, it is imperative to ensure that both the dependent and explanatory variables do not deviate significantly from their mean value. To address this concern, a technique known as an error correction mechanism (ECM) is devised.

3.10 Econometric Model

The study adopted stochastic model which was modified as;

$A_t = f(I_t, F_t, E_t)$……3.1

In expansion equation 3.1 becomes

$A_t = \beta_0 + \beta_1 I_t + \beta_2 F_t + \beta_3 E_t + \varepsilon_t$ ……3.2

Where, A_t is the Agricultural sector performance, $\beta_0$is the intercept, I_t is inflation , F_t is the foreign direct investment, E_t is the External Debt and ε_t is the stochastic term, t is the time, $\beta_1, \beta_2, \beta_3$ are regression estimate parameters which represent the slopes of I, F and E showing the changes in Agricultural sector performance; A when I, F and E changes .

The moderating effect was measured using hierarchical regression analysis. A unique type of multiple linear regression analysis called a hierarchical linear regression adds more variables to the model in discrete increments known as "blocks." This is frequently done to statistically "control" for certain factors, to determine whether including more variables significantly enhances a model's capacity to forecast the criterion variable, and/or to look into a variable's moderating impact.

Testing the moderation effect of population growth regarding the connection between inflation and agricultural sector performance is shown by equation 3.3 while equation 3.4 shows the effect of the moderating factor on the relationship between Foreign Direct Investment and Agricultural sector performance. Consequently, equation 3.5 shows the moderating effects of population growth on the relationship between External Debt and Performance of Agricultural sector. Then equation 3.6 and 3.7 shows the effect of population growth on the linkage between Foreign Direct Investment, inflation and external debt on agricultural sector performance in Kenya. The model is in the form;

$A_t = \beta_0 + \beta_1 I_t + \beta_2 F_t + \beta_3 E_t + \beta_4 P_t + \beta_5 (I * P)_t$.....3.3

$A_t = \beta_0 + \beta_1 I_t + \beta_2 F_t + \beta_3 E_t + \beta_4 P_t + \beta_5 (F * P)_t$.....3.4

$A_t = \beta_0 + \beta_1 I_t + \beta_2 F_t + \beta_3 E_t + \beta_4 P_t + \beta_5 (E * P)_t$.....3.5

$A_t = \gamma_0 + \gamma_1 I_t + \gamma_2 F_t + \gamma_3 E_t + \gamma_4 P_t + \gamma_5 (I * P) + \gamma_6 (F * P) + \gamma_7 (E * P)$……...3.6

$A_t = \gamma_0 + \gamma_1 I_t + \gamma_2 F_t + \gamma_3 E_t + \gamma_4 P_t + \gamma_5 (I * P) + \gamma_6 (F * P) + \gamma_7 (E * P)\, \gamma_8 (I * F * E * P)$…….....3.7

γ_1, γ_2 , γ_3, γ_4, γ_5, and γ_6 measures the moderation effect of population growth on the linkage between foreign direct investment, inflation and External Debt on agricultural sector performance.

Following tests for Stationarity and Cointegration, the study adopted the vector error correction estimation technique. To make sure the coefficients are the Best Linear Unbiased Estimators, several pretests were carried out. Additionally, this model is

adaptable, simple to implement, and successful in these series analysis, which justifies its employment (Greene, 2018).

3.11 Description and Measurement of the Variables

Table 3. 1: Description and Measurement of Variables

Variable	Description	Measurement	Prior-Expected Sign
Inflation	is the rate of price growth over a specific time period.	Consumer price index (CPI).	+/-
Foreign Direct Investment	is an ownership position made by a foreign investor, business, or government in a foreign project or firm.	Productivity as percentage of GDP	+/-
External Debt	the percentage of a country's debt that it has borrowed from international financial institutions, commercial banks, or governments	Gross external Debt	+/-
Agricultural sector Performance	It represents the agricultural value added's yearly growth rate in terms of stable local currency.	As a percentage of GDP	+/-

Source: (Author, 2023).

3.12. Diagnostic Tests

Model miss-specification in regression analysis can have a significant detrimental effect on the sample characteristics of both estimators and tests. Furthermore, it is important to consider the potential consequences of making forecasts and drawing inferences based on the fitted model. In the field of econometrics, there is a significant emphasis on the

evaluation of a model's specification correctness, leading to the development of several methodologies. The approaches employed in this study primarily emphasize the structural definition of the model, encompassing its functional form, the selection of regressors, and the potential presence of measurement errors. Additionally, the authors acknowledge and discuss any potential assumptions that might have been made concerning the distribution of the error component in the model.

This research investigation utilized several statistical tests, including the t-test, F-test, Jarque-Bera Test (a test for normality), and Langrage Multiplier (LM) Test. The Langrage Multiplier (LM) Test was utilized to test for autocorrelation. The F-tests were utilized to assess the overall validity of the model. The application of a linear regression model to two variables that exhibit linear correlation yields negligible utility. In order to ascertain the presence of a significant linear relationship between the independent and dependent variables, the t-test was employed to assess the statistical significance (Wanjala, Iravo, Otieno & Shalle, 2017).

3.12.1 Autocorrelation

When an inaccuracy at one period crosses over into another in a time series of data, autocorrelation happens. Additionally, it can occur when the error term for one observation is influenced by the error term for another. It is necessary for the error term's subsequent values to be sequentially independent for the linear regression error term (Ibrahim, Ifeyinwa, and Yahaya, (2021). The OLS estimators lose their efficiency in the presence of autocorrelation but continue to be objective, consistent, and asymptotically normally distributed. In this study the Langrage Multiplier (LM) test for serial correlation was

employed to ascertain whether there was any association and the null hypothesis stated that ;No serial correlation.

3.12.2 Multi-collinearity

Multicollinearity refers to a condition in which there is a strong connection between two or more independent variables, and it can have a negative impact on the results of multiple regression analyses. High Multicollinearity can be indicated by inter-correlations among independent variables that exceed certain thresholds. According to Hair et al. (2006) as cited by Saunders et al. (2009), inter-correlations above 0.9, 0.8 (Garson, 2013), or 0.7 (Sekaran and Bougie, 2010) are considered indicative of high Multicollinearity. Additionally, when a model exhibits both a high R-squared value and significant F tests, but the coefficients of the variables show non-significant t-tests, this can also be an indicator of high Multicollinearity.

Multicollinearity arises when there is a moderate or strong association between two or more factors inside a regression model. Regrettably, when this occurs, it has the potential to undermine the integrity of analysis and restrict the scope of research findings. The presence of Multicollinearity can be assessed using the variance inflation factor (VIF), which quantifies the extent to which the variance is inflated. Multicollinearity is indicated when the t-tests for each individual slope yield non-significant results ($P > 0.05$), while the overall F-test for testing all of the individual slopes simultaneously yields a significant result ($P < 0.05$). Multicollinearity is absent if the average value of the Variance Inflation Factor (VIF) is below 10.

3.12.3 Heteroscedasticity

Heteroscedasticity refers to the phenomenon where the variability of a variable exhibits varying patterns across distinct ranges of values of a second variable that serves as a predictor. The present study employed the Glejser Test to assess the presence of Heteroscedasticity.

3.12.4 Residual Normality

The graphical plots and other statistical tests can be used to evaluate the actual degree of divergence from normalcy, according to Hair et al. (2010). The Jarque-Bera Test was employed in this investigation. It is a statistical test to determine whether the data's overall distribution departs from a comparable normal distribution. The distribution of the sample is not significantly different from a normal distribution if the test results are non-significant (p>. 01), (p>. 05), or (p>. 10).Therefore, rejecting the null hypothesis and coming to the conclusion that the variable is not normally distributed is supported.

3.13 Ethical Consideration

This study was conducted according to the set ethical standards of confidentiality and privacy, voluntary and informed consent and avoidance of information that are highly intensive, offensive and immoral, this enables for professionalism in the research work. The researcher sought permission to undertake the study from Masinde Muliro University of Science and Technology and also from The National Commissions for Science (NACOSTI). All study information gathered from various sources were not divulged to third parties and were kept in strict confidentiality as the study was for the academic purpose.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATIONS AND DISCUSSIONS

4.1 Introduction

An examination of the data is provided in this chapter. The chapter provides a report on regression results, descriptive statistics for the data, and hypothesis testing. The analysis focuses on the evaluation of the relationship between inflation, foreign direct investment, external debt, and agriculture sector performance.

4.2 Descriptive statistics

The mean and standard deviation of the study's statistics were looked into. While the standard deviation, which quantifies how widely apart a collection of observations are, is important for evaluation purposes, the relative frequency distribution's nucleus is located using the mean. As indicated in Table 4.1, values of maximum and minimum are included.

This study considered a total of 44 observations with five variables in play (one dependent variable, three independent variables and one moderating variable). Agricultural sector performance is the dependent variable and the independent variables are; inflation, Foreign direct investment and External Debt .Population growth is the moderating variable. Table 4.1, shows that data across variables is highly dispersed due to the nature of time series data, particularly those whose aggregates follow a stochastic or random process, it was highly anticipated.

Table 4.1: Summary of Descriptive Statistics and Normality

	A	I	F	E	P
Mean	19.78250	6.983409	1.607928	2.225513	2.340655
Median	19.46000	6.335000	1.518236	2.296334	2.289300
Maximum	22.62000	16.45000	3.456496	4.673457	2.970000
Minimum	18.32000	3.960000	0.146724	0.075467	2.000000
Std. Dev.	1.247515	2.881355	0.824768	1.291426	0.224545
Skewness	0.857772	2.025986	0.418312	0.105788	0.831490
Kurtosis	2.884277	6.598232	2.518426	1.807726	3.279691
Jarque-Bera	5.420218	53.83721	1.708397	2.688184	5.213502
Probability	0.066530	0.000000	0.425624	0.260776	0.073774
Sum	870.4300	307.2700	70.74882	97.92257	102.9888
Sum Sq. Dev.	66.92063	356.9950	29.25039	71.71461	2.168078
Observations	44	44	44	44	44

Source: (Author, 2023)

A- Agricultural Sector Performance
I – Inflation
F- Foreign Direct Investment
E-External Debt
P- Population Growth

The Agricultural sector performance in Kenya which was measured as percentage of the sector's contribution to Kenya's GDP with an average of 19.78250, the minimum value of 18.32, the maximum value of 22.62 showing the maximum growth in the agricultural sector for the period under study and standard deviation of 1.247515. Inflation had an average of 6.983409, the minimum value of 3.96, the maximum value of 16.45 and standard deviation of 2.881355 .Foreign Direct Investment had an average value of 1.607928, the minimum value of 0.146724, the maximum value of 3.456496 and standard deviation of 0.824768. External Debt had an average value of 2.225513, the minimum value of 0.075467, the

maximum value of 4.6734557 and standard deviation of 1.291426. Population Growth had the average value of 2.340655, the minimum value of 2.0, the maximum value of 2.97 and standard deviation of 0.224545. From table 4.1, agricultural sector's performance, which has a high mean, is a sign that it has expanded quickly over the previous ten years. With a standard deviation of 2.881355 among the independent variables, data for inflation was more evenly distributed than other variables. This is a result of variations in the cost of products and services brought on by unfavorable economic situations including famine, disease, corruption, and politics, among other things.

Normality tests are conducted to ensure that data can be accurately described by a normal distribution and to determine the probability that a random variable underlying the data set is normally distributed. The Jarque-Bera test was employed to assess the normality of the data in the study. The hypothesis of the data's conformity to a normal distribution can be evaluated by employing the Jarque-Bera statistic. In the event that the data does indeed follow a normal distribution, this statistic will asymptotically exhibit a chi-squared distribution with two degrees of freedom. Skewness is a quantitative term that characterizes the degree of symmetry exhibited by a probability distribution centered on a random variable. The magnitude and direction of skewness are given. In contrast, kurtosis quantifies the extent to which the center peak deviates from the standard normal distribution in terms of both magnitude and position.

The Jarque-Bera Test results indicate that the null hypothesis posits the variable's normal distribution, while the alternative hypothesis suggests the variable's departure from normal distribution, with a significance level of 5%. Based on the probability values presented in Table 4.1, it can be concluded that the Agricultural sector performance (A) exhibited a P-

value of 0.066530, which is greater than the significance level of 0.0500. Consequently, the null hypothesis, which states that Agricultural sector performance (A) follows a normal distribution, was accepted. The variable of inflation (I) was found to have a P-value of 0.0000, which is less than the significance level of 0.0500. As a result, the null hypothesis, which states that the variable is normally distributed, was rejected. Conversely, the alternative hypothesis, which suggests that the variable is not normally distributed, was accepted.

The null hypothesis, which posits that the variable of interest, Foreign Direct Investment, follows a normal distribution, was accepted based on the observed p-value of 0.425624, which is more than the predetermined significance level of 0.0500. The external debt (E) exhibited a P-value of 0.260776, which is greater than the significance level of 0.0500. Consequently, we accept the null hypothesis that the variable follows a normal distribution. Similarly, the population growth (P) yielded a P-value of 0.073774, again exceeding the significance level. Therefore, we accept the null hypothesis that this variable is normally distributed.

Additionally, it was found that the values of skewness and kurtosis for all variables above the threshold of 0.05. This finding indicates that the distribution of variables around their means exhibited asymptotic normality in terms of both skewness and kurtosis. Consequently, the null hypothesis (Ho) that the data follows an asymptotic normal distribution was favored over the alternative hypothesis (H_1) that the data does not follow an asymptotic normal distribution, leading to its rejection.

4.3 Lag Length determination

When estimating the Vector Error Correction Model (VECM) or the Vector Autoregressive model, it is critical to determine the lag length of the unrestricted VAR order and the VEC order (VAR). Lag length must be given in order to assess the quantity of VECM model cointegration ranks or fit cointegration. In a VAR model with stationary variables, the lag duration can be chosen using a variety of methods, (Engle and Granger in 1987). From the output in table 4.2 the lag length used was two lags for this multivariate model because the AIC: Akaike information criterion used revealed that at lag length of two there was the highest number of lag order selected by the criterion , which were indicated by the (*) .

Table 4. 2 Lag Length determination

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-243.4762	NA	3.817602	12.69109	12.86171	12.75230
1	-123.1236	209.8455	0.018203	7.339673	8.192781	7.645761
2	-79.70744	66.79412*	0.004590	5.933715	7.469310*	6.484673*
3	-66.23988	17.95675	0.005617	6.063583	8.281666	6.859412
4	-47.54936	21.08673	0.005651	5.925608	8.826177	6.966308
5	-21.96121	23.61983	0.004474*	5.433908*	9.016964	6.719478

* indicates lag order selected by the criterion
LR sequential modified LR test statistic (each test at 5% level)
FPE Final prediction error
AIC Akaike information criterion
SC Schwarz information criterion
HQ Hannan-Quinn information criterion

Source: (Author, 2023)

The estimation of lag duration for various parameters used to determine lag length is shown in Table 4.2. The lag-order selection statistics for a series of vector auto regression of order are final prediction error (FPE), Akaike's Information Criterion (AIC), Schwarz's Information Criterion (SIC), and Hannan and Quinn Information Criterion (HQ). For all

entire VARs with orders lower than or equal to the highest lag order, a series of likelihood-ratio test statistics are also presented.

According to Liew (2004), FPE are generally acceptable when there are fewer than 60 observations, whereas Hannan-Quin is favored when there are more than 120 observations (Lutkepohl, 2005). While estimating the VAR and VECM model, it's critical to pick the right lag length. According to Lutkepohl (1993), the mean square variance of the residuals increases when utilizing a higher order lag. Yet, a little lag order causes an autocorrelation issue (Ozcicek, 1999).

4.4 Stationarity test

Most economic variables are typically non-stationary. Therefore, before generalizing any relationship, it is important to test for Stationarity. In this Study, the presence of unit roots was examined using the Augmented Dickey-Fuller tests, Dickey and Fuller, (1979). All of the variables were nonstationary, according to the test. After the first difference, they were made stationary because, according to Granger and Newbold (1974), non-stationary variables cause regression findings to be inaccurate. From VECM models after differencing, regression was carried out using the stationary variables to prevent this.

Table 4. 3: Unit root tests – Augmented Dickey Fuller (ADF) at level

At Levels	**Number of observations = 42**					
Variables	**ADF T-statistic**	**Prob**	**Critical values**			**Conclusion**
			1%	5%	10%	
A	0.510476	0.9852	-3.592462	-2.931404	-2.603944	Unit root
I	-0.851831	0.3408	-2.622585	-1.949097	-1.611824	Unit root
F	-1.952138	0.3062	-3.592462	-2.931404	-2.603944	Unit root
E	-1.871647	0.3420	-3.596616	-2.933158	-2.604867	Unit root
P	-0.344738	0.5547	-2.622585	-1.949097	-1.611824	Unit root

Source: (Author, 2023)

Table 4.3 displays the Augmented Dicker Fuller test results as extracted from output attached in appendix I .The alternative hypothesis for the ADF test is that the time series data is stationary, while the null hypothesis for the ADF test is that the time series data has a unit root. The variables exhibited a unit root at level, Agricultural sector Performance (p value 0.9852 > 0.0500), Inflation (p value 0.3408 > 0.0500), Foreign Direct Investment (p value 0.3062 > 0.0500), External Debt (p value 0.3420 > 0.0500) and Population growth (p value 0.5547 >0.0500) .The ADF T-statistic values were greater than 1%, 5% and 10% critical values. This suggested that the alternative hypothesis of Stationarity was rejected in favor of the null hypothesis that there is a unit root. As a result, the time series data was not level stationary.

Table 4. 4: Unit Root Test -ADF at First Difference

		Number of observations = 42 **First difference**				
Variables	**ADF T-statistic**	**Prob**	**Critical values**			**Conclusion**
			1%	**5%**	**10%**	
A	-6.266486	0.0000	-3.596616	-2.933158	-2.604867	*Stationary*
I	-5.386381	0.0000	-2.624057	-1.949319	-1.611711	*Stationary*
F	-5.245448	0.0001	-3.596616	-2.933158	-2.604867	*Stationary*
E	-13.47240	0.0000	-3.596616	-2.933158	-2.604867	*stationary*
P	-14.88696	0.0000	-2.621185	-1.948886	-1.611932	*stationary*

Source: (Author, 2023)

Table 4.4 shows that upon first differencing, the time series data is stationary as revealed by the ADF test statistics values lower than 1%, 5% and 10% ADF critical values and Probability values < 0.0500.Agricultural Sector performance (A) (p value 0.0000 < 0.0500), Inflation (I) (p value 0.0000 < 0.0500), Foreign Direct Investment (F) (p value 0.0001 < 0.0500), External Debt (E) (p value 0.0000 < 0.0500) and Population Growth (P) (p value 0.0000 < 0.0500) . Therefore, the alternative hypothesis that the variables had no

unit root was accepted in place of the null hypothesis, and it was concluded that the time series data was stationary at first difference.

4.5 Inferential Statistics

4.5.1 Correlation Analysis

The results of the Pairwise Correlation Analysis used in this study to ascertain the kind and direction of relationship between variables are provided in Table 4.5.

Table 4. 5 Correlation Analysis

Correlation t-Statistic Probability	A	I	F	E	P
A	1.000000 ----- -----				
I	-0.261176 [-1.753476] (0.0868)	1.000000 ----- -----			
F	-0.380078* [-2.663033] (0.0109)	0.592273* 4.763792 0.0000	1.000000 ----- -----		
E	0.359591* [2.497475] (0.0165)	-0.246762 -1.650231 0.1064	-0.317810* -2.172263 0.0355	1.000000 ----- -----	
P	-0.163681 [-1.075276] (0.2884)	-0.106984 -0.697336 0.4894	-0.251169 -1.681673 0.1001	-0.451770 -3.281801 0.0021	1.000000 ----- -----

Note. Values in [ ] indicate t-Statistic and values in parentheses ( ) indicate p-values and * shows significance at 5% level of significance i.e. p-value < 0.05

Source: (Author, 2023)

From Table 4.5, the correlation results shows that inflation (I) had an inverse relationship with agricultural sector performance (A), as shown by a negative value of -0.261176 and a p-value of (0.0868) 0.05; Foreign Direct Investment (F) and Agricultural sector performance (A) had a negative and significant relationship, as shown by a negative value of -0.380078 and a p-value of (0.0109) 0.05; External Debt (E) and Agricultural sector performance (A) had a direct and significant linkage with a value of 0.359591 and a p-value of (0.0165) 0.05 and Agricultural sector performance (A) is negatively correlated with population Growth with a value of -0.163681 and a p-value of (0.2884) 0.05 . The p values for the variables are all 0.05 and are shown in brackets. Additionally, although there was a substantial correlation between the independent variables, none of them had a correlation larger than 0.8, showing that the independent variables are not strongly correlated and ruling out the Multicollinearity issue.

4.6 Cointegration test – Johansen Cointegration

The link or long-term equilibrium between two or more variables is known as co-integration (Gujarati 2004). Johansen's Cointegration Test was selected for this inquiry instead of the Engle-Granger technique, which only applies to bivariate correlations, because it is suited for multivariate connections (Lutkepohl, 2005). With its resistance to departures from normalcy and lack of the normalization problem, Johansen's method is preferable to other cointegration techniques (Momanyi, Mohamed &Nyongesa, 2013).

It was necessary to perform the Johansen Test for cointegration after it was determined that each individual time series was integrated of order three. The Johansen cointegration test procedure used two test statistics from Tables 4.6 and 4.7: maximal Eigen value statistics

for the second test statistic and trace statistics for the first test statistic (Cameron & Trivedi, 2005). It was determined that there are three cointegrating equations from the results shown in Tables 4.6 and 4.7.

Table 4. 6 Trace Statistics

Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.810261	107.2314	47.85613	0.0000
At most 1 *	0.469901	44.07141	29.79707	0.0006
At most 2 *	0.408450	19.95313	15.49471	0.0099
At most 3	7.33E-05	0.002785	3.841466	0.9553

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
Source: (Author, 2023)

Results of the Trace Statistics Test for the Johansen Test for Cointegration are shown in Table 4.6. There is no co-integration relationship when it is at rank zero. As a result, there is only one co-integration equation if the rank is greater than 1. The trace statistic at maximum rank of 0 is shown to be (107.2314), which is higher than its critical value at 5% (107.2314>47.85613), and as a result, the null hypothesis of no cointegration was rejected at maximum latency of 0. The trace statistic exceeded the crucial value at the 5% level of significance at maximum rank 1 (44.07141>29.79707), rejecting the null hypothesis of maximum one cointegration once more.

Additionally, it was discovered that the trace statistic exceeded the crucial value (19.95313>15.49471) at the maximum rank of 2, rejecting the null hypothesis of no

cointegration in favor of the alternative hypothesis of at least two cointegrating equations. The trace statistic was smaller than the 5% critical values (0.0027853.841466) at the maximum rank of 3, and the null hypothesis that there was no cointegration was accepted. As a result, the trace test revealed three cointegrating equations at the 0.05 level.

Table 4. 7 Maximum Eigenvalue Statistics

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.810261	63.15998	27.58434	0.0000
At most 1 *	0.469901	24.11828	21.13162	0.0184
At most 2 *	0.408450	19.95035	14.26460	0.0057
At most 3	7.33E-05	0.002785	3.841466	0.9553

Max-eigenvalue test indicates 3 cointegrating eqn (s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: (Author, 2023).

In a similar vein, the application of the Johansen cointegration test with the utilization of the Maximum Eigen Value Test, as presented in Table 4.7, demonstrated that for rank values of 0, 1, and 2, the maximum Eigen Statistics surpassed the critical values at a significance level of 5%. Consequently, the alternative hypothesis, which posits the existence of at least two cointegrating equations, was favored above the null hypothesis, which suggests the absence of cointegration. The null hypothesis, which states that there is no cointegration, was supported by the findings. Specifically, when considering a rank of 3, the Maximum Eigen Statistics was found to be lower than the Critical value at a significance level of 5%.

The Maximum Eigen Statistics technique yielded results indicating the presence of three cointegration equations. The Johansen test for cointegration yielded evidence of three instances of cointegration among the variables, indicating a long-term relationship between the variables being examined. The decision to employ the Vector Error Correction Model (VECM) instead of the Vector Autoregressive (VAR) model was based on the presence of three integrating equations in the study.

Table 4. 8 Normalized Cointegration coefficients

Normalized cointegrating coefficients (standard error in ( ) and t-statistics in [ ])

A	I	F	E
1.000000	1.471401	-7.403734	-2.112312
	(0.17521)	(0.78756)	(0.35950)
	[8.39814]	[-9.40087]	[5.87568]

Source: (Author, 2023)

From Table 4.8, the cointegration equations become:

$$A_t + 1.47I_t - 7.40F_t - 2.11E_t = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.1$$

$$A_t = -1.47I_t + 7.40F_t + 2.11E_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.2$$

$$A_t = 12.6 - 1.47I_t + 7.40F_t + 2.11E_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.3$$

From the cointegration equations above, it was concluded that in the Long run, inflation (I) has a negative effect on Agricultural sector Performance (A). Meaning that if Inflation increases by 1%, then the Agricultural sector Performance would decrease by 1.47%.In addition, Foreign Direct investment (F) has a positive influence on the Agricultural sector performance such that if Foreign Direct Investment (F) increases by 1%, then Agricultural Sector Performance (A) would increase by 7.40%.

The results contradict those of Djokoto (2013), who found no evidence of a long-term association between FDI and the success of the agriculture sector. Similarly, External Debt (E) has a positive effect on Agricultural Sector Performance (A) .If External Debt increases by 1%, then there would be an increase in growth of Agricultural Sector by 2.11%. The findings concurs with the findings of (Elmendorf and Mankiw, 2015), that, in the short term, the output of the agricultural sector is positively impacted by external debt. Budget deficits (and higher debt) will likely have a significant beneficial short-term effect when the nation's output is well below its potential. Elmendorf and Mankiw (2015) discovered that the opposite is true over the long term.

4.7 Vector Error Correction Mechanism (VECM)

This study employed the Vector Error Correction Model (VECM) to show how quickly the dependent variable changes in response to changes in the independent variables and to determine both the short- and long-term correlations between the variables. In the VECM model, the variable coefficient(s) indicate the short run elasticity (Lutkepohl, 2005; Lutkepohl and Kratzik, 2004). A negative and significant sign must be affixed to cointegrating equations at a 5% level of confidence in order for them to demonstrate the long-term link between the variables (Lutkepohl, 2005; Lutkepohl and Kratzik, 2004)

Table 4. 9: Vector Error correction model results

Vector Error Correction Estimates
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
A(-1)	1.000000			
I(-1)	1.471401 (0.17521) [8.39814]			
F(-1)	-7.403734 (0.78756) [-9.40087]			
E(-1)	-2.112312 (0.35950) [-5.87568]			
C	-12.60483			
Error Correction:	**D(A)**	**D(I)**	**D(F)**	**D(E)**
CointEq1	-0.144181 (0.04379) [-3.29224]	-0.133327 (0.08763) [-1.52153]	0.052310 (0.02816) [1.85785]	0.383431 (0.19103) [2.00721]
D(A(-1))	-0.252489 (0.19809) [-1.27459]	0.097635 (0.39636) [0.24633]	0.037644 (0.12736) [0.29558]	0.287281 (0.86407) [0.33247]
D(A(-2))	-0.144557 (0.18122) [-0.79770]	-0.091275 (0.36259) [-0.25173]	0.025194 (0.11651) [0.21624]	-1.206626 (0.79045) [-1.52650]
D(A(-3))	0.032419 (0.18743) [0.17297]	0.384397 (0.37502) [1.02501]	-0.058491 (0.12050) [-0.48540]	-0.483786 (0.81754) [-0.59175]
D(A(-4))	0.702846 (0.25344) [2.77323]	0.034538 (0.50710) [0.06811]	0.091853 (0.16294) [0.56372]	-1.505132 (1.10548) [-1.36151]
D(A(-5))	0.418407 (0.28115)	0.256615 (0.56254)	0.165047 (0.18075)	-2.801560 (1.22634)

	[1.48822]	[0.45617]	[0.91310]	[-2.28449]
D(I(-1))	0.560041	1.203920	-0.126051	-0.437875
	(0.12449)	(0.24909)	(0.08004)	(0.54302)
	[4.49866]	[4.83325]	[-1.57489]	[-0.80637]
D(I(-2))	0.102459	-0.413638	-0.046137	-0.750693
	(0.12547)	(0.25104)	(0.08066)	(0.54727)
	[0.81663]	[-1.64768]	[-0.57196]	[-1.37170]
D(I(-3))	-0.060717	0.432695	-0.021908	-0.029242
	(0.10698)	(0.21406)	(0.06878)	(0.46664)
	[-0.56755]	[2.02141]	[-0.31851]	[-0.06266]
D(I(-4))	0.187844	-0.558553	0.017421	-0.084308
	(0.09912)	(0.19834)	(0.06373)	(0.43238)
	[1.89502]	[-2.81619]	[0.27336]	[-0.19499]
D(I(-5))	0.289814	0.384093	-0.106654	-0.660269
	(0.09529)	(0.19066)	(0.06126)	(0.41565)
	[3.04141]	[2.01451]	[-1.74090]	[-1.58854]
D(F(-1))	-0.840758	0.489009	0.096995	1.412217
	(0.32987)	(0.66003)	(0.21208)	(1.43887)
	[-2.54875]	[0.74089]	[0.45735]	[0.98147]
D(F(-2))	-0.746221	-0.066278	0.381211	0.618591
	(0.19345)	(0.38707)	(0.12437)	(0.84381)
	[-3.85748]	[-0.17123]	[3.06509]	[0.73310]
D(F(-3))	-0.889769	0.020776	0.343646	1.854839
	(0.23623)	(0.47268)	(0.15188)	(1.03044)
	[-3.76648]	[0.04395]	[2.26262]	[1.80005]
D(F(-4))	-0.828196	-0.806972	0.146029	1.389077
	(0.22228)	(0.44475)	(0.14291)	(0.96955)
	[-3.72597]	[-1.81445]	[1.02185]	[1.43270]
D(F(-5))	-0.547405	-0.496885	0.006366	0.961245
	(0.17770)	(0.35556)	(0.11425)	(0.77512)
	[-3.08047]	[-1.39747]	[0.05572]	[1.24012]
D(E(-1))	-0.345226	-0.222648	0.149024	-0.110732
	(0.09806)	(0.19620)	(0.06304)	(0.42771)
	[-3.52072]	[-1.13482]	[2.36389]	[-0.25889]

D(E(-2))	-0.259330	-0.338306	0.137685	0.559275
	(0.11257)	(0.22523)	(0.07237)	(0.49101)
	[-2.30379]	[-1.50203]	[1.90247]	[1.13903]
D(E(-3))	-0.320005	-0.111320	0.023415	0.749825
	(0.12120)	(0.24251)	(0.07792)	(0.52867)
	[-2.64030]	[-0.45904]	[0.30049]	[1.41833]
D(E(-4))	-0.423259	-0.268131	-0.060152	0.831608
	(0.12231)	(0.24473)	(0.07864)	(0.53351)
	[-3.46050]	[-1.09562]	[-0.76493]	[1.55874]
D(E(-5))	-0.210481	0.183117	-0.044421	0.525615
	(0.09133)	(0.18273)	(0.05872)	(0.39836)
	[-2.30472]	[1.00211]	[-0.75655]	[1.31945]
C	0.154923	-0.028302	-0.075858	0.231096
	(0.07032)	(0.14070)	(0.04521)	(0.30673)
	[2.20315]	[-0.20115]	[-1.67792]	[0.75343]
R-squared	0.745327	0.940043	0.649120	0.667275
Adj. R-squared	0.411068	0.861349	0.188591	0.230573
Sum sq. resids	1.199554	4.802442	0.495832	22.82323
S.E. equation	0.273810	0.547862	0.176038	1.194342
F-statistic	2.229791	11.94557	1.409508	1.527988
Akaike AIC	0.540136	1.927310	-0.343333	3.485965
Mean dependent	0.098158	-0.038684	-0.058434	0.024446
S.D. dependent	0.356794	1.471328	0.195428	1.361586

Source: (Author, 2023)

In order to demonstrate that the (VECM) has a long-term relationship, the error correction term of the first cointegrating equation was estimated by the Vector Error Correction Model (VECM) to equal -0.144181. Additionally, this demonstrated that errors from prior years were fixed within the current year at a convergence speed of 14.411 percent. The absolute figure showed that the lagged period of error shock has been used to modify 14.411 percent of long-run disequilibrium. This demonstrated how past values of the variables have an immediate impact on present values (Gujarati, 2009). With a t-statistic of 3.29224, it was

determined that the cointegrating equation was statistically significant. This supports the long-term link between the study's independent and dependent variables.

The second part of VECM model shows the short run relationship. It demonstrates how the performance of Kenya's agricultural industry is impacted by lagged inflation, foreign direct investment, and external debt. Values are lagged basically to show the effect of the past on the present. The results in Table 4.9 reveals that the coefficient of the fourth lagged difference of Agricultural sector performance rates is 2.77323 which is statistically significant because the t-statistics is greater than or equals to 2. This implies that keeping other variables in the study constant, Agricultural sector performance in the past fourth last quarter still affects agricultural sector performance in the present by 27.7%.

From the results, inflation rate for the first and fifth lagged last quarters affects the current performance of Agricultural sector since the coefficients of the two quarters are statistically significant. The differenced lag values of External debt and Foreign Direct Investment for the five last quarters indicate from the findings that the coefficients are statistically significant, meaning that for all the lagged quarters, External Debt and Foreign Direct investment affects the current Agricultural sector Performance.

Upon inclusion of Population growth which is the moderating variable, as depicted by the output in Appendix II, The Vector Error Correction Model (VECM) illustrates how population expansion affects the performance of Kenya's agricultural sector in relation to macroeconomic issues. When population increase by 1%, the Agricultural Sector performance in the long term increases by 16.74%. Population Growth as a moderating variable reduced the influence of Foreign Direct Investment, Inflation and External Debt

on Agricultural Sector Performance because R-squared reduced from 74.53% to 50.95% showing a reduction in the Agricultural sector performance by 23.58%.

Similarly, Population Growth reduced the coefficient of Inflation from 1.47 to 1.23 implying that if Inflation increases by 1%, then the Agricultural sector Performance would decrease by 1.23%. Population growth also showed a decrease in Foreign Direct Investment Coefficient from 7.40 to 6.59 .This implies that if Foreign Direct Investment (F) increases by 1%, then Agricultural Sector Performance (A) would increase by 6.59% which is a reduction in Agricultural sector performance by 8.1%. Consequently, Population growth increased the coefficient of External Debt (E) from 2.11 to 2.61 implying that if External Debt increases by 1%, then there would be an increase in growth of Agricultural Sector by 2.61% which is an increase in the sector's performance by 5%.

The coefficients A, I, F, and E exhibit both favorable and statistically significant effects at a 5% level of significance. The findings indicate that the fourth hypothesis is rejected, leading to the conclusion that population growth plays a moderating role in the link between inflation, foreign direct investment, external debt, and agricultural sector performance in Kenya.

4.8 Diagnostic Tests

4.8.1 Autocorrelation

When an error term from one period crosses into another, the resulting time series data exhibit autocorrelation. The linear regression error term suggests that consecutive error term values are sequentially independent (Baltagi, 2008). Under the null hypothesis that there is no serial correlation, the Langrage Multiplier (LM) test for serial correlation was

employed to ascertain whether there was any association. In the event that the probability value (p-value) is more than 0.05 percent, the null hypothesis is not disproved.

Table 4. 10 Autocorrelation Langrage Multiplier (LM)

VEC Residual Serial Correlation LM Tests
Sample: 2010Q1 2020Q4
Included observations: 38
Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	Df	Prob.	Rao F-stat	Df	Prob.
1	15.67470	16	0.4759	0.988683	(16, 28.1)	0.4938
2	11.03600	16	0.8073	0.648914	(16, 28.1)	0.8166
3	9.367215	16	0.8975	0.537246	(16, 28.1)	0.9030
4	19.11663	16	0.2627	1.271426	(16, 28.1)	0.2802
5	12.84117	16	0.6843	0.775832	(16, 28.1)	0.6979

Source: (Author, 2022)

The results of LM test from Table 4.10 shows that all the p-values were higher than 0.05. As a result, the null hypothesis was accepted, indicating that there is no autocorrelation issue.

4.8.2 Multicollinearity

Multicollinearity typically happens due to significant correlations involving two or more predictor variables. To evaluate Multicollinearity, one uses the variance inflation factor. Multicollinearity is deemed to occur when the variance inflation factor exceeds 10. (Laurens, 2018). If the centered VIF value is lower than 10, Multicollinearity does not exist.

Table 4. 11 Test for Multicollinearity using Variance Inflation Factors

Sample: 2010Q1 2020Q4
Included observations: 44

Variable	Coefficient Variance	Uncentered VIF
I	0.014968	8.435796
F	0.181314	7.445387
E	0.042255	3.514235
P	0.141052	9.851173

Source: (Author, 2022)

The Test results in table 4.11 shows that all the centered values of VIF were lower than 10 hence Multicollinearity does not exist.

4.8.3 Heteroscedasticity

The Glejser test was employed in the present investigation to ascertain whether the error components within the model exhibited a consistent variance. The null hypothesis for the test is that there is no Heteroscedasticity, meaning that the variance is constant (homoscedasticity). If the p-value exceeds 5%, the null hypothesis is retained. Heteroscedasticity is a common outcome when the variance of the error term varies across different values of the independent variable. The results are presented in Table 4.12.

Table 4. 12 Glejser Test for Heteroscedasticity

Heteroscedasticity Test: Glejser

F-statistic	2.145635	Prob. F(4,39)	0.0934
Obs*R-squared	7.936351	Prob. Chi-Square(4)	0.0939
Scaled explained SS	6.921509	Prob. Chi-Square(4)	0.1401

Source: (Author, 2023)

The null hypothesis of constant variance was maintained since Table 4.12's F-statistics probability was larger than 0.05. Hence no Heteroscedasticity. This therefore implies presence of Homoscedasticity.

4.8.4 Residual Normality

The study conducted a normality test to make sure the residual values in the model were distributed normally. VEC residual normality test was conducted, and the outcomes are shown in Table 4.13

Table 4. 13 VEC Residual Normality Tests

Null Hypothesis: Residuals are multivariate normal

Component	Skewness	Chi-sq	Df	Prob.*
1	-0.736527	3.435660	1	0.0638
2	-0.508265	1.636113	1	0.2009
3	-0.801319	4.066708	1	0.0437
4	-0.140206	0.124499	1	0.7242
Joint		9.262980	4	0.0549

Source: (Author 2023)

All the probability values associated with the VEC Residual Normality Tests, as presented in Table 4.13, exhibited a magnitude greater than 0.05. The acceptance of the null hypothesis that the residuals exhibit multivariate normality. This observation indicates that the residuals of both variables have a regular distribution. The normality of the residuals was not contested at a significance level of 5%.

4.9 Results and Discussions

The primary objective of the study was to examine the performance of Kenya's agriculture industry from 2010 to 2020, with a particular focus on the influence of macroeconomic factors. The specific objectives of the study were as follows: The objective of this study is

to examine the influence of external debt on the agricultural sector's performance in Kenya. Additionally, it aims to evaluate the effects of foreign direct investment on the sector, analyze the impact of inflation on the Kenyan agricultural sector, and assess the moderating role of population growth in the relationship between macroeconomic factors and the sector's performance.

The study incorporated three independent variables, namely inflation, foreign direct investment, and external debt, with the moderating impact of population growth. The utilization of descriptive and inferential statistics was contingent upon the objectives of the investigation. The results of the investigation, utilizing multiple regression, are presented in Table 4.14. Based on the regression analysis findings, the model exhibited a probability value of 0.0000, which is below the conventional significance level of 0.05, indicating statistical significance at a 5% level. Based on the Durbin-Watson value of 2.002264 (Garson, 2012), it may be concluded that there is no presence of autocorrelation issue. The coefficient of determination (R2) was found to be 0.935191, suggesting that the independent variables in the model explain about 93.52% of the variability in the agricultural sector's performance in Kenya. The remaining 6.48% of the variation is attributed to unaccounted factors that were not considered in this particular study.

Table 4. 14 Regression Result

Dependent Variable: A

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
E	0.5309	0.03043	17.44670	0.00891
F	0.1324	0.05261	2.51705	0.00826
I	-0.2546	0.08830	-2.88303	0.00775
C	6.1977	1.47702	4.19611	0.00677

R-squared	0.935191	Mean dependent var	2.983845
Adjusted R-squared	0.928369	S.D. dependent var	0.062040
S.E. of regression	0.016604	Akaike info criterion	-5.249371
Sum squared resid	0.010477	Schwarz criterion	-5.044581
Log likelihood	117.8615	Hannan-Quinn criter.	-5.173851
F-statistic	137.0855	Durbin-Watson stat	2.002264
Prob(F-statistic)	0.000000		

Source: (Author, 2023)

The following is the regression equation obtained;

$A_t = f(I_t, F_t, E_t)$……. .4.4

In expansion equation 4.4 becomes

$A_t = \beta_0 + \beta_1 I_t + \beta_2 F_t + \beta_3 E_t + \varepsilon_t$ ……..…...4.5

$A_t = 6.1977 - 0.2546 I_t + 0.1324 F_t + 0.5309 E_t + \varepsilon_t$ ……...……...4.6

Where, A_t is the Agricultural sector performance, $\beta_0$is the intercept, I_t is inflation , F_t is the foreign direct investment, E_t is the External Debt and ε_t is the stochastic term, t is the time, $\beta_1, \beta_2, \beta_3$ are regression estimate parameters which represent the slopes of I, F and E showing the changes in Agricultural sector performance; A when I, F and E changes

4.9.1 The Effect of Inflation on Performance of Agricultural Sector in Kenya

The study's first Specific objective was to examine the effect of inflation on performance of Agricultural sector in Kenya. Based on the regression Results as shown in Tables 4.14, the hypothesis that there is no significant effect of inflation on performance of Agricultural Sector was tested. Inflation was discovered to be a macroeconomic factor affecting Performance of Agricultural Sector in Kenya with a p-value of 0.00775< 0.05 showing that the coefficient is statistically significant and has a negative coefficient of -0.2546, implying that a one-percentage increase in inflation decreases the performance of Kenya's Agricultural sector by 25.46%, when all other factors are held constant.

The findings agree with Chaudhry, Ayyoub, and Imran (2018), who used time series data to study the impact of inflation on Agricultural Sector growth in Nigeria and discovered that inflation had a significant negative effect on the Agricultural Sector Performance.

4.9.2 The effect of Foreign Direct Investment on Performance of Agricultural Sector in Kenya

The second aim of this study was to assess the impact of Foreign Direct Investment on performance of Agricultural sector in Kenya. To accomplish this, the second hypothesis of the study stated that there is no significant effect of Foreign Direct Investment on performance of agricultural Sector in Kenya. Foreign direct Investment had a positive and significant impact on Kenya's Agricultural Sector Performance according to the regression results in Table 4.14 .The t-statistics value of 2.51705 shows that Foreign Direct Investment has a positive and significant effect on performance of Agricultural Sector. The coefficient of Foreign Direct Investment was 0.1324 implying that 1% increase in the

foreign direct Investment would lead to 13.24% increase in the Agricultural Sector Performance in Kenya.

This study's findings agrees to the findings of Mohammed Ameen Fadhil (2010) who found out that Foreign Direct Inflows to Agriculture has significant and positive impact on the performance of Agricultural Sector in Malaysia using time series data for the period between 1975-2010. On the other hand, the findings do not agree with findings of Djokoto (2011), who found no evidence of a direct relationship between FDI in agriculture and the expansion of the agricultural sector.

4.9.3 The Effect of External Debt on Performance of Agricultural Sector in Kenya.

The third objective of the study majorly was to investigate the effect of External Debt on performance of Agricultural sector in Kenya .The regression outcome in Table 4.14, External Debt had coefficient of 0.5309 which is statistically significant and it means that there is a positive linkage between External Debt and Agricultural Sector Performance such that 1% rise in External Debt leads to rise in Agricultural Sector Performance by 53.09%. Because of this, the impact of external debt on the agricultural industry Performance in Kenya is statistically significant and displays an expectedly good indication. The results of this study concur with those of Adetual 2009, who thoroughly investigated the influence of foreign debt on agricultural output in Nigeria. It was found that external debt had a considerable impact on agricultural productivity.

4.9.4 The moderating effect of Population Growth on the relationship between Macroeconomic Factors and Performance of Agricultural Sector in Kenya

The fourth aim of the study sought to find out the moderating effect of Population Growth on the relationship between Macroeconomic Factors and Performance of Agricultural Sector in Kenya.

Multiple Regression Model was used to determine the relationship and the results were as displayed in Table 4.15. From the results. According to Pivato and Misani (2008), it is essential to test for the relevance of the model's interaction variable (moderator). According to Pivato and Misani (2008), a moderating variable (Z) in correlational analysis is a third variable that has an impact on the magnitude of the correlation or the direction of the relationship between the dependent (Y) and independent variable (X). The influence of a moderator can be demonstrated through the interaction between X and Z. (Kang et al., 2021).

Table 4.15: Moderating Summary for Moderating Variable of Population Growth

Dependent Variable: A

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
E	0.8502	0.03409	24.93921	0.001
F	0.1261	0.05282	2.38681	0.0081
I	-0.0705	0.08612	-0.81856	0.0093
P	6.5841	0.35294	18.65511	0.0007
C	-2.7680	1.50960	-1.83361	0.0085

R-squared	0.940763	Mean dependent var	2.983845
Adjusted R-squared	0.932758	S.D. dependent var	0.062040
S.E. of regression	0.016088	Akaike info criterion	-5.292753
Sum squared resid	0.009576	Schwarz criterion	-5.047004
Log likelihood	119.7942	Hannan-Quinn criter.	-5.202128
F-statistic	117.5221	Durbin-Watson stat	2.037440
Prob(F-statistic)	0.000000		

Source: Authors 2023

Table 4.15 presents the results of moderating effect of population growth on the linkage between Macroeconomic factors and Performance of Agricultural sector in Kenya. The R squared value was 0.940763 thus the independent variables employed in this model explains 94.08% of the variance in Performance of Agricultural Sector in Kenya.

Inflation's regression coefficients of -0.0705 with a p value of 0.0093 revealing a negative linkage between Inflation and Agricultural Sector performance. Which was significant at 5 % level (p value < 0.05). As inflation increases by 1% Agricultural Sector performance (A) would decrease by 7%. Foreign Direct Investment (F) had a coefficient of 0.1261 with p value of 0.0081 which show that Foreign Direct Investment has a positive and significant relationship with Agricultural sector performance. This shows that as Foreign Direct investment increases by 1% Performance of Agricultural sector increases by 0.13%.

Researchers whose results concur with this study discovered that improving foreign direct investment in agriculture boosts performance in the industry. Therefore, the government stands a good chance of improving the agriculture sector's performance when it attracts more foreign direct investment (Husmann, and Kubik, 2019). Agricultural sector growth and external debt have a positive and statistically significant association, as indicated by the external debt (E) coefficient of 0.8502 and p value of 0.001. Population increase was significant and had an impact on the significance of other independent variables, hence it had a controlling effect on the model. It had a considerable impact on the R squared value as well.

These findings are in agreement with the findings of (Michael, 2017) who did a study on agricultural sector performance and economic growth of Nigeria and realized that

Population growth significantly affect the performance of Agricultural sector. It can therefore be generalized that based on the regression results of the moderating effect of population growth on the linkage between Macroeconomic Variables and Agricultural sector performance, this research rejects the fourth null hypothesis that there is no significant moderating effect of population growth on the linkage between macroeconomic factors and performance of agricultural sector in Kenya. The regression equation for the moderating variable therefore become;

$$A = -2.7680 - 0.0705 I + 0.1261F + 0.8502 E + 6.5841 P \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4.7$$

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The findings from the previous chapter are summarized in this chapter. Numerous inferences are made and suggestions are given in light of the findings. Further study areas are also discussed.

5.2 Summary of the Findings

This study investigated the effect of macroeconomic factors on performance of Agricultural sector in Kenya. The Macroeconomic Variables employed in this study were; Inflation, Foreign Direct Investment and External debt. Population growth was used as the moderating variable. The study used descriptive as well as inferential statistics. Descriptive statistical analysis was used to assess outliers and define basic characteristics of the sample. Augmented Dickey Fuller (ADF) test was employed to establish stationary of the data set. Post Diagnostic tests were done on the estimated model. The Jarque-Bera test for normality revealed normality of the data.

Langrage Multiplier test for residual autocorrelation showed absence of autocorrelation at the specified lag length of five, Glejser test did not reveal the presence of Heteroscedasticity, The VIF test for Multicollinearity revealed that there was no problem of Multicollinearity and Residual Normality Tests showed that the Residuals are multivariate normal. The VECM model was estimated to determine the coefficients and the statistical significance of the independent variables with respect to the dependent variable after the Johansen cointegration test revealed that the variables were cointegrated. The study found that FDI and External Debt had a positive influence on Agricultural Sector

Performance whereas inflation had a negative effect on the Performance of Agricultural Sector. Population growth used as the moderating variable had a negative impact on the linkage between the dependent variable and the independent variables.

5.2.1 Effect of inflation on Performance of Agricultural Sector in Kenya

The first aim of this study was majorly to examine the effect of inflation on performance of Agricultural sector in Kenya. From the findings, inflation reduces the Agricultural sector performance in Kenya .This is clearly shown by the coefficient value of (-0.2546) in the Regression results. This could be due to the fact that inflation has a connection with the increase in oil prices, leading to negative shocks in agricultural and industrial sectors in developing and developed nations. The findings concur with the findings of (Hansson and Olofsdotter, 2017) and those of Kigume (2018), who discovered a negative and significant linkage between inflation and Agricultural Sector performance in Kenya.

5.2.2 Effect of Foreign Direct investment on Performance of Agricultural Sector in Kenya

The study's second aim was to assess the effect of Foreign Direct Investment on performance of Agricultural sector in Kenya. The results revealed that foreign direct investment and Agricultural Sector Performance in Kenya have a significant positive relationship, hence the null hypothesis is rejected .FDI inflows causes an increase in Performance of Agricultural sector in Kenya as shown by a positive and significant coefficient of (0.1324) from the Regression model. This finding can be attributed to the fact that FDI investments and capital accumulation through an indirect channel can promote agricultural sector growth and hence spur economic growth.

5.2.3 Effect of External Debt on Performance of Agricultural Sector in Kenya

The third goal of this study was to investigate the effect of External Debt on performance of Agricultural sector in Kenya. From the findings, External debt was established to positively influence Agricultural Sector performance. And hence it was found that 1% increase in External Debt increases Agricultural Sector Performance by 0.53%. External debt in most cases enables governments to manage their projects as it considerably lowers financial vulnerability levels of many nations hence boosting growth in various sectors in the economy. Thus, the report urges increased foreign lending for agricultural development.

5.2.4 The moderating effect of population growth on the relationship between Macroeconomic factors and performance of agricultural sector in Kenya.

The Fourth aim of the study was to evaluate the moderating effect of population growth on the linkage between Macroeconomic Factors and Performance of agricultural sector in Kenya. The findings revealed that there existed a statistically significant moderating effect of Population Growth on the linkage between Inflation, Foreign Direct Investment and External Debt on Agricultural Sector Performance. Moreover, Population Growth as a moderating variable reduced the effect of Inflation, Foreign Direct Investment and External Debt on Agricultural Sector Performance because R-squared changed from 0.93519 to 0.940763 showing a change in the Agricultural sector performance by 0.56%.

5.3 Conclusion

From the findings, there is a connection between Inflation, FDI and External Debt on Agricultural Sector Performance in Kenya. This shows that, throughout the time period

under study, inflation exhibited a statistically significant negative linkage with Agricultural Sector Performance in Kenya, on the other hand, External Debt and foreign direct investment had a statistically significant positive relationship with Agricultural Sector Performance in Kenya. This therefore led to a conclusion that, Inflation, Foreign Direct Investment and external debt do not have a statistically significant effect on Agricultural Sector Performance in Kenya, refuting the null hypothesis. Similarly, the study concluded that the linkage between Inflation, Foreign Direct Investment and External Debt on Agricultural Sector Performance was moderated by Population growth.

5.4 Recommendations

The study's findings revealed a statistically significant relationship between Agricultural sector Performance and Inflation. Inflation was found to negatively and moderately lower the Agricultural sector Performance. This therefore points out to the Government of Kenya that there is great need to control inflation levels. To reduce the effect of inflation on Performance of Agricultural sector, the government should implement monetary and fiscal policies aimed at controlling inflation rates through measures such as adjusting interest rates, managing money supply, and fiscal discipline. The government of Kenya should also establish price stabilization mechanisms, such as buffer stocks, strategic reserves, and commodity price supports, to shield farmers from volatile market prices.

The study also revealed that FDI had a statistically significant positive effect to the Agricultural sector Performance in Kenya. Inflows of foreign direct investment to the agricultural sector were found to be a motivating factor of the Agricultural sector growth. From the findings, the study recommends that the government of Kenya should implement

policies that promote a conducive business environment, including transparent regulations, clear land tenure systems, and streamlined administrative processes for foreign investors in the agricultural sector. Second, in order to draw in more foreign investors, more especially in the Agricultural sector, then the government needs to encourage partnerships between foreign investors and local agricultural stakeholders to facilitate the transfer of advanced agricultural technologies, practices, and knowledge. The government should also allocate resources to agricultural research institutions and promote collaboration between research institutions, private sector, and foreign investors to drive innovation and productivity improvements

The study also shows that External Debt had a significant positive effect on Kenya's Agricultural sector performance. From these findings, the government should ensure that borrowed funds are allocated efficiently and effectively to projects and initiatives that have a clear positive impact on the agricultural sector, such as infrastructure, technology, and capacity-building. The Government should also Use debt proceeds to improve rural infrastructure, including roads, irrigation systems, storage facilities, and energy supply, to enhance productivity and reduce post-harvest losses.

Lastly the study revealed that population growth has a negative effect on the relationship between Inflation and Performance of Agricultural sector in Kenya. In addition, population growth has a positive effect on the linkage between FDI and External Debt on the Performance of Agricultural Sector in Kenya. Consequently, population growth leads to a reduction in the overall Performance of Agricultural sector. This therefore leads to a conclusion that there exists a statistically significant moderating effect of Population Growth on the linkage between Macroeconomic Factors and Agricultural Sector

Performance in Kenya. Based on these conclusions and finding the study recommends that the government should focus on increasing the productivity of the Agricultural sector such that it be possible to accommodate the growing population.

5.5 Suggestions for Further Research

The study focused on the Performance of Agricultural Sector in Kenya. Therefore, a similar study should be conducted in other countries especially those that are highly dependent on agriculture to expand on knowledge and make a comparison of the findings for a solid conclusion and for policy recommendation in African countries and beyond.

Additional macroeconomic variables not included in the study such as capital stock, Human Capital Development Index, Technological development, Corruption Index, and unemployment rates need to be included in future research to determine how each of them affect performance of Agricultural sector in Kenya.

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APPENDICES

Appendix I: Vector Error Correction Model with Moderating variable, (P)

Vector Error Correction Estimates
Sample (adjusted): 2011Q2 2020Q4
Included observations: 39 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
A(-1)	1.000000
I(-1)	1.238497 (0.21566) [5.74286]
F(-1)	-6.589593 (1.35439) [-4.86536]
E(-1)	-2.611235 (0.77242) [-3.38058]
P(-1)	-16.74317 (3.16587) [-5.28864]
C	27.62644

Error Correction:	D(A)	D(I)	D(F)	D(E)	D(P)
CointEq1	-0.029328 (0.04519) [-0.64897]	-0.210132 (0.06607) [-3.18033]	0.032147 (0.01831) [1.75551]	0.013193 (0.16665) [0.07917]	-0.001781 (0.02457) [-0.07248]
D(A(-1))	0.168319 (0.25470) [0.66085]	0.912367 (0.37239) [2.45001]	0.001421 (0.10321) [0.01377]	-0.287701 (0.93926) [-0.30631]	-0.087980 (0.13847) [-0.63538]
D(A(-2))	-0.223174 (0.23132) [-0.96480]	0.282965 (0.33820) [0.83668]	0.029988 (0.09373) [0.31993]	-0.918994 (0.85301) [-1.07735]	0.004133 (0.12575) [0.03287]
D(A(-3))	-0.085696 (0.23232)	0.585114 (0.33966)	-0.126581 (0.09414)	0.159782 (0.85670)	0.035854 (0.12630)

	[-0.36888]	[1.72263]	[-1.34464]	[0.18651]	[0.28389]
D(A(-4))	0.469119	0.604690	0.116152	-1.204282	0.124304
	(0.32889)	(0.48086)	(0.13327)	(1.21283)	(0.17880)
	[1.42638]	[1.25752]	[0.87156]	[-0.99295]	[0.69522]
D(I(-1))	0.204129	0.704885	-0.056272	0.242514	0.055437
	(0.11962)	(0.17489)	(0.04847)	(0.44111)	(0.06503)
	[1.70652]	[4.03048]	[-1.16097]	[0.54979]	[0.85250]
D(I(-2))	-0.062752	-0.258551	0.029042	-0.263495	0.000361
	(0.14114)	(0.20635)	(0.05719)	(0.52046)	(0.07673)
	[-0.44462]	[-1.25296]	[0.50781]	[-0.50627]	[0.00470]
D(I(-3))	-0.075729	0.241999	-0.011034	0.178224	-0.075743
	(0.12013)	(0.17565)	(0.04868)	(0.44302)	(0.06531)
	[-0.63037]	[1.37776]	[-0.22666]	[0.40230]	[-1.15973]
D(I(-4))	0.155683	-0.307523	-0.042742	-0.177059	0.062098
	(0.08794)	(0.12858)	(0.03564)	(0.32430)	(0.04781)
	[1.77027]	[-2.39170]	[-1.19942]	[-0.54597]	[1.29884]
D(F(-1))	-0.341681	-0.211566	0.130085	-0.513505	0.075177
	(0.26070)	(0.38117)	(0.10564)	(0.96138)	(0.14173)
	[-1.31062]	[-0.55505]	[1.23140]	[-0.53413]	[0.53043]
D(F(-2))	-0.177815	-0.086232	0.282088	-0.293081	-0.210049
	(0.26562)	(0.38835)	(0.10763)	(0.97951)	(0.14440)
	[-0.66944]	[-0.22205]	[2.62085]	[-0.29921]	[-1.45461]
D(F(-3))	-0.289769	0.165636	0.228019	-0.009141	-0.270829
	(0.26432)	(0.38646)	(0.10711)	(0.97474)	(0.14370)
	[-1.09626]	[0.42860]	[2.12888]	[-0.00938]	[-1.88469]
D(F(-4))	-0.307778	-0.226915	-0.157608	-0.231206	0.086983
	(0.24491)	(0.35808)	(0.09924)	(0.90315)	(0.13314)
	[-1.25670]	[-0.63370]	[-1.58814]	[-0.25600]	[0.65330]
D(E(-1))	-0.170381	-0.530978	0.073797	-0.854702	0.000784
	(0.14199)	(0.20760)	(0.05754)	(0.52360)	(0.07719)
	[-1.19997]	[-2.55774]	[1.28263]	[-1.63235]	[0.01016]
D(E(-2))	0.015370	-0.534081	0.054165	-0.252488	-0.017572
	(0.15047)	(0.21999)	(0.06097)	(0.55487)	(0.08180)
	[0.10215]	[-2.42770]	[0.88838]	[-0.45504]	[-0.21481]

D(E(-3))	-0.032329	-0.423473	0.045998	0.058087	-0.003249
	(0.16188)	(0.23669)	(0.06560)	(0.59698)	(0.08801)
	[-0.19970]	[-1.78916]	[0.70122]	[0.09730]	[-0.03691]
D(E(-4))	-0.113702	-0.470747	-0.034213	0.085126	0.012712
	(0.11768)	(0.17205)	(0.04768)	(0.43395)	(0.06397)
	[-0.96623]	[-2.73609]	[-0.71750]	[0.19617]	[0.19871]
D(P(-1))	-0.976004	-3.508812	0.015182	-1.003549	-0.704222
	(0.91501)	(1.33782)	(0.37077)	(3.37426)	(0.49744)
	[-1.06666]	[-2.62279]	[0.04095]	[-0.29741]	[-1.41568]
D(P(-2))	-0.459769	-2.653790	-0.227273	-0.777735	-0.444442
	(0.83379)	(1.21906)	(0.33786)	(3.07474)	(0.45329)
	[-0.55142]	[-2.17691]	[-0.67268]	[-0.25294]	[-0.98049]
D(P(-3))	-0.057394	-2.024346	0.462688	-0.009876	-0.479996
	(0.71828)	(1.05018)	(0.29106)	(2.64878)	(0.39049)
	[-0.07990]	[-1.92761]	[1.58968]	[-0.00373]	[-1.22921]
D(P(-4))	-0.505143	-1.004635	0.028808	-0.018748	-0.031973
	(0.55169)	(0.80662)	(0.22355)	(2.03446)	(0.29993)
	[-0.91563]	[-1.24549]	[0.12886]	[-0.00921]	[-0.10660]
C	0.094510	-0.201234	-0.061584	0.170905	0.000665
	(0.07824)	(0.11439)	(0.03170)	(0.28852)	(0.04254)
	[1.20795]	[-1.75915]	[-1.94246]	[0.59234]	[0.01564]
R-squared	0.509497	0.942414	0.750012	0.541535	0.654876
Adj. R-squared	-0.096418	0.871277	0.441202	-0.024805	0.228547
Sum sq. resids	2.312573	4.943510	0.379718	31.44841	0.683486
S.E. equation	0.368827	0.539254	0.149453	1.360113	0.200512
F-statistic	0.840871	13.24803	2.428722	0.956201	1.536080
Log likelihood	-0.247187	-15.06162	34.98322	-51.14194	23.52157
Akaike AIC	1.140881	1.900596	-0.665806	3.750869	-0.078029
Schwarz SC	2.079301	2.839015	0.272613	4.689288	0.860390
Mean dependent	0.096410	0.023590	-0.049984	0.024672	-0.000208
S.D. dependent	0.352237	1.503024	0.199930	1.343551	0.228289
Determinant resid covariance (dof adj.)		5.31E-06			

Source: (Author's Computation based on EViews v.10, 2023).

Appendix II: Data used in the analysis

Month	A	F	E	I	P
2010q1	18.97	0.146724	1.008345	7.03	2.97
2010q2	18.72	0.24974863	1.015637	5.43	2.053
2010q3	18.92	0.395634	1.00857607	4.4	2.8683
2010q4	18.85	0.44516	1.00995	3.96	2.69
2011q1	18.86	2.6745367	1.02345678	4.49	2.5511
2011q2	18.89	2.945673	1.0567289	6.88	2.4639
2011q3	18.88	3.167489	1.017845637	10.18	2.319
2011q4	18.87	3.45649583	1.08462455	14.02	2.0681
2012q1	18.82	3.14536	1.21456728	16.45	2.556
2012q2	18.79	2.978465	1.06378	15.97	2.2333
2012q3	18.8	2.46478	1.05367898	13.29	2.2833
2012q4	18.83	2.73755207	1.067	9.38	2.0286
2013q1	18.64	2.43562789	0.075467	6.33	2.6386
2013q2	18.62	2.13678	0.456723	4.56	2.44
2013q3	18.61	1.89745	1.783456	4.75	2.32
2013q4	18.6	2.030853	2.2069905	5.72	2.3097
2014q1	18.35	1.89845	1.9563789	6.39	2.444
2014q2	18.32	1.7893456	0.10845678	7.05	2.6269
2014q3	18.33	1.43567835	4.6734569	7.19	2.2794
2014q4	18.36	1.33593816	0.330349878	6.88	2.5978
2015q1	19.37	1.278645	4.1563789	6.31	2.225
2015q2	19.45	1.145367	4.027892	7.03	2.394
2015q3	19.47	0.99456378	3.9674567	5.97	2.2928
2015q4	19.47	0.95605671	3.852679269	6.58	2.3114
2016q1	20.01	0.88354678	3.78536	6.45	2.2769
2016q2	20.03	0.9768546	3.456728	5.8	2.3628
2016q3	20.02	1.034567	3.02456782	6.34	2.2128
2016q4	20.04	0.98107096	3.16288481	6.35	2.2858
2017q1	20.88	1.1784456	2.986745	6.76	2.21
2017q2	20.87	1.34567	2.7987645	8.13	2.117
2017q3	20.89	1.556789	3.0456783	8.4	2.2472
2017q4	20.7	1.60314043	3.146534782	7.98	2.2317
2018q1	20.31	1.74567	2.7835635	6.89	2.1472
2018q2	20.33	1.938734	2.385678	5.2	2.05
2018q3	20.32	1.99678	2.64578	4.53	2.1556
2018q4	20.4	1.85214778	2.8312456	4.69	2.1588
2019q1	20.76	1.7362789	3.194689	5.24	2
2019q2	20.85	1.546738	3.34567	5.16	2.17

2019q3	20.86	1.48973378	4.54914304	4.67	2.156
2019q4	21.02	1.3947644	3.404145368	5.24	2.1588
2020q1	22.62	1.14567	2.826300188	5.84	2.73
2020q2	22.61	0.836783	1.09817	6.16	2.403
2020q3	22.5	0.637897	1.245367	5.79	2.408
2020q4	22.62	0.72516795	1.985678	5.41	2.543

Appendix III: Map of Kenya

Appendix IV: Research Permit

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Date of: **2 /August 2022**

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