EFFECTS OF SELECTED MACROECONOMIC FACTORS ON KENYA'S MAIZE PRODUCTION FOR FOOD SECURITY

SHILWATSO HUSNA

Thesis Submitted to Masinde Muliro University of Science and Technology's School of Business and Economics in partial fulfillment of the requirements for the award of a master's degree in science and economics

APRIL, 2024

DECLARATION

This Thesis is my original work prepared by me and has not been presented elsewhere for any award including a degree. It has borrowed a few concepts from the indicated sources.

Signature…… Date……..…

Shilwatso Husna

ECO/G/01-70012/2020

APPROVAL BY SUPERVISORS

The undersigned confirms that they have gone through the document recommend that the document be accepted by Masinde Muliro University of Science and Technology, a proposal entitled, “Effect of Selected Macroeconomic factors on Kenyan’s maize production for food security.”

Signature……. Date……

Dr. Reuben Rutto

Department of Economics

Masinde Muliro University of Science and Technology

Signature……. Date……

Dr. Edwin Simiyu

Department of Economics

Masinde Muliro University of Science and Technology

COPYRIGHT

DEDICATION

I dedicate my thesis to my parents. Mr. Juma Shilovele Shikokoti and Madam Hellen Muhonja for their encouragement and financial support throughout my studies and research work.

ACKNOWLEDGEMENT

First and foremost, I am incredibly appreciative to Allah Almighty, who has granted me the ability to think and write. Without His favor, I could not have made it this far in my journey and has been my source of strength the entire time.

I wish to thank my supervisor Dr. Reuben Rutto and Dr. Edwin Simiyu for their constant support throughout this research work. Much appreciation to my classmates Daisy Wamukoya, Aberton Okoth, Roseline Olumo, Innocent Wabwile and the late Teresia Macharia for their timely assistance and moral support during the educational struggle.

I express my profound appreciation to Dr. Reuben Rutto and Dr. Edwin Simiyu for extremely useful comments and suggestions at the initials and critical stages of the work. A special thanks to Head of department, lecturers and all the staff members of the school of economics and business for their help, encouragement and support throughout my studies. Gratitude goes to Masinde Muliro University of science and Technology for making this course of masters in Economics accessible in Kenya and for getting access to resources and facilities that provided helpful assistance.

ABSTRACT

Food security was emphasized at the meeting as “freedom from want “in terms of the availability and supply of food. United Nation applied a global proclamation in 1975 that proclaim everyone unalienable right to be free from hunger and malnutrition. The kilo-calorie supply of maize has continuously decreased despite its dominance in providing food security and the observed development in a number of supply- and demand-side factors that affect food security. The purpose of this study was to investigate the effect of selected macroeconomic factors on Kenyan’s maize production for food security. These objectives were actualized through determining the effect of inflation on Kenyan’s maize production for food security, establishing the effect of unemployment on Kenyan’s maize production for food security, and examining the effect of Gross domestic product on Kenyan’s maize production for food security. Sen’s entitlement theory, food availability decline theory and Malthusian theory of population would be instrumental in guiding this study in examining how the selected macroeconomic factors affect maize production for food security in Kenya. Using a causal research design with time series data obtained from databases of World Development Indicators ,world bank website and Food and Agriculture Organization from 1990-2022 the study employed EVIEWS software version 10 for descriptive statistics, correlation analysis and multiple regression analysis to achieve research objectives. This helped establish the relationship between the macroeconomic factors and Maize production (quantity) in Kenya. At level, the Augmented Dickey Fuller and Phillips-perron unit test root showed the presence the presence of unit root for maize production and unemployment and but at first difference ,the time series data was stationary. The variance inflation factor (VIF) test values were less than 10 showing no Multicollinearity. The study employed descriptive and inferential statistics. Jarque–Bera test revealed a normal distribution of the series at 5percent level of significance where the p-value 0.7942>0.05. F Bounds test revealed no integration among variables. Breusch-Godfrey Autocorrelation test revealed absence of serial correlation with a p-value 0.0565>0.05. Breusch-Pagan –Godfrey test for heteroscedasticity had probability 0.064>0.05 showing that there is no problem of heteroscedasticity. The study also revealed that Gross Domestic Product has a positive and a significant relationship on maize production for food security. with a co-efficient of 0.1367 and a p-value of 0.0001<0.05 and Inflation and unemployment has a negative and significant relationship on Maize production for food security with a coefficient -0.1531 and -0.2618 and p-value of 0.0002<0.05 and 0.0036<0.05.The measure of goodness of fit R-squared was 0.5883 showed that the variance in regressor predicted 58.8279%of variance in the dependent variable. From the study the government of Kenya needs to attract more National income directed to maize production sector and there is a great need to reduce the inflation rates and unemployment levels since they negatively affects the maize production for food security in Kenya.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

HDI	:	Human Development Index
FAO	:	Food and Agriculture Organization
WFP	:	World Food Programme
GDP	:	Gross Domestic Product
KNBS	:	Kenya National Bureau of Statistics
FAOSTAT	:	Food and Agriculture Organization Statistics Databases.
SPSS	:	Statistical Packages for Social Sciences
KARI	:	Kenya Agricultural Research Institute
GMO	:	Genetically modified organism
VAR	:	Vector Auto Regression
LLC	:	Limited Liability Company
NCPB	:	National Cereal and Produce Board
USDA	:	United States Department of Agriculture
OECD	:	The Organization for Economic Cooperation and Development
US	:	United States
IFPRI	:	International Food Policy Research Institute
UN	:	United Nation
CIMMYT	:	International maize and wheat improvement center
OLS	:	Ordinary Least Squares
VAR	:	Vector Auto Regression
VIF	:	Variance Inflation Factor
STATA	:	Statistical Software Packages

OPERATIONAL DEFINITION OF TERMS

Maize	A central American cereal plant that yield large grain (corn or sweetcorn) set in row on a cob. The many varieties include some used for stock feed and corn oil
Food Security	when everyone, everywhere, has physical, affordable access to enough wholesome food that satisfies their preferences and dietary needs for an active, healthy life.
Macroeconomic Determinants	Is an influential fiscal, natural, or geopolitical event that broadly affects a regional or national economy
Inflation	The rate of increase in the cost of products and services
Unemployment	when someone who is looking for work but is unemployed is unable to locate employment
Human Development index	Is a broad indicator of typical performance in important areas of human development
Economic Growth	A rise in an economy's output of products and services.
Economy	Is the study of scarcity and how it affects the use of resources, the production of goods and services, the growth of production and welfare over time, and other complex issues of the greatest significance to society?
Input Cost	Is the total amount of expenses incurred in producing a good or service

Output	The quantity of something that a person, equipment, or enterprise produces
Development Index	Is a metric used to describe the average performance of a nation in the three areas of human development Life expectancy at birth indicates a long and healthy life, and years of schooling and predicted years of schooling indicate knowledge.
Technology	Applying scientific knowledge to real-world situations, Particularly in the business world.
Market Condition	Is the phrase used to describe how an industry or economy is doing
Government Policies	Is a guideline or principle that should help decision-makers make better choices that benefit the community or Unit.
Firm	is a business that operates as a limited liability company (LLC), partnership, or corporation that provides professional services.
Fertilizers	Anything, manufactured or natural, organic or inorganic, that provides one or more of the chemical components needed for plant growth.
Labor	Is a term used to describe the labor that individuals put in to generate things and services. It encompasses the mental and physical labor required to produce commodities and services.
Production	It's the amount (value) of agricultural output produced per unit amount (value) of input(s) required in the process (OECD, 2001).
Market	These are the intended customers who are prepared and eager to purchase the farmers' produce at a price that has been negotiated

between the buyer and the seller.

CHAPTER ONE
INTRODUCTION

1.1. Background of the Study

International delegates from forty-four countries convened in Hot Springs, Virginia, in 1943, worries about food security were brought up due to growing concerns that a population in Europe would suffer from severe famine as a result of the Second World War (FAO [2022). The term "freedom from want" in relation to the availability and quantity of food was used to emphasize food security at the discussion. Achieving "freedom from hunger" was one of the main priorities of the Hot Springs conference, which aimed to combat the widespread hunger of the post-war era. As a result, during the 1950s and 60s, the development of significant staple crops became the primary emphasis of food and agricultural policy (Ingutia & Sumelius, 2022).Since there was insufficient harvests, the amount of grains available to each person globally fell precipitously in the 1970s. Costs of food have gone up in several countries. A World Food Conference was subsequently held in Rome in 1974 to discuss the matter (Mathenge, Sonneveld, & Broerse, 2023). In 1974, the United Nations adopted a worldwide declaration affirming that every individual has an inalienable right to be free from hunger and malnourishment. In order to meet rising demand and price volatility, a production-oriented definition of food security was also created, concentrating on the availability and sufficiency of essential goods (Pilcher, 2023).

Although food shortage was a key contributing element to famines, Amartya Sen advanced the concept of food security by highlighting in his article on entitlement and deprivation that food production is insufficient on its own to achieve food security (Sen, 1981).distributional and economic disparities might also cause famines. He added that there could still be food insecurity in spite of increased production levels. His approach focused on the necessity of having both financial and physical access in order to comprehend worries about the security of food. As noted by FAO (2012), it established the foundation for the idea to be broadened to encompass

sufficiency, accessibility, and stability.

Since maize is essential for both human and animal consumption and as a raw material for production, its production has been crucial on a global scale (Nyangena & Juma, 2020). At least 40% of the world's maize is produced in the United States, with China, Brazil, France, Argentina, and Mexico being among the top producers (FAO, 2016). One of the main drivers of the agricultural economy in the area, maize contributes significantly to the industry that makes animal feed, household income, and food supply (Kamau, 2021). South Africa is the continent's top producer of maize, yet it ranks twelfth in the world (Musaba & Bwacha, 2022).

One of the most significant crops grown in Mexico for a very long time is maize. Maize's significance comes from its contribution to the country's economic production as well as from its close ties to Mexican culture and, most importantly, from its vital role in sustaining rural livelihoods (Mghenyi, 2016). To comprehend the history of Mexico, one must grasp the significance of maize, or corn, on an economic, political, and cultural level. Corn cultivation is still intricately entwined with rural communities' customs and culture, even in the face of laws that have forced Mexico to import one-third of its grain. Furthermore, Mexico's political stability and food security depend on maize prices and production (FAO, 2022).

From an African perspective According to Olaseye and Mao (2023) Nigerian maize farmers faced a number of challenges, including low yields, pests and diseases, climate change, a lack of infrastructure, a dearth of essential inputs, a paucity of irrigation water, and an inadequate supply compared to the growing demand. Nigeria has previously seen a scarcity of maize cropped. Prices for corn and other products made from it rise during seasons of low production and sharply decline during seasons of excess production. Doyle (2017) claims that the deregulation of the South African Beginning in the 1980s, the agricultural sector progressively altered the roles and organization of those involved in the maize industry. Farmers and agribusiness alike were exposed to foreign interests during this deregulation and freedom process. The macroeconomic

contributing variables of employment, national income, inflation, fiscal policy, and international trade were pressed by these pressures. Significantly impacted the production of agriculture, particularly maize

Countries in Eastern Africa have come to view maize production as a vital component of their development. Research, extension, and policy makers need to pay more attention to a number of difficulties, according to Kaliba's (2021) research on the use of maize

production methods in central Tanzania.

According to Nyameino, Kagira, and Njukia (2003), over 80% of Kenyans rely primarily on maize as a staple diet, and a lack of the crop is largely correlated with food insecurity. Nearly every agro-ecological zone in the nation, from humid coastal lowlands to semi-arid regions, is suitable for growing it. 20% of total agricultural production and 25% of jobs in agriculture are thought to come from maize (Republic of Kenya, 2003). Large-scale farmers generate the remaining 25% of the nation's maize crop, with over 3.5 million small-scale farmers producing the remaining 75% (Nyoro, 2002). All told, nevertheless, a sizable portion of the marketed maize output comes from large-scale commercial farms.

The Kenyan government has long pushed policies that affect maize marketing and production because of the crop's critical role in ensuring food security (Onono, Wawire, and Ombuki, 2013). The goal of achieving self-sufficiency in maize has been the primary foundation for the policies, which have undergone multiple revisions.

1.1.1 Inflation and Maize Production for food security

Food costs have been rising in Kenya between 2016 and 2022.When compared to the CPI for non-food items, the food CPI has climbed more quickly. The cost of some key foods, including rice, wheat, and corn, has skyrocketed within the past three years. Despite a drop in global food costs in the first quarter of 2009, food prices in Kenya have remained high (Iddrisu,Gafa,Emini &Beaumais(2020). While prices on the global market have decreased, Kenyan food staples, such

maize, have continued to be expensive.

The cost of maize is extremely high and continuing to rise, making food increasingly less accessible to the less fortunate members of society. However, because the area is experiencing a drought, vulnerable individuals, particularly pastoralists will not have access to maize on the market and will hence require food assistance.

A low level of price transmission from Kenya's domestic market to the global market is shown by these consistently high food prices. The weather, changes in local output, shocks to consumption and illness, inflation, and evolving informal trading patterns are some of the elements that influence local price variations. The recent drop in food prices abroad appears to have resulted from a number of economic variables, including high interest rates and inflation, rather than only from a decrease in supply or a rise in demand. This suggests that the food crisis is still ongoing(Glauber,Hemandez &Laborde(2023).

Other significant economic causes that have fueled the crisis in food prices include financial instability, dysfunctional markets, speculation, and insecurity in certain nations. Kenya's food security is negatively impacted by a tendency of consistently high and rising food costs, as evidenced by an examination of the country's monthly price fluctuations.

Food prices have been rising on the domestic market at never-before-seen rates. Even while global prices have dropped, the cost of staple foods like rice, wheat, and maize has increased.40% rise in Fuel prices have caused significant increases in food prices, which has made it more difficult for millions of Kenyans, particularly the poor and vulnerable groups, to pay.

Kenyans had a brief diversion from some of the nation's problems during the August elections. The most pressing issue among these is food insecurity. Food prices in the nation have increased more than they have in the past in 2022 (Loening, Durvall, and Birru, 2009). Maize is one of the commodities whose prices have increased significantly. In the last year, the cost of this fundamental item has risen. There are numerous causes contributing to the present food inflation. First, the COVID-19 pandemic had an impact on food production as well as the supply of production inputs. Input prices began to climb in the final quarter of 2021 on international

markets, coinciding with issues with the supply chain.

1.1.2 **Unemployment and Maize Production for food security**

The majority of African citizens' social and economic well-being is negatively impacted by unemployment (Endris and Kasegn, 2022). Covid 19 caused job loss, income reduction or loss, and health risks due to hazardous working conditions, which reduced global maize production. It undermines food security in Africa directly by causing disruptions to food systems, and indirectly by negatively affecting household income and food availability.

1.1.3 **Gross Domestic Product and Maize production for food security**

Kenya's economy has historically been heavily dependent on agriculture, which has contributed more than 20% of the nation's GDP on average each year over the past ten years. In 2018, the agriculture sector made up 56% of jobs and almost 52% of the GDP (AfDB, 2020).Four agricultural subsectors are identified by Kenyan Vision 2030. The first is the industrial subsector, which produces and processes cash crops like sugarcane, tea, and coffee.The production of staple crops for immediate use is the responsibility of the food crop sector; consumable food and non-consumable commodities, such as flowers, are provided by the horticulture sub-sector; and meat and fish are provided by the livestock and fisheries sub-sector (GoK, 2017).While each of the four subsectors can contribute to a reduction in The food crop sub-sector is crucial for guaranteeing food security because of Kenya's high rate of poverty and its comparatively small contribution to agricultural exports (Shayo, 2020). It directly affects how much food is consumed as well. When it comes to its share of the agricultural GDP, the horticulture subsector—which prioritizes export growth—has only sporadically overtaken the food crops sub-sector over the years. The most produced food crops, according to a more thorough analysis of the food crops subsector, are maize and legumes. The proportions of maize and legumes to the agricultural GDP were 15% and 14%, respectively (GoK, 2017).

Historically, staple crops have been deemed the most critically needed during times of severe economic or political hardship, especially following World War II when the rate of hunger

reached frightening proportions. The idea is that, in the process of trying to end hunger, producing a large quantity of basic foods at first will make it possible to diversify diets later on. Even though Kenya offers a wide range of food crops, maize is the primary staple food since it is grown on more than 75% of all farms in the nation. Seventy-eight percent of people live in rural areas and actively participate in the production of maize for both marketing and sustenance. Over 75% of Kenyans make their living from agriculture, and the sector accounts for 5.4% of the country's GDP growth in 2018 (Aguilar-Rivera, 2020). Because agriculture is the foundation of Kenya's economy, 66% of the manufacturing sector is agro-based. One of the most prominent and well-established subsectors is agro-grain processing, which processes major cereal foods like maize, wheat, rice, sorghum, millet, and barley.

1.2 Statement of Research Problem

Due to its high calorie content, the consumption of staple foods such as rice and maize meal (known as unga when raw and ugali when cooked) has increased while the consumption of other food crops has decreased, making maize the most popular crop in Kenya (FAO, 2020). The Production of maize has been steadily decreasing despite its supremacy in guaranteeing food security, even in spite of the observed expansion in a number of supply-side and demand-side factors of food security. Kenya's official and informal imports of maize through cross-border trade have been substantial, but the supply and production have not kept up with demand to guarantee Kenya's food security, according to KNBS (2023).

Since 1999, Kenya's population has grown from 28.7 million to over 55,100,586 in 2023, according to the KNBS (2023). Similarly, FAO data from 2023 reveals that Kenya's maize productivity increased slowly from 23.2 metric tons in 1999 to 30.1 tonnes in 2023, with no correlation to the country's population growth

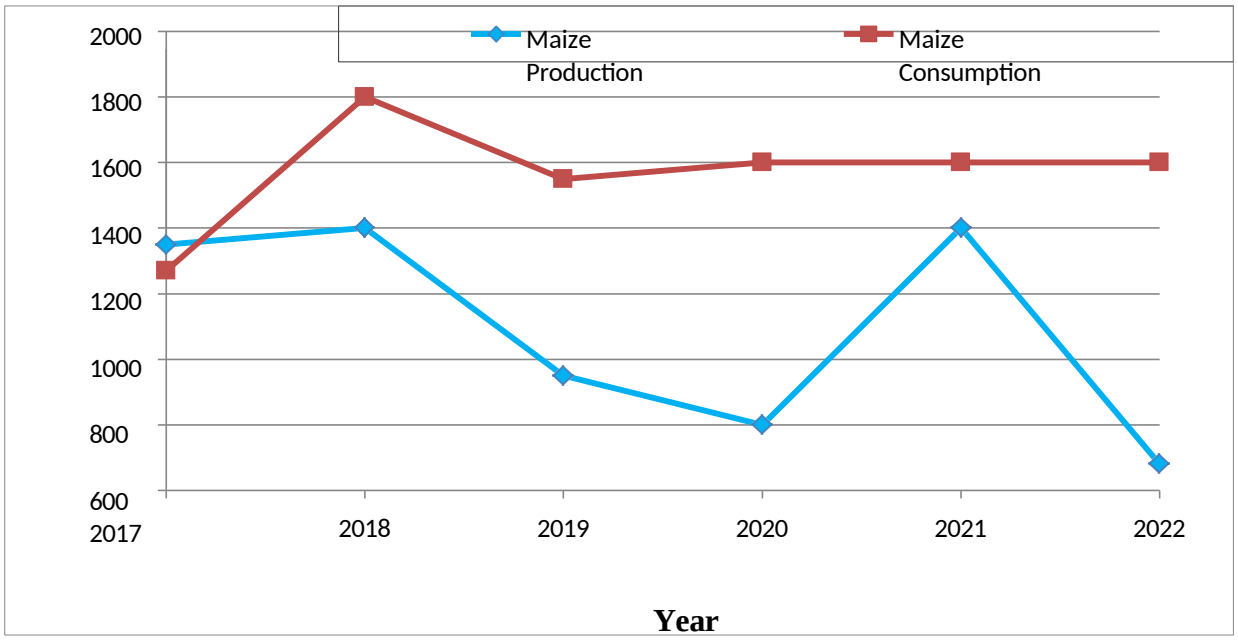


Figure 1.1: Maize Production and Consumption in Kenya 2010-2022

Source: Production and Consumption 2022

Maize production is influenced by the Prices of commodities such as maize hybrid seeds,fertilizers and pesticides (Iddrisu, Gafa, Emini & Beaumais, 2020). Recommended retail prices for all varieties is ksh.530 for the 2kg packet which is invariable to maize production farmers. In Kenya, maize production makes for around 85% of all cereal production.due to fertilizer price increases in 2020-2021 maize production dropped by 550,000 metric tons (MT).

Some unemployed people may be more interested in other aspects of agriculture, such as poultry, horticulture, or livestock rearing, than in producing maize. Some people view agriculture as a failed industry, thus they only pursue it as a last resort rather than as a career (Tembo, Tembo and Ndengu, 2023). While some people may be interested in growing maize but lack experience, others may be landless (especially single women, who are essentially prohibited from owning land, which is the most important asset for any farmer) or suffer from environmental constraints, which results in low maize production nationwide.

Corn was designated as the main food staple by public policy. Through the government-controlled marketing board, its manufacturing and promotion got financial backing (Nyangito and Kimenya, 2020).Resettlement initiatives combined with a rise in small-scale farming significantly enhanced maize production, resulting in significant excess yields (Republic of Kenya, 2015, Nyangito and Kimenya).

FAO (2022) also reported that between 2017 and 2022, maize production fell from 4,013,777 tons to 3,087,000 tons. These data call into question how much the persistent shortfall in maize output and the issue of food security are caused by macroeconomic variables like inflation, unemployment rates, and national income. This is true even though KARI (2009) and FAO (2022) have provided evidence about the importance of maize in Kenyan diets, and despite the fact that attempts to raise output and lower demand for it have failed. According

to World Bank data from 2022, undernourishment is common in Kenya was 22.4 percent in 2017, which had grown from 29.3 percent in 2022 resulting from increased food insecurity levels in Kenya.

Despite several studies by Kungu (2014) and Mumo, et al. (2018(Chen and Villoria, 2019) examining the food security and maize production situation in Kenya, it has found mixed reaction and unclear findings. This makes this study significant to examine and investigate the contribution of macroeconomic factors such as inflation, unemployment levels, and national income, on production of maize and eventually addressing maize production and food security which is the main goal of this study and the knowledge gap this study intends to fill.

1.3. Objective of the Study

General objective

The study's main goals will be to ascertain the impact of selected macroeconomic factors on Kenyan's maize production for food security.

Specific Objectives

i. To ascertain how inflation affects Kenya's maize production for food security.
ii. Determining the impact of unemployment on Kenya's maize production for food security.
iii. To assess the effect of gross domestic product (GDP) on Kenya's maize production for food security.

1.4. Research Hypothesis

H_{O1}: Inflation has no statistically significant impact on Kenya's output of maize for food

security.

H_{O2}: Regarding Kenya's production of maize for food security, unemployment has no statistically significant impact.

H_{O3}: Th In Kenya, the GDP has no statistically significant impact on the country's maize production for food security.

1.5. Scope of the Study

The research was centered on the evaluation of the effect of selected macroeconomic factors on Kenya's maize production for food security. This study utilized data from the year 1990 to the year 2022. 6th May 2010 is a fundamental reference period for this study as it refers to the economic changes affecting the agricultural sector after the implementation of the new constitution. This study narrowed down to the time series data for a period from 1990 – 2022. These changes influenced the international trade patterns and regimes, the government employment policy, the inflation rates trends and nations gross domestic product which may have a significant implication of on the production of maize and by extent the food security of the nation Kenya. This study is limited to Kenya which has 47counties and its capital is in Nairobi city. It has a total area of 580,370km^2 (224,084mi^2) and a total coastline of 536km (333.1mi). The Food and Agriculture Organization (FAO), the World Bank Development Indicators, and the Kenya National Bureau of Statistics provided the data for this study.

This study thus takes advantage of the online database called FAOSTAT that provide access to data on agricultural production. National agricultural agencies and the Kenyan National Bureau of statistics (KNBS)

1.6. Significance of the Study

This study's relevance extends to the researcher, Kenyan society, academic institutions, and universities.

1.6.1 Universities, stakeholders, and researchers

This research report will be useful to researchers, academicians and stakeholders as it will made available in libraries for additional reading. This study's findings forms future research work in the university, decision making among stakeholders and show areas of further studies and research work extension.

1.6.2 Government officers and Policy Makers

The study's conclusions informs policy making process of the determinants effects of maize supply especially when addressing food security in Kenya. This study is of great help to policy makers' especially in understanding the selected macroeconomic determinant on maize production and will provide significant information in policy making process

1.6.3 Community and Citizen of Kenya

The community and Kenyans will make use of this study in decision making and implementation of food security strategies through maize production. This study further shows the challenges facing maize production and provides various recommendations on possible solution on curbing problem facing maize production. This serves as a foundation to community and citizen of Kenya who would take part in curbing maize production problems and shortages.

1.7. Limitation of the Study

This study anticipates limitations whereby on the same variable, various sources might present conflicting information and data. Finding the appropriate data may be challenging as a result, the researcher will use the triangulation method to solve the problem. Triangulation method entails conducting qualitative research using a variety of techniques or data sources to develop a comprehensive understanding of a phenomenon hence to select one internationally renowned sources: World Bank development indicators and KNBS among other sources many be scouted in order to ensure that the data obtained was reliable.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This section examines the literature on theory., conceptual literature, the empirical literature, the conceptual framework and the operationalization of the variable of the study.

2.2. Theoretical Literature Review

This study is anchored on the following theories.

2.2.1 Sen’s Entitlements Theory

An alternate paradigm for studying famines was provided by Amartya Sen's entitlement theory, which was originally published in 1981. It redefined the problem of food security as one of demand—more precisely, the incapacity of individuals to get staple foods—rather than a decrease and supply scarcity. Sen famines in Asia and Africa, and came to the conclusion that while a lack of food might endanger a person's life, famines could also be linked to a reduction in one's exchange entitlements, or all the other goods (entitlement set) that one can obtain in exchange for everything that one already possesses (endowment set), material or immaterial (Osmani, 1993). In Osmani (1993). According to Sen, an endowment requires that a person Production (farming); trade (purchasing food); labor (creating food); and transfer (by bequest or kindness) are the sources of legal ownership. According to Sen's view, the main cause of hunger, famine, and starvation is a shortage of sufficient food resources. According to him, there are two ways to explain food insecurity: This leads to food insecurity.

Food security was examined from the perspective of production and availability of food to that of distribution and access through the entitlement method. Food insecurity and hunger can result from a wide range of factors, Sen found, with food availability being just one of them. Hunger and famine can also be brought on by other causes, such as stagnant wages or inflation brought on by the money supply or by failures in international trade that lower a person's purchasing power. Although some writers have suggested that the entitlement method and the FAD approach really

differ in that the latter emphasizes entitlement, the former focuses mostly on aggregated availabilitythe entitlement concept is obviously demand-side, while the argument about declining food availability is supply-side. (Osmani, 1993); others have vehemently affirmed this (Ravallion, 1997).

2.2.2 Food Availability Decline Theory

This theory's central claim is that a sharp decrease in the amount of food available is what leads to food insecurity. Stated differently, the theory treats the issue of food availability as being equivalent to the issue of food security. As long as it is acknowledged that a decline in the amount of food resources available is the cause of food insecurity, it ignores any current causes or circumstances that might account for the inadequate supply of food (Sen, 1976).

Up to the food crisis of 1972–1973, this notion was widely accepted before both world wars. Harriet Friedmann claims that "surplus regimes" that had enacted protectionist agricultural policies aimed at driving up local farm prices were what defined the political economics of food in both Europe and the US between 1947 and 1972 (Friedmann, 1993). Because of the agri-food

interactions, countries choose to buy legally designated agricultural produce at predetermined rates while also implementing export subsidies and import controls. In the end, these incentives produced an agricultural excess above market demand, which in turn prompted food aid programs designed to deal with these excesses.

Due to unfavorable weather in the 1970s, there was a 55 million ton food shortage worldwide. The Soviet Union's high demand for food imports as a result of low harvest losses made the situation even worse (Shaw, 2017). Food prices suddenly rose as a result of the mounting issues affecting availability and production. There was general agreement that because of the previous stability that had prevailed before the food crises of 1972–1973, a drop in the world

food supply was the reason behind the coming threat of hunger, starvation, and famine. In a 1973 speech to the UN General Assembly, the United States of America and Secretary of State Henry Kissinger expressed support for a World Food Conference with the aim of guaranteeing a consistent supply of food (Shaw, 2017).Not to mention that the Food Availability reduction (FAD) theory basically states that any disruptions in food production will almost certainly eventually result in a reduction in the food supply, ignoring other immediate reasons of insufficient food supply. Therefore, problems like the diminishing marginal returns on land that have an impact on factors of production, especially land, are implicitly covered by FAD. Given that the amount of land available is limited, the study by classical economists indicated that productivity could only be increased through technology and by increasing inputs like labor and capital, but that any gains would only be temporaryEventually, declining returns would take precedence (Wrigley, 1988). Examining the available land resource is necessary, as the law of declining marginal returns on accessible land emphasizes.

According to Amartya Sen (1976), the FAD theory and the Malthusian Theory of Population are frequently combined since population growth has always been driven by the need to consume more food. Thus, hunger frequently accompanies a sharp decline in the food supply. Sen also makes the point that the FAD hypothesis works optimal when food is consumed by a family

is farmed exclusively for the household without the need for any kind of foreign trade. But if food commerce is permitted by the economy, the household's ability to purchase food will likewise be dependent on

2.2.3 Malthusian Theory of Population

The fundamental tenet of the Malthusian theory—which was first presented by Rev. Thomas Robert Malthus in 1798—is that population expansion followed an exponential trend, whilst food production followed a linear one. From Malthus' point of view, food security was just an

issue of the food supply not keeping up with the rapid population growth. He adamantly argued that it would be incorrect to assume that population and food growth followed the same progressive ratio. According to his theory, the population increased unchecked by a geometric ratiowhile food increased by an arithmetic ratio due to the fixed character of land as an asset (Barrus, 2014). In accordance with his theory that wealth drove population expansion (Wrigley, 1988), a plentiful supply of food would promote population growth.

The population would eventually outgrow food production due to the disparity in growth patterns, which meant that positive and preventive checks (like late marriages and celibacy) and disasters (like war, pestilence, floods, and famine) would be necessary to keep the population in check and maintain a balance with the current subsistence levels. He was called a pessimist for implying that disease, starvation, and conflict were a normal corrective tendency to unchecked population expansion (Sen, 1982).

The Malthus population theory is heavily intertwined with the claim that changes in population dynamics will subsequently impact changes in food demand. This is an important amplification of the theory that this research work seeks to investigate (Villarreal & St. loukal, 2015). Different patterns of food supply and demand result from any changes in population dynamics. Population dynamics that impact people's spatial distributions are reflected in urbanization, namely that caused by rural-urban migration. Because only 2% of metropolitan areas in Kenya prioritize food security, this issue may be significant. Food produced in urban regions accounts for 98% of consumption, with purchases accounting for the remaining 30% in rural areas (Gitu, 2016). This discrepancy is exacerbated by the fact that the majority of consumption in urban areas comes from food produced there. This puts policy analysts in a challenging position because they have to determine if migration from rural to urban areas is good for commercial agriculture and population pressure relief, or bad because it disrupts vital rural labor markets

and negatively impacts trends in food production and consumption. Analysts of policy are eager to highlight discover how the loss of human resources in rural regions due to rising urbanization might ultimately result in a larger dependency on food imports.

2.3 Conceptual Review

2.3.1 The MDGs to SDGs Transition and Food Security

The United Nations adopted the Millennium Declaration in 2000 during its global summit in New York, USA, as a means of tackling poverty worldwide. Eight broad objectives that will direct the development agenda through 2015 were subsequently adopted. The 18 targets and 48 indicators that make up the monitoring and evaluation framework became known as the Millennium Development Goals (MDGs). The declaration of "objective 1"—to end severe poverty and hunger—and "target 1C”—to cut the number of hungry people in half—captured the idea of food security. The percentage of the population consuming less calories from food than the required level and the incidence of underweight children under the age of five (United Nations, 2020) remaining underweight. With regard to this, the Ministry of Devolution and Planning of the Government of Kenya brought to light a number of difficulties faced in the process of attempting to achieve the MDGs. They included changing output levels owing to climate change and extreme weather; fast population increase; inadequate infrastructure limiting market access; and urbanization displacing arable land (GoK, 2023).

By 2015, it was evident that the MDGs had become the primary focus for restructuring the global campaign to end hunger's decision-making process. Significant advancements have been achieved in improving food security and decreasing world hunger. Specifically, between 1990 and 2020, the prevalence of undernourished individuals in developing nations decreased by around 50%, and the number of underweight children decreased from one in four to one in seven (United Nations,

2015).

Despite notable progress, the 2015 United Nations Millennium Development Goals report revealed that nearly one in nine individuals globally lacked access to sufficient food, and one in four children still experienced stunting.

The Sustainable Development Goals (SDGs) have become essential points of reference for decision-makers since they began guiding the post-2015 development agenda in 2015. The 2030 Agenda for Sustainable Development, an extension of the Millennium Development Goals, is intended to be implemented using the 17 goals, 169 targets, and 230 indicators that comprise the SDGs. They can integrate the social, economic, and environmental facets of sustainable development and are potentially more aspirational since they are globally applicable to both developed and developing nations. They continue to place the same emphasis on eradicating poverty. The second objective is to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture." There is a mention of food security in this. Woodbridge (2015) Aiming for an average yearly economic growth of ten percent, the Kenya Vision 2030 economic pillar is associated with the second Sustainable Development Goal (SDG). Agriculture is one of the six main industries that together account for over half of Kenya's GDP and are predicted to sustain the country's 10% annual economic development, according to Kenya Vision 2030 (GoK, 2007).

Consequently, the Kenyan government has been putting into practice a number of programs, such as contributing to irrigation projects, planting crops resistant to drought, and offering subsidies for fertilizer and seeds (Ogana, 2017).In keeping with this, the 2018 "Big Four Agenda" for Kenya makes a special effort to stress how crucial achieving food security is to the country's development objectives.

Kenya has lowered the country's poverty headcount rate by 13% between 2006 and 2022, with urban areas experiencing a greater drop than rural ones. According to the 2019 SDGs progress

report. This shows the degree to which Kenya is approaching the achievement of SDG Goal 2. (GoK, 2019). Six counties—Turkana, Mandera, Samburu, Busia, West Pokot, and Marsabit—were singled out for recognition for their achievements in achieving food security and ending hunger, despite the fact that more than half of the population lived in food poverty. An further 35.8% of youngsters, most of whom resided in rural regions, were reported to be food impoverished. According to the Institute for International Food Policy Research (IFPRI), Kenya is experiencing a serious food crisis. Despite the fact that the Kenyan global hunger index decreased from an alarming 36.9 in 2000 to a more tolerable 25.2 in 2019, this is still the case (IFPRI, 2019).

2.3.2 Decomposition of Food Security

As with any other aspect of the economy, food security is largely amenable to macro and micro analysis. Specifically, the degree of food security at the individual and societal levels. The former occurs when all citizens of a nation have access to enough food, whereas the latter is defined by a nation having enough food supply to feed its whole population (AfDB, 2022). The African Development Bank (AfDB) asserts that while ensuring national food security is important, household sufficiency is not assured. Individual food security is not guaranteed even though the country's strategic grain stores are fully stocked if the supplies are unavailable because of unstable prices, a weak distribution system, or any other socioeconomic issue. It thus becomes clear that both of these The foundational elements of food security are the availability and provision of food. (Masarirambi and Oseni (2011)

The concept of provision is linked to the availability of food resources inside a nation. According to (Desta (2019), a country should work to achieve production sufficiency by increasing research and implementing innovative agricultural technologies.

This might be accomplished by using drought-resistant seed, as it has been noted that climate change has an impact on food production in many nations. Yields, in turn, are impacted by this,

and they ultimately decide the availability of food on a local and regional level (Hoolst, et al., 2019). Thus, one component of the supply side of food security is food availability. Water, climate change, and agricultural production are highlighted by the Asian Development Bank.

Production-side elements that contribute to food security include availability (Asian Development Bank, 2023). Conversely, demand-side variables include, among other things, urbanization and food prices. Therefore, it is arguable that food security can be further divided into production-side and consumption-side factors.(Jaramillo, Larsen, and Murray- Tortarolo, 2018).

The world community began to become increasingly concerned in the 1960s and early 1980s about the impending rise in world hunger because population expansion had begun to outpace agricultural output, especially in Asia. Therefore, it was generally believed that the only way to address the issue of food security was to ensure that there would always be a sufficient supply of food (Fukuda-Parr & Orr, 2014). Later, when hunger persisted despite greater agricultural production, policymakers like Amartya Sen questioned this idea. Consequently, the idea that food security included both financial and physical access to food started to take hold. After examining poverty and famines, Amartya Sen came to the conclusion that there are many likely reasons why a person could starve, and that not having enough food to eat is just one of them. He argued that while a lack of food supplies could cause famine, the depletion of a person's entitlements is the primary cause of starvation (Sen, 1981).Put another way, because of disparities that could affect people's incomes, food costs, and distribution, hunger may persist in an individual even in the presence of plentiful food resources. The consumption idea of "entitlements" to food was established by the emphasis on individual food security, demonstrating the equal importance of production and demand-side elements in determining food security. Consequently, we arrive at the aspects of food security that were briefly discussed before. Food security as defined by the World Food Summit in 1996 makes reference to these characteristics. Firstly, food's actual physical presence is known as its availability, and it is determined and influenced by the production,

storage, and exchange at equilibrium.

Second, access denotes the ease of access to food production both practically and economically, bridging the gap between individual and national food security. Policymakers accordingly concentrate on incomes, prices, and rural infrastructure, among other aspects, to improve accessibility. Accessibility insights may be gained by examining patterns in economic empowerment as measured by GDP per capita and distribution infrastructure, such as road networks (Abbade, 2017).)

Thirdly, since utilization refers to how the body absorbs the nutrients included in food (FAO, 2008), food sufficiency alone does not ensure that nutritional deficiencies would not arise from the distribution of food in homes. Health, nutrition, and consumption are all included in this dimension. Using clean water and having access to quality healthcare are two non-food factors that impact utilization in addition to dietary intakes (Fukuda-Parr & Orr, 2014). Nutritional information is captured by anthropometric markers, such as the proportion of stunted and wasting children. The number of children under the age of five who pass away readily reflects the health situation. According to (Jones (2013), anthropometry is widely recognized as a substitute for use and has been associated with death, illness, and cognitive development. As a result, some authors view the utilization dimension as a persuasive indicator of the results of food security since it shows how effectively people utilize the food that is readily available to them.

Lastly, the three previously described elements need to remain steady over time in the face of external shocks that could be political, ecological, or economic. The idea of stability encompasses people's susceptibility to food insecurity as a result of disturbances in the other previously described characteristics (Barrett, 2010). It takes into consideration the fact that food insecurity can change over time—becoming either chronic or cyclical (McKay, et al., 2019). According to a study done in Ethiopia, temporary food hardship is unrelated to inflationary pressures brought on by budget deficits and misreporting of food crop, but chronic food insecurity is (Desta, 2016). Thus, coordinated execution of the dimensions is required to attain food security

.

2.3.3 Trends of Maize Food Security in Kenya

The Food and Agriculture Organization (FAO) notes that "all hungry people are food insecure, but not all food-insecure people are hungry" (FAO, 2008) and lists a number of potential explanations for food insecurity. For the purposes of this study, food insecurity is defined as the intermittent incapacity of some individuals to have physical and/or financial access rather than food security, they have access to food that safely and nourishingly satisfies their dietary preferences and nutritional needs (Food Security Information Network, 2020). Put otherwise, the idea that there is food insecurity stems from the lack of any one or more of the generally recognized definition of food security from 1996.

The Food and Agriculture Organization (FAO, 2016) estimated that maize accounted for 83% of Kenya's total harvested cereal area. In recognition of its importance, the Kenya Agricultural Research Institute (KARI) describes maize as a "strategic food security crop whose yields unavoidably affect the level of food shortage and famine in the country" (KARI, 2019). The largest food shortages in Kenya have typically been followed by a sharp drop in the quantity of buyable maize. While other food groups have been consumed less in Sudan and Kenya, according to the FAO, maize consumption has increased. consumption has increased in Kenya.An increase among the main foods consumed (FAO, 2020). Maize makes up a large portion of the average diet, accounting for 36% of total calories and 65% of calories from staple foods, despite the fact that Kenya's main food crops are pulses, vegetables, roots and tubers, and other crops (Kariuki, 2015).

According to a report by Kariuki (2015), there are six concerning developments that directly affect Kenya's food security. It was observed that even while 43 percent of Kenyans experienced food insecurity, the nation's food import burden was increasing as a result of poor output, population increase, and insufficient private sector investment. The report highlights the fact that by 2050,

there will be a 52% increase in the number of people living in rural areas, placing strain on the availability of food, land, and jobs (Kariuki, 2015). He points out that due to a growing population, Kenya's need for maize will double from its current level to over 8.6 million tonnes by 2050. This is the case even if the intercensal population growth rate decreased from 2.6 to 2.2 percent (KNBS, 2019).

Kenya's increasing reliance on imported food is another concerning trend that has been noted. This puts the country's food security at risk from unstable international pricing, which could raise national inflation and negatively affect income levels, particularly for the poor. The observation that output growth is primarily reliant on land area growth was the third pattern that was found. The fourth trend was farmers producing less and using low-quality, low-yielding non-maize seeds. It was observed that some farmers were sowing seeds that were inappropriate for specific agricultural ecological zones. The government's substantial market share was a fifth trend. large market share owned by the government resulting in decreased investment and research in the private sector. This is especially evident in Kenya, where 11 parastatals control the majority of the seed industry (Kariuki, 2015). The sixth trend examined in relation to the previous trends was the condition of Kenya's apparent growing food deficit. The nation's food insecurity will surely get worse if the other trends continue. There has been a bias towards focusing on calories when measuring food security because it is assumed that other dietary requirements will be satisfied once calorie intake is sufficient (Beyene & Muche, 2010). One area of worry has been the fact that, despite an upward trend in maize yield, the food supply derived from the crop has been decreasing since 1976, when per capita consumption of the crop was 1135 kcal per day, as illustrated in figure 2.1 below.

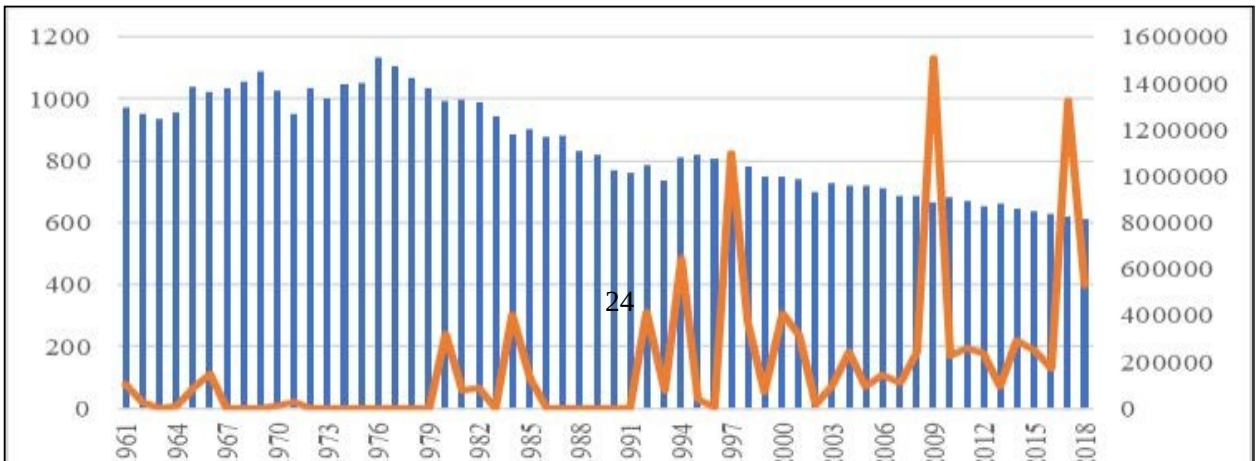


Figure 2.1: Trend of Imported Maize Quantity (MT) and Maize Kilo-caloric Food Supply

Source: Data from Food and Agriculture Organization

The issue of whether individuals have access to the food that is available is brought up by the growing trends in maize production and importation. Despite attempts to boost production and augment it with imports, food security has been worsening, as seen in Figure 2.1 above. a comparison between the trend in the amount of food consumed in kilograms and the frequency of undernourishment. The FAO uses the percentage of a nation's population that experiences hunger to determine the prevalence of undernourishment and food security (Wanner, 2014). Figure 2.1 illustrates that in the years 2000–2002, the kilocalorie food Undernourishment became more common as the supplies shrank. Though the reduction in the kilo-calorie supply of maize was higher than the decline in the proportion of hungry persons, both measures declined at the same time between 2003 and 2012. The two measures diverged significantly between 2013 and 2017, with the frequency of undernourishment increasing from 22.3 percent to 29.4 percent and the kilo-caloric supply of maize continuing to decline.

2.4.3. Macroeconomic Determinants (Interest rate, Fiscal policy, international trade and Gross domestic product)

The variables that are not affected by income levels are known as macroeconomic variables. These are elements that have a big impact on economic expansion. Rather than focusing on specific markets, they address the functioning, makeup, dynamics, and the decision-making process of an entire economy. These elements affect national income, output, consumption, unemployment, inflation, savings, investment, international trade, and international finance, claim Sharma and Singh (2011). Key

indications or arrows pointing to the current economic developments are known as macroeconomic variables. The GDP, the unemployment rate, and the inflation rate are examples of macroeconomic factors. (Khalid et al, 2012).

The main focus of microeconomics, on the other hand focuses on the actions of specific agents, such businesses and clients, to hat sets prices and quantities in specific marketplaces. Put differently, macroeconomics examines the economy as a whole, while microeconomics focuses on its constituent parts. Value of the nation's gross, nation's GDP is the total of all of its productivity for a specific year. All produce and livestock, all improvements in asset values, all growth in intangible investments, and all locally produced goods are included in GDP. As to Sharma and Singh (2011), inflation refers to the gradual escalation of prices.

Inflation can be affected positively or negatively by smaller variables such as the availability of credit, commercial banking, fiscal policy, and the consumer price index. The quantity of inhabitants who are actively looking for work but are not currently employed is measured by unemployment. A single macroeconomic factor can have an impact on several aspects of economic growth, including banking, the consumer price index, and regulatory changes (Mishkin, 2014).

2.4.4 Maize compared to other cereals (Rice, wheat) in Kenya

The food crisis, which is defined as rising and unstable food costs and food insecurity, is a global occurrence. International prices for a variety of commodities have risen dramatically since 2013, often more than doubling in a matter of years, in certain circumstances. (Figure 2.2). Prices of these commodities have also been rising in Kenya.

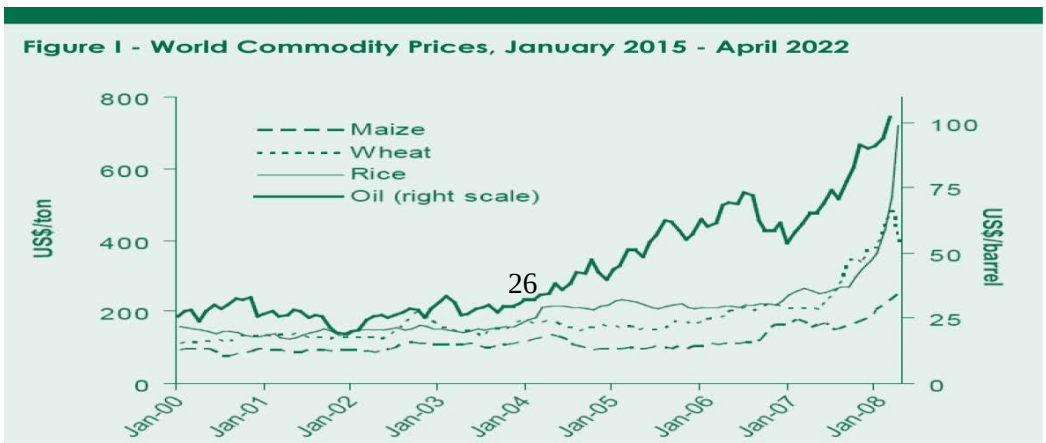


Figure 2.2 Maize compared to other cereals (Rice, wheat) in Kenya

Sources: IFPRI 2018.

The world's impoverished population are particularly concerned about a rise in food prices. Almost everyone in poverty spends a significant amount of their household income on food, and many of them rely on the production of food for their subsistence. There are legitimate worries that this crisis may push millions of people into poverty and that increased hunger and malnutrition may cause even more suffering for individuals who are already destitute (Heady and Fan, 2018). Prices that are growing quickly provide little room for adjustment or substitution, especially for the impoverished in cities.

For governments in developing nations, rising food prices present significant policy challenges. Allowing local prices to fluctuate in line with global pricing results in inflationary pressures and serious problems for low-income people without access to social safety nets. If governments want to stabilize domestic consumer prices, they can also utilize export limits or food subsidies, but doing so exacerbates increases in food costs globally and threatens a system of trade based on rules. As evidenced by the most recent occurrence, several nations choose to return the adjustment responsibility to international markets (Lustings, 2019). A lot of emerging nations in Latin America, Asia, and Africa are experiencing this condition. Protests over high commodity prices have been observed throughout Africa (Tunisia, Egypt, Kenya, Uganda, etc.), and in certain cases unanticipated political upheavals, as in the cases of Egypt and Tunisia (The Economist, 2020 and 2022). In certain other African nations, like Cameroon and Uganda, riots over exorbitant food costs have also taken place.

The government had complete control over the delivery system and the trading environment for maize inputs prior to 1987. Prices for corn and corn meal were fixed on a seasonal and territorial basis. The cost of inputs like seeds and inorganic fertilizers was also regulated. Additionally, the

government managed the flow of corn between districts. The National Cereals and Produce Board (NCPB), which controlled the marketing of maize, enforced regulations.

.

When the nation launched the Cereal Sector Reform Program (CSRP) in 1987 as part of its broader structural adjustment initiatives, the stringent policy framework was altered. Early in the 1990s, the government removed movement restrictions on the selling of maize, deregulated the prices of maize and maize meal, and stopped providing direct subsidies on maize sold to millers that were registered, all in response to pressure from foreign lenders. This marked the beginning of a more aggressive reform process (Jayne and Kodhek, 1997). The maize market was entirely liberalized by the end of 2010. Nonetheless, the NCPB continued to operate in the liberalized market, albeit with a diminished function as an agency buyer rather than a lone trader.

Maize in order to create national strategic reserves. The supply of maize, a crucial grain for ensuring food security, was severely disrupted and decreased by these policies.Owing to the significant costs connected with producing maize and the high levels of post-harvest losses, these reforms have caused Kenya to lose its competitiveness in producing maize compared to its bordering regions (Njoro, 2021). Although this tactic has performed poorly in Kenya, lowering production costs to raise yield per unit area by improving technological efficiency would be one of the most significant ways to enhance the availability of maize.

2.4. Empirical Literature

Several investigations have examined the macroeconomic determinants of maize production, focusing on factors such as inflation, unemployment and HDI. The following literature review provides an overview of some of the key finding from these studies.

2.4.1 Inflation and maize production for food security

Mazivila (2020) used time series analysis and ordinary least squares to determine the price

response coefficiency for maize in Mozambique. The study estimated the maize supply response to price policy for the years 1975–2000 using a Nerlovian adjustment type model. The study discovered that Mozambican farmers did not respond to incentives, despite the fact that 62% of the variance in the area harvested was explained by changes in the dependent variables (lagged price, area and yield, and actual rainfall). Rainfall and shorter policy lags were also determined to be unimportant while studying. However, the study discovered that the traditional farming practices of Mozambican farmers and the agroclimate had an impact on the availability of maize. A crucial factor that the study overlooked was having access to funding and infrastructural development in the study.

According to Simatele (2016), food production in Zambia (which includes maize, millet, sorghum, groundnuts, sweet potatoes, and cassava) was affected by a few major structural adjustment programs. The study used the Heckeman selection model to estimate price elasticities and used these to estimate effects of policies on the production of several food crops in Zambia. This actual-versus-target approach involves setting performance targets for the economy and evaluating the program's effectiveness based on how well it performs against the preset targets. In spite of this, the study

observed that maize production might have suffered as a result of the exchange rate's ongoing rise. A paltry 5.8% boost in maize output would result from simply releasing the exchange rate, according to simulated policy effects. It was discovered that the own price elasticity was negative for the remainder of the crop and positive and considerable for groundnuts and maize. The findings also revealed that maize output responded slowly to non-price influences. The conclusion was that one important staple was maize. Compared to other crops, food was more reliant on structural factors like finance, market distance, and information. Using a 4-year panel of post-harvest data was identified as one of the study's weaknesses. Perhaps a longer study period would

have produced better results.

Kingori (2019) examined how prices are transferred from OECD countries to Kenyan maize prizes in order to examine the effect of agricultural trade support in developed nations on Kenyan maize prizes. The examination of price transmission was conducted using the Vector Auto Regression (VAR) model. In order to calculate the cost of importing maize if market price support and producer payment were removed in industrialized nations, a simulation of import prices was performed. According to the study, domestic maize prices in Kenya are influenced by global pricing for the crop, suggesting that over time, these prices would move together and that developed nations' prices have been transmitted to the domestic maize market.

The fact that developed nations accounted for 35% of all maize imports between 1995 and 2004 led to the decision to investigate the effects of OECD prices. This, in our judgment, was not a large share of the imports, and a comparison of the effects of pricing from other regions from which the nation imports maize would have improved the analysis.

Jayne et al. (2022) calculated how government policies affected wholesale maize prices and how volatile they were. A counterfactual set of maize prices that would have existed between 1990 and 2004 if tariffs had been removed and the NCPB had not become aroused was estimated by the authors. The study discovered that while the import tax has a minimal impact on open market maize price levels, NCPB operations enhance wholesale market prices. Although the VAR technique aids

in overcoming the Lucas criticism by policy indigenization Variables don't provide as much information as simulation models' behavioral supply-demand relationship. Nyangito (2019) conducted a study and evaluation of the policies implemented over time to determine the primary policy issues in the maize sub-sector that require attention.

The study pointed out that the identification would assist the stakeholders in overcoming the obstacles in maize production and marketing. The study examined pricing, marketing, inputs, and

research and extension policies. In terms of research policy, the study found that in order to ensure that private companies' investments in maize breeding can be well protected, it is necessary to develop high-yielding varieties for the medium-potential growing areas, remove the Kenya Seed Company's monopoly on KARI outputs, and establish an unbiased institution to oversee the production and marketing of maize seed. Regarding extension services, the research emphasized the importance of concentrating on extension programs that would enable the efficient transfer of upgraded technology from research facilities to agricultural fields. Reducing the high costs connected with input use and improving the flow of information to farmers regarding the appropriateness and extent of use of better inputs were the two primary policy concerns around inputs.

The main policy issues arising from the impact of maize pricing and marketing policies were identified by the study as follows: how to put in place a pricing policy that would make maize affordable for consumers while also stabilizing domestic prices to encourage increased production; how to support the private sector in its efforts to develop and improve the efficiency of the maize trade; and how the public sector could work effectively with the private sector to achieve food security and stabilize supplies through imports and exports or domestic purchases. The study suggested more research be done on maize breeding and agronomy as the primary foundation for the technologies that are offered to enable higher productivity. The study suggested investing in infrastructure and having public and private extension services provide information on the advantages of applying fertilizers correctly and optimally in order to encourage small-scale producers to use fertilizers, in addition to recommending the group method of extension for farmer training. The study suggested three instruments to stabilize maize prices: buffer stocks, which are publicly held from domestic production; buffer funds, which allow imports or exports to be adjusted to counteract changes in domestic maize availability; and compensation funds to handle surplus and shortage.

According to a Zimbabwean study by Dercon and Krishnan (2019), high rates of inflation lowered farmers' purchasing power and raised production costs, which in turn caused maize production to decline. In Pakistan, Tahir and Naseer (2018) discovered that high rates of inflation reduced farmers' income and raised input costs, which in turn had a detrimental effect on maize production. According to Moses et al. (2014), there was no discernible variation in the supply response for maize production previous to and following market liberalization. Data on small-scale maize production for the Trans Nzoia district from 1980 were analyzed in the study using co-integration analysis and the error correction model (ECM).

The findings indicated that the aggregate reaction to maize supply was positively influenced by both high maize and low fertilizer costs. It was demonstrated that historical prices were a more accurate gauge of the observed supply response than current prices. The study concluded that in addition to price incentives, additional complementary interventions were required to achieve the desired supply response. These interventions included enhanced technology, good infrastructure, household access to information, extension, and credit.

Olwande et al. (2019) used cross-sectional farm-level data for 334 households growing maize in Kenya's high potential maize zone throughout the main crop season of 2015/2019 to evaluate how sensitive labor demand, fertilizers, and maize yield were to price and non-price factors. Normalized restricted trans-log profit function was used in the study to derive the output and factor sharing functions. The study discovered that maize had a positive own-price supply elasticity, meaning that a 10% rise in price would translate into a 1.1%

when the supply of maize increased and all other parameters remained unchanged. Because of the inelasticity of the supply of maize relative to the price of the grain, raising the price of maize would not significantly boost production. According to the study, it would be preferable if the government invested in efficient port infrastructure and rural infrastructure to lower fertilizer prices. It would also be beneficial to promote standards of commerce that would encourage

commercial agents to engage in fertilizer importation, wholesaling, and retailing. Despite the fact that land was the most responsive factor, the reality that land had been divided into small, unprofitable portions meant that the only way to increase output would be to employ fertilizer in combination with other productivity-enhancing inputs.

(Mbithi, 2004, Mose et al 2007; Olwande et al 2009) on the responsiveness of Kenyan maize production to producer prices revealed inelastic responses. This shows price measures are unsuccessful in increasing the production of maize. In order to determine the factors influencing maize production in Kenya and the effects of liberalizing the maize market, Mbithi (2004) examined data for the years 2000–2010 and examined the effects of output prices, rainfall, liberalization, fertilizer prices, and time trend. Findings from the calculated double log function as per the Nerlove (2008) model indicated that there was a 0.18 percent decrease in maize output for every 1% increase in the fertilizer to maize costs. The low response was ascribed to small-scale subsistence farmers keeping a sizable amount of their maize harvest for domestic use.The analysis came to the conclusion that the producer price strategy could not significantly increase maize production since it would benefit large-scale producers more than small-scale producers.

Narayana and Shah (2018) estimated Nerlovian response functions for big and small farms in Kenya using auto regressive integrated moving average (ARIMA) estimations of projected prices and yields. Based on historical prices and yields, projected prices and yields were determined through determining each previous price and yield's stationery and random elements. The findings indicated that small farms' supply response was influenced more by (anticipated) yield levels than by predicted output prices, while large farms responded more forcefully to output prices. The response of acreage to predicted output prices and expected yield levels was the main focus of the study, which took into account broad agricultural aggregates.

Kiori and Gitu's 2019 study concentrated on broken-down estimates for each major agricultural and animal commodity, examining differences between large- and small-scale production systems as well as at the national and district levels. The hectare-by-hectare response to agricultural production prices was examined in all single commodity crop trials. Although there was variation in the calculated elasticities, the findings of these investigations confirmed the earlier hypothesis that producers would react favorably to output prices.

.

2.4.2 Unemployment and maize production for food security

Straus (2019) asserts that improving labor productivity through nutrition consumption is crucial for promoting economic growth. Enhancements in dietary consumption will lead to greater human health and nutrition, improved decision-making skills, and higher economic growth. Furthermore, the author argues that improved nutrition in early childhood will boost academic performance, guarantee higher-quality instruction, and boost labor productivity. Deolalikar (2016), who discovered that nutrition based on the minimum Dietry Energy Requirement (MDER) is crucial in determining the degree of labor productivity, supports these concerns.

The analysis of this author indicates that there is a considerable degree of elasticity between agricultural output and the MDER of family workers. This implies that more agricultural productivity and stronger economic growth will result from workers consuming better nutrition.

According to Barret (2010), there are three key ideas related to food security: usage, availability, and access. Food availability: As previously noted, South Africa's unemployment rate is presently 25.2% (Taborda 2014).

As to the findings of Altman and Ngandu (2010), there is a positive correlation between the number of unemployed individuals or the unemployment rate and the levels of food insecurity and household income. Consequently, job levels have an impact on household food insecurity.

A lack of options for earning cash limits the purchasing power of many South African households, particularly those in rural areas like Alice (Statistics South Africa, 2011). As a result, many households in the country are unable to buy food. In South Africa, the majority of rural households are finding it harder and harder to afford food.

The Human Sciences study Council and Medical Research Council published study in 2014 that found that just 45.6% of South African households had access to enough food, while 28.3% were at danger and 26% actually did. The biggest number of food insecure households is found in the Eastern Cape, where over 30% of households experience hunger. Food security may be enhanced by educating rural households, even through non-formal means, according to Statistics South Africa (2012). According to Musemwa et al. (2013), the Eastern Cape's high rate of food insecurity may be related to the province's low skill levels. 10.5% of individuals over 20 had never attended school.

Labadarios et al. (2019) found that there is a relationship between education level and food access by the way it affects jobs. Ndhleve et al. (2012) discovered that households with restricted access to food in Hamburg, Eastern Cape, also had lower incomes and lower levels of education. This study provides evidence for the link between food poverty and education. Labadari-os et al. (2019) discovered that when incomes are low and food costs are high, employment does not significantly boost access to food, despite the United Nations Development Program's (2006 Report) proposal linking food insecurity, income, and unemployment.

According to Van der Merwe (2016), in order to guarantee food security, households must have stable living earnings. The minimal salary that is adequate to meet a person's fundamental necessities is known as the living wage. But according to the South African Trade Union Congress (2012). claims that a decrease in employment occurred as a result of the implementation of minimum wages. Setting a minimum wage puts pressure on job creation because, given South Africa's high unemployment rate, it lowers demand for labor (Congress of South African Trade Union, 2011). Terrell and Gindling (2010) state that this means that policymakers must determine a minimum wage that is both reasonable in light of workers' needs and living expenses and won't

negatively impact employment.

According to Altman and Ngandu (2022), if wage income is still the primary source of income, achieving household food security will remain difficult even with a halving of unemployment. As a result, they suggest that more policy attention is required to ensure food security for low-income households. Despite the fact that every South African resident is guaranteed access to food and water by the country's constitution (Act 108 of 1996), it is evident from the foregoing that the country's policies are not succeeding in achieving food security for households. The constitution of South Africa has come under fire for permitting food access but not ensuring that every citizen would have access to enough food.

According to Abraham Vinoj (2009), during times of distress, the income level falls below the subsistence level, necessitating the unemployed population to enter the labor force in order to boost the household income. The agricultural sector is typically plagued by distress that results in decreased output, decreased income, and stagnation.The study demonstrates how the farming industry's financial problems resulted in an increase in jobs in rural areas.

According to Bairagyaindrajit (2018), the rate of unemployment rises with greater education levels and was higher among educated people than among illiterate people. The causes of the economy's rising unemployment rates are examined in this article. The essay demonstrates that persons who have completed more schooling are more likely to demand well-paying jobs and to dislike work in the unorganized sector. The study reaffirms that increasing capital production is necessary to lower India's unemployment rate.

Few young people envision a future in agriculture, according to the Kenya Youth Employment Report (2020). Due to this, a large number of young people have left the agricultural industry, despite the industry's great potential to offer decent living conditions, jobs, prospects for earning

money, and wealth development. Youth potential in the agricultural industry remains untapped, despite initiatives from the public and commercial sectors. For the most part, young people find working in agriculture unappealing, and most have negative

view of everything related to agriculture. A few of the primary issues influencing young people's involvement in agriculture are limited access to land, challenges obtaining funding and insurance for agriculture, Inadequate knowledge, expertise, and support services, as well as outdated technology and limited market accessibility KNBS in 2020 .

The high rate of movement from rural to urban areas has resulted in a decline in the young population in rural areas, even with the rise in the young population. In 1990, 75.78% of youth resided in rural regions; by 2020, that percentage had dropped to 53.41%, and it is predicted that this trend will continue (KNBS 2020).Based on these facts, agricultural labor has shifted to urban areas due to the higher rate of migration from rural to urban areas. Though some young people in metropolitan areas are unemployed, the majority are underemployed. If the right measures, strategies, and policies are put in place, agriculture offers fantastic opportunity for young people who are unemployed or underemployed. 2020 Kenya Labor Force Participation, ILOSTAT 2020 Report, 2018) Currently making up 28.47% of the total youth work force, the young labor force in the agricultural sector has been decreasing. Unemployment rises even though it may seem high since the manufacturing and service sectors are unable to employ 72% of the remaining young labor force. More youth engagement and employment in the agriculture food systems are needed since, when compared to other sectors, agriculture has the greatest potential to produce jobs and boost food security in Kenya. (2021) Julia Faria

2.4.3 Gross domestic product and maize production for food security

According to Kinsella (2022), diet plays a major role in extending life expectancy and lowering the death rate. But in wealthy nations, consuming more food can lead to obesity and shorten life expectancy from chronic illnesses.An increase in weight will cause a diabetes epidemic and shorten life expectancy. Nonetheless, raising this intake can lower death rates and lengthen life expectancy in dry land developing nations where a considerable proportion of the population has inadequate nutrition intake (Wall et al, 2012).

According to Miller et al. (2019), long-term poverty impairs young children's cognitive development. This issue is brought on by low birth weight and nutritional deficiencies, which can affect children's verbal memory, vocabulary, arithmetic and reading achievement, and behavior. These developing nations do, however, have access to enough food to support healthy bodily development, disease prevention, increased productivity, and economic expansion.

According to Salehi et al. (2018), if all parents and family members involved received food and nutrition education, children in poverty-stricken communities could have adequate nutrition needs. All family members, including parents, must fulfill their responsibility as caregivers by providing their children with affordable, sanitary, and simple foods that provide enough calories and protein. These methods can boost kids' academic achievement and help them grow as individuals. According to Plessis's analysis from 2022, all factors influencing economic growth have the greatest impact on convergence.This supported the economic growth model's inclusion of the food security component. The Solow growth model predicts that as population grows, food accessibility decreases and low capital has a favorable effect on growth performance. This finding is consistent with the negative effects of growing population on economic growth.

Timmer (2020) asserts that there are several measured ways to achieve food security. Pro-poor growth, or The first element of a food security strategy is the rate and distribution of economic

growth.The other long-term method for attaining both food security and economic prosperity is the broad stability of food prices by the Asian government with the aim of fostering economic growth. The third strategy, domestic price stability, is better for economic growth Focusing on the Asian viewpoint on food security, the author's work will boost the effectiveness of the private marketing sector. Rice is the main crop item for this study because it's a

significant Asian staple meal. Second, farmers grow rice on small estates. Thirdly, every Asian nation shields its farmers and consumers from the unstable world rice market by shielding them from shifts in world prices.

Agboola (2018) conducted a study to determine the impact of food security on growth in Sub-Saharan Africa (SSA) countries between 1970/74 and 2000/09. The study used panel data from 128 countries. According to the study's findings, beginning investment, life expectancy, food security, and the rate of enrolment in schools all had a beneficial impact on economic growth in the nations under consideration. Additionally, the GDP, inflation rate, and population growth rate have a negative impact on the rate of economic growth. It was also observed that long-term growth is impeded in African countries experiencing food insecurity. The study's findings were attained through the use of a normal regression model.

The results of Plessis's (2020) study concluded that all factors influencing economic growth have the greatest impact on convergence, which supports the inclusion of the food security variable in the model of economic growth. Population growth has a negative impact on economic growth, which is consistent with the Solow Growth Model's prediction that rising population will decrease food accessibility and, as a result, slow down economic growth. Furthermore, Plessis demonstrated that growth performance is positively impacted by higher levels of capital.

.

The advancement of food security for entire societies has been enhanced by the development of financial systems. Economic expansion and food security are intimately associated (Timmer,

2004). A multitude of strategic approaches can be employed to attain food security. The first element of a food security policy is the pace and distribution of economic growth, also referred to as pro-poor growth. The second long-term method for attaining both food security and economic growth is the Asian government's stability of food prices generally in order to spur economic growth. The third approach, domestic price stability, is a better economic strategy since it will boost the effectiveness of the private marketing sector. The author has focused on the Asian perspective on food security, utilizing rice as the main crop commodity for this study because it is an important staple food in Asia. Third, worldwide rice markets are regarded as unreliable markets, which forces all Asian countries to insulate their own farmers and consumers against shifting global prices. Second, rice is produced by farmers on small holdings.

According to Torero's (2014) investigation into the connection between economic expansion and food security, the Food and Agriculture Organization of the United Nations (FAO) concluded that high levels of food malnutrition reduce GDP by 4 to 5 percent yearly. According to the report, increasing agricultural productivity through innovation and research can lead to food security. Food stability and long-term security are linked to economic prosperity, according to Torero. Human capital is adversely impacted by food insecurity. Food insecurity is linked to higher fiscal expenses for the government, which in turn raises government spending because the problem of food insecurity is not addressed. As a result, over time, economic growth became stagnant.

Gay, Fellmann, and Kavallari (2014) used an AGLINK–COSIMO recursive–dynamic to examine how food security affects economic growth. The study's findings suggested that long-term growth in less developed countries is impacted by food insecurity. The findings showed that rapid economic expansion, as anticipated, improves trade balances for third-world countries but does not alleviate internal food security issues by driving up consumption. This

study took into account both upward and downward shocks to economic growth and how they affected the evolution of agricultural commodities markets between 2012 and 2021.

Destaand Asayehgn (2016) conducted this study to look into potential connections between Ethiopia's food security and economic growth. Through the development of an eclectic framework in the analysis, the goal was accomplished. The causal relationship between Ethiopia's growth and food security was the gap they aimed to fill. In this philosophical study, the authors reviewed the literature and concluded that Ethiopia's food insecurity was a result of the government's neglect of the financial infrastructure that fuels inflation. The review examined every study done on the relationship between food security and economic growth.

.

Aseyegn (2016) conducted a study aimed at determining the relationship in Ethiopia between rising food prices and stabilizing measures (access to food stock). The study specifically demonstrated a direct relationship between food availability and economic growth. As a result of rising money supply in the economy, population expansion, budget deficits, a lack of storage facilities, shoddy institutions, and instability in the resource base, the study's findings suggested that Ethiopia was experiencing acute (chronic) food insecurity.

According to Torero's (2014) examination into the relationship between food security and economic growth, the United Nations Food and Agriculture Organization (FAO) concluded that high levels of food malnutrition reduce GDP by 4 to 5 percent yearly. According to the report, increasing agricultural productivity through innovation and research can lead to food security. Food stability and long-term security are linked to economic prosperity, according to Torero. Human capital is negatively impacted by food insecurity. Food insecurity is linked to higher government fiscal expenses, which in turn raise government expenditures as a result of the inability to solve the problem. Ultimately, this results in stagnant economic growth.

2.5. Summary of Knowledge Gap

This study's objective was to investigate the relative effects of a few chosen macroeconomic variables on Kenya's maize production for food security and to assess how well these factors complement one another. Comprehensive studies that concentrate on the unique elements influencing maize production for food security are scarce. There isn't one element that has been found to have a greater impact on the amount of maize produced than any other. The study also reveals that farmers don't have access to technical knowledge about all the variables influencing Despite their efforts to increase maize production by adopting the newest equipment, they have been unable to provide an explanation for why their amounts of maize are dropping due to their outdated farming practices.

Table 1: Summary Table of research Gaps

Author	Title	Finding and conclusion	Knowledge gap	Address Gaps
1. Mazivila (2020)	Price coefficient	62% of the variation in the area harvested was explained by the changes in dependent variable	The study did not consider some important variable such as access to credit and infrastructural development in the study.	Variable such as access to credit and infrastructural development will be addressed to enhance efficiency in supply of maize
2. Simatele (2016)	Impact of selected structural adjustment policies on food production	Sluggish response in maize output to non-price factors	Study used a 4years panel of post-harvest data	Increase the panel period to achieve better results
3. Gay, Fellmann and	Impact of	Food insecurity in less developed	Does not help in addressing food	Government policies

Kavallari (2014)	agricultural trade support in developed countries	world affect growth in the long-term	security domestically	should intermediate about the prices so that everyone can afford to purchase the food
4. Aseyegn (2016)	concepts associated with food security	Ethiopia was experiencing extreme food insecurity as a result of inflation brought on by an increase in the amount of money in the economy.	Prices of food and stabilization policies were addressed but not clearly how to be addressed	Other variables such as unemployment and inflation should be addressed for individuals to be in a position access adequate food
5. Plessis (2022)	problem of household food security	Since food security has the biggest convergence impact among all economic growth drivers, its inclusion is warranted.	The issue of all determinants of macroeconomic determinants were addressed as it affects food security	Other factors such as infrastructural development should be addressed to ensure maize supply effectively
6. Torero (2014),	Household	High levels of food malnutrition cause	Fiscal costs and government	The issue of

	income	the reduction in gross domestic product.	expenditure were addressed as a measure of food stability	unemployment should be addressed because with low income individuals will not access the food they need
7. Agboola (2018)	Economic growth	The rate of school enrolment and the crucial investment life expectancy for food security are two factors that positively impacted economic growth.	The probability of obtaining food security decreased with each additional household member; other determinants are assumed to remain constant.	If other determinants such as members added to the family, land size the results will be better
8. Timmer (2020).	Approaches of Achieving food security		Education and employment alone do not improve effectiveness to access food.	Other factors such prices should be addressed to improve affordability.
9. Salehi et al (2018)	Impact of hybrid maize adoption on the	The utilization of hybrid seeds increased asset values in addition to yearly incomes.	The depth between the nation's major and minor maize-growing regions was decreased by the use of hybrid seeds..	Use of technology will highly improve the supply of maize.

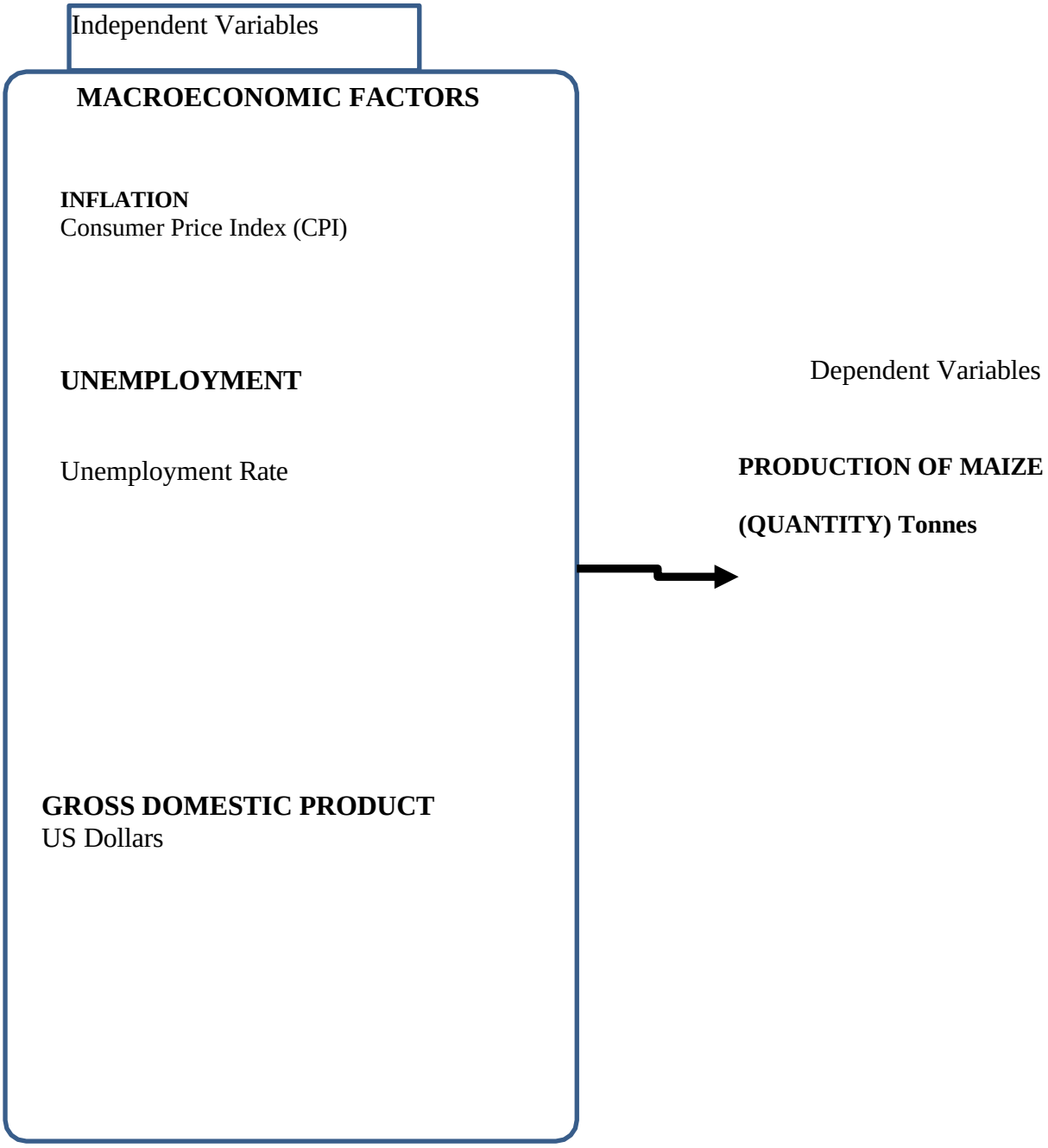
	welfare of farming households in Kenya.	possibly reflecting long-term welfare effects.		
10. Kinsella (2022)	Unemployment and maize production	unemployment rates had negative impact on maize production by reducing demand for agricultural inputs and decreasing farmers' access to credit	Unemployment without the access to credit will not improve result of maize supply	Factors such prices and access to credit should be addressed to avoid spurious results

Source: (Author, 2023)

2.5. Conceptual Framework

The research outlines the independent and dependent variables of the study and is based on the following research model. The dependent variable in this case is maize production while macroeconomic determinants, inflation, unemployment and Gross Domestic product as the variable.

Figure 2.6 Conceptual Framework



Source: Author 2024

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction

This chapter covers the research design, study site, population, sample size and procedures, research instruments, data collection techniques, and data analysis.

3.2 Research Design

Research design refers to framework indicating the approaches and procedures for gathering and analyzing information necessary to facilitate the research (Weinbrenner, 2022). This study adopted a causal research design owing to its ability to gather large data in a short period besides explaining statistical relationship between the production of maize for food security and macroeconomic factors such as inflation, unemployment levels and national income. With this design, the degree and extent of cause-and –effect relationship between two or more variables is identified. Furthermore, the design is suitable for time series data as it captures trends and seasonality of variables across time (Kothari, 2022).

3.2. The Location of the Study

Africa's Eastern Region contains the Republic of Kenya. Based on UN estimates, the population is roughly 54 million people. Nairobi, in the country's south-central region, serves as its capital city. With five additional nations, Kenya shares borders. With borders to Southern Sudan spanning 306 km, Ethiopia 779 km, Somalia 682 km, Tanzania 769 km, and Uganda 772 km, Kenya's international land borders span 3,446 km. The coordinates of Kenya are 37.90620E and 0.02360S, respectively. According to Kenya's GPS coordinates, the equator divides the nation in half. roughly 50% of Kenya is in the Northern hemisphere. Kenya was chosen as the study area owing to huge demand and consumption pattern in Africa being second after South Africa. Despite Kenya having a high demand for the commodity, there has been disequilibrium between its demand and supply leading food insecurity which is a threat to the nation (Mathenge, Sonneveld, & Broerse, 2023). This warrants the investigation into contribution of macroeconomic factors into the problem of maize production in Kenya.

3.3. Data Collection

Due to changes in regimes, unemployment levels, inflation rate trends, and nation gross domestic product, which may have a significant impact on the production of maize and, to a lesser extent, the food security of the country Kenya, this study was limited to a quarterly time series data for a period from 1990 - 2022. Data was derived from the FAO (2023) Online Statistics and the world development indicators which are compiled by the World Bank databases and the Republic of Kenya Economic Surveys. Data from macroeconomic indicators such as inflation, unemployment, and national income was generated from the database of KNBS as well as from Food and Agriculture organization.

3.4. Data Analysis

The Version 10 of the EVIEWS program was used for the data analysis, which included both

descriptive and inferential statistical methods. The data was cleaned up and turned into ratios before being entered into EVIEWS for analysis. The program is recommended for time series analysis because it can conduct many tests. The correlation matrix was used to look at linear relationships between the explanatory variable. To investigate the autocorrelation between the dependent variables and the residuals, the Breusch-Godfrey Serial Correlation LM test d-statistic was employed. When a variable's serial correlation is 0, there is no correlation and every observation is independent of every other observation, and vice versa. The residuals serve as the error correction term in this situation.

Unit root tests was conducted using augmented Dickey Fuller Test (ADF) statistics and Phillips–Perron test to evaluate the impact of macroeconomic shock and prevent erroneous regression caused by non-stationary variables. The number of lag lengths depends on the test statistics and the crucial values. Correlation analysis was carried out after applying lagging to all variables until this is accomplished. Determination of the optimum lag length was carried out in two different ways. The first to determine the variables' long-run Ordinary Least Square (OLS) equation integrated to order (n), in this case n=1.Including the Error Correction term in an OLS was the second step.Descriptive Statistics

Descriptive statistics was computed to give an overall view and summarized the data, as well as to remove outliers (Wigginton, and Abecasis, 2015).

3.4.1. Inferential statistics

Comparing the variations between both the treatment groups was done using inferential statistics. The estimation of multivariate regression analysis was incorporated in inferential statistics. The effect of inflation, unemployment, and national income on Kenyan's maize production for food security was examined using inferential statistics.

3.4.2. Economic Model Specification.

The econometric model developed in this study was designed to measure the effect of selected macroeconomic factors on Kenyan's maize production for food security. The maize production for food security in this model was represented by (LNPMZt) which is proxied by the quantity supplied. Independent variables which are selected macroeconomic factors; model includes control variables such as inflation ($LNINFX_{1t}$), Unemployment ($LNUNPX_{2t}$), and GDP ($LNGDPX_{3t}$). The stochastic model is designed to represent all variables as shown in equation (i)

$LNPMZt=f(LNINFX_{1t}, LNUNPX_{2t}, LNGDPX_{3t},)$----------Equation i

In expansion equation 1 becomes

Step 1; $LNPMZt=B_O+B_1LNINFX_{1t}+B_2LNUNPX_{2t,} + B_3LNGDPX_{3t}+Ut$----------Equation (ii)

Where: LNPMZt-Maize

supply(t) $LNINFX_{1t}$, -Inflation(t)

$LNUNPX_{2t}$-Unemployment(t)

$LNGDPX_{3t}$-Gross Domestic Product(t)

B_O, B_1, B_2, B_3 and B_4 are intercept and co efficient to be estimated respectively

Ut-the stochastic error term or disturbance.

LNPMZ=The amount of maize that was supplied by the country

B_O=Constant. The amount of maize supplied when all the independent variable are equal to zero.

B_1=the correlation coefficient that explains the change in LNPMZt when LNINFX1t changes by a single unit.

B_2,=The correlation coefficient that explains the change in LNPMZt when LNUNPX2t changes by a single unit.

B_3=The correlation coefficient that explains the changes in LNPMZt when LNGDPX3t changes by a single unit.

The regression model above indicates the relationship between the selected macroeconomic factors on Kenyan's maize production for food security. The variance of each parameter

estimate was generated using the EVIEW software. Multiple coefficient determination (R^2) was used to measure the variation LNPMZt (maize production, quantity) explained by the variation in macroeconomic factors which are, inflation ($LNINFX_{1t}$) Unemployment ($LNUNPX_{2t}$), and Gross Domestic Product ($LNGDPX_{3t}$).

3.4.3. Description and Measurement of Variables

Description and measurement of variable was summarized in the table below.

Table 3. 1: Description and Measurement of the Variable

Variable	**Description**	**measurement**	**Expect sign**
Maize supply (quantity)	Maize supply from the main store to other parts of the country	(Quantity)hectare/acre maize supplied	+/-
Inflation	Increase in prices	Inflation rate	+/-
Unemployment	Term used to describe people who are actively looking for work and are employable but are having trouble finding it.	Unemployment rate =unemployed people/total labor force*100	+/-
Gross Domestic Product	The total monetary or market value Considering all completed products and services generated inside a country's borders in specific	GDP=C+I+G+(X-M) C –consumer spending I-investment G-government spending X-M net export	+/-

Source: (Author, 2023)

3.5. Diagnostic Tests

This study conducted ordinary least squares (OLS) in data analysis. The EVIEW version 10 econometric package was used to run the required regression following are indeed to confirm the correctness and consistency of the data, the relevant tests were performed.

3.5.1. Stationarity

The time series data in this study was tested for stationarity using the Phillips-Perron unit root test and the Augmented Dickey-Fuller (ADF) test. H0:$=0 was the null hypothesis. H1:<0 was the alternative hypothesis. If, at a given level of significance, Since there is a unit root and the estimated ADF statistics are greater than the ADF critical value, the null hypothesis is not rejected. If the computed ADF statistics was smaller than the ADF critical Value, the null hypothesis was rejected since there was no unit root and the series was stationary. Every single one of the series are diverged once to render them immobile when they reach a specific significance level (Gujarati, 2009).

3.6.2.Testing for Unit roots/Stationarity Test

The statistical characteristics of the data in a time series stay consistent throughout time when they are stationary. In other words, there is no consistent difference between the variance and mean across time.When mean and variance are not constant, biased estimators arise due to the OLS assumption of constant mean and variance not being met.Stationarity is the property that a change in period shouldn't have an impact on the series' distribution form. If unit roots (deterministic or stochastic trends) are present, it suggests that the pattern is non-stationary, which implies that it was an irregular and thus unexpected

systematic pattern. That is, the data series contained many trends. An analysis problem that could occur was a spurious regression. caused by Unit roots. To check for stationarity, the augmented Dickey-Fuller and Phillips-Perron tests were employed. While the latter was utilized because it corrects for serial correlation and heteroscedasticity in the error terms, the former was used in the event where the error terms showed autocorrelation. Unit root(s) trends over time are displayed by time series data. In order to ascertain whether stationarity exists in time series data, it is important to ascertain the integration order of the data. The mean and variance of the data at any delay will remain constant or unchanged regardless of the point at which they are measured if it is in time series order and stationary, that is, of order 0 indicated as 1(0). They are thus time invariant. An order 1 time series, represented as 1 (1), on the other hand, was non-stationary and might have either a variable mean over time, a variable variance over time, or both.

3.5.2. Normality

This test evaluates whether or Determine whether a data set has a normal distribution or not, as well as the likelihood that the data set's underlying random variable has a normal distribution. The Jarque-Bera test was utilized to evaluate the study's normality.

For big data sets, the Jargue-Bera test was suitable. It particularly examines if the normal distribution is skewly zero or kurtosis three, respectively.

3.6.4 Co-integration Test and Error Correction Model

In the event that our data is non-stationary, cointegration must be

checked. When one or more non-stationary series exhibit a comparable long-term connection or stochastic trend, it is known as co-integration. This means that even when one variable is regressed on another, the results are not erroneous (Gujarati & Porter, 2009). The integration of two cointegrated variables that are combined linearly will be of a lower order than the integration of each of the variables separately.

The relationship between a large number of variables, each of which has a unit root, is examined using cointegration tests. It is impossible to regress two non-stationary time series variables without getting misleading results. One defense against erroneous regression is to determine if the time series are co-integrated. If there is a stable, long-term relationship between two or more variables, cointegrated variables are those that fall within that category. When both variables, X and Y, are integrated of order one and there is a linear combination of the two that is stationary, 1(0), the two variables are said to be co integrated of order one, 1 (1). One of two methods yields the linear combination.

$Yt=a0+B_{0}X_{t}+U0t$ ---------- Equation1

$Xt=a1+B_{1}Y_{t}+U1t$ ---------- Equation 2

The ARDL Bounds cointegration test was employed in this study to check for co-integration. Random shocks are the main cause of short run departures from equilibrium; however, these deviations are constrained because stabilizing mechanisms frequently return the system to equilibrium (Engle and Granger, 1987). The error correcting process restores the long-term relationship between the levels of the variable. Granger and Engle residual based test involves two steps. The initial step was to run an OLS regression on the level-based series produce residuals. The residual from a unit root test should be saved in the second face. The two series are co-integrated if the residuals are stationary. In order to provide a methodological procedures for adjusting disequilibrium that prevent the dependent and explanatory variables from deviating too far from their mean value an error correction mechanism (ECM) is developed.

3.5.3. Test for multi-collinearity

Multi-collinearity in a multivariate regression model arises from the reliance or non-independence of independent variables. Multicollinearity can cause issues only when there is a high inter-correlation between the independent variables. Considering that multicollinearity occurs frequently among variables, what counts is the degree of multi- collinearity.For OLS regression to be effective, each independent variable must be genuinely independent and must not have any bearing on any other independent variable. This study used the variance inflation factor (VIF), which looked at the amount that an estimate co-efficients variance increases as the regressor are linked, to test for the presence of multicollinearity. The strength of the found association is gauged by the variance inflation factors. If the factor is not 1. OLS estimates and their standard errors become extremely sensitive to changes in observational data when there is considerable multicollinearity (Gujarati, 2019).

3.5.4. Test for Autocorrelation

Autocorrellation is the results of an error in one period carrying over into subsequent period.in a time series of data it can also happen when one observation's error term influences another term of another observation. The subsequent values of the error terms for the linear regression error term need to be sequentially independent (Mukras, 1993). The OLS estimators are less effective in the presence of autocorrelation, but they nevertheless maintain their asymptotically normally distribution, objectivity, and consistency. We shall evaluate the hypothesis on the presence or absence of autocorrelation. According to Magnus and Neudecker (2019), the alternative hypothesis contends that the error term exhibits autocorrelation, while the null hypothesis contends that the error term lacks autocorrelation.

3.6.7.Test for heteroscedasticity

A situation known as heteroscedasticity arises when the error term's variance fluctuates for every value of the independent variables. The variance of the error terms is influenced by the size of the independent/explanatory components since the error term can differ between samples. Heteroscedasticity reduces the efficiency of the OLS estimator slightly, but it does not change its impartiality. As a result of its lower variance in small sample, the OLS estimator is asymptotically inefficient in high sample sizes compared to other unbiased estimators in the class. Das, (2019) uses the Breush–Pagan test to determine whether heteroscedasticity is present in this study.

3.6. Ethical Consideration

The designs and techniques of your study are guided by a set of rules known as ethical concerns in research (Williams & Anderson, 2018). Among these guiding principles are the possibility of harm, outcomes communication, anonymity, informed consent, and voluntariness. When it came to research ethics and codes, this study was careful. Examine

By initially receiving permission to conduct the study from the Masinde Muliro University of Science and Technology Department of Economics and the Masinde Muliro University of Science and Technology Research Ethics Committee of the, the study's ethical requirements were guaranteed. graduate school's directorate. The researcher also requested permission to access and gather records from several government agencies, including the National Archives, from the Kenya National Council for Science, Technology, and Innovation. Whose identity was the respondent from whose data was gathered throughout the The project was handled with extreme confidentiality. Unless the individual concerned gave written agreement in advance, all information disclosing the identity of research subjects was destroyed at the end of the project. Neither the final product nor any other correspondence created throughout the project contained any information that would have revealed the identify of any individual.

CHAPTER 4:
DATA ANALYSIS, PRESENTATION AND DISCUSSIONS

4.1 Introduction

This section presents the study's conclusions, which were arrived at by applying the methodological techniques covered in chapter 3 to a critical analysis of the data.The analysis focuses on the evaluation of the relationship between inflation, unemployment and Gross domestic Product and Kenya’s maize production for food security. Interpretation of the results is also discussed.

4.2 Descriptive Statistics

The statistical mean and standard deviation for the study 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 30 observations with four variables in play (one dependent variable, three independent variables). Maize production for food security is the dependent variable and the independent variables are; inflation, Unemployment and Gross Domestic Product.

Table 4.1, shows that data across variables is highly dispersed due to It was highly predicted given the nature of time series data, especially those whose aggregates exhibit a stochastic or random process.

Table 4. 1 Descriptive Statistic

	LNPMZ	LNINF	LNUNP	LNGDP
Mean	14.873710	2.130182	1.175790	1.074819
Median	14.88612	2.131082	1.124924	1.430322
Maximum	15.20524	3.828182	1.730593	2.086724
Minimum	14.55220	0.441043	1.015231	-1.459800
Std. Dev.	0.193732	0.700629	1.978078	0.963561
Kurtosis	1.748553	3.886004	5.776828	3.750321
Jarque-Bera	1.977684	0.987812	29.20242	10.65043
Probability	0.372007	0.610238	0.259283	0.004867
Sum	446.2113	63.90545	35.27371	32.24457
Sum Sq.Dev.	1.088436	14.23554	1.064036	26.92502
Observations	30	30	30	30

Source: (Author, 2024)

LNPMZ-Maize production for food security

LNINF – Inflation

LNUNP- Unemployment

LNGDP-Gross Domestic Product

The Maize production for food security in Kenya which was measured with an average of 14.8737107, the minimum value of 14.55220, the maximum value of 15.20524 showing the maximum production for the period under study and standard deviation of 0.193732. Inflation had an average of 2.13, the minimum value of 0.44, and the maximum value of 3.83 and standard deviation of 0.70. Unemployment had an average value of 1.18, the minimum value of 1.02, the maximum value of 1.73 and standard deviation of 0.19. Gross Domestic Product had an average value of 1.07, the minimum value of -1.46, the maximum value of 2.09 and standard deviation of 0.96. From table 4.1, Maize production for food security, which has a high mean, is a sign that maize production has increased quickly over the previous ten years. With a standard deviation of 0.19 among the independent variables, data for unemployment 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. Skewness show the asymmetry of a distribution .A skewness value of less than two, a kurtosis value of less than 6.Ought to be considered normally distributed (Maniagi,2018).positive skewness signals the mean of a data set is greater than the median value, while negative skewness indicates that median value is greater than the mean value (Odour,2021).From table 4.1,maize production for food security had a skewness value of -0.0633,indicating that it was moderately negatively skewed, with a kurtosis of 1.7486.The above two tests showed the maize production for food security was distributed normally.

Inflation was positively skewed (0.0362), with a kurtosis of 3.8860 indicating that it was normally distributed. Unemployment was positively skewed (1.9781), had a kurtosis of 5.7768 indicating normal distribution. Gross Domestic Product was negatively skewed (-1.4104), has a kurtosis of 3, 7503 showing it was 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.

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 Maize production for food security (LNPMZ) exhibited a

P-value of 0.372007, which is greater than the significance level of 0.0500. Consequently, the null hypothesis, which states that Maize production for food security (LNPMZ) follows a normal distribution, was accepted. The variable of inflation (LNINF) was found to have a P-value of 0.610238, which is more than the significance level of 0.0500. As a result, the null hypothesis, which states that the variable is normally distributed, was accepted. Conversely, the alternative hypothesis, which suggests that the variable is not normally distributed, was rejected.

The null hypothesis, which posits that the variable of interest, Unemployment (LNUNP), follows a normal distribution, was accepted based on the observed p-value of 0.259283, which is more than the predetermined significance level of 0.0500. Gross Domestic Product (LNGDP) exhibited a P-value of 0.084867, which is greater than the significance level of 0.0500. Consequently, we accept the null hypothesis that the variable follows a normal distribution.

Furthermore, it was discovered that all variables' skewness and kurtosis values were higher than the 0.05 cutoff. This result suggests that both skewness and kurtosis of the variable distribution around their means showed asymptotic normality. As a result, the alternative hypothesis (H1), which states that the data do not follow an asymptotic normal distribution, was rejected in favor of the null hypothesis (Ho), which states that the data do.

4.3.1Correlation 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 4.2.

Table 4. 2: Correlation Analysis

	LNPMZ	LNINF	LNUNP	LNGDP
LNPMZ	1.000000			
	……			
	…….			
LNINF	-0.280446	1.000000		
	[-3.546021]	……..		
	(0.0333)	……		
LNUNP	-0.162595	-0.127318	1.000000	
	[-2.871974]	-0.67932	……	
	(0.0106)	(0.5026)	……	
LNGDP	0.695795	-0.372869	0.145650	1.000000
	[5.126135]	[-2.126381]	[0.779015]	……
	(0.0000)	(0.0424)	(0.4425)	

Source:(Author,2024)

Values in parentheses [ ] indicate t-Statistic and values in brackets ( ) indicate the p-values.

From Table 4.2, the correlation results shows that inflation (I) had an inverse relationship with Maize production for food security (LNPMZ), as shown by a negative value of -0.280446 and a p-value of (0.0333) 0.05; Unemployment (LNUNP) had a negative and an inverse relationship as shown by a negative value -0.162595 and a p-value(0.0106)0.05 and Gross Domestic Product (LNGDP) had a Positive and significant relationship, as shown by a positive value of 0.695795 and a p-value of (0.0000) 0.05; Gross Domestic Product and maize production for food security (LNPMZ) had a direct and significant linkage with a value of 0.695795 and a p-value of (0.0000). The p values for the variables are all less than 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.

4.3 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 non-stationary, 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.

Table 4.3: Unit root tests – Augmented Dickey Fuller (ADF) at level

			Number of observations = 30			
Variables	**ADF T-statistic**	**Prob**	**Critical values**			**Conclusion**
			1%	5%	10%	
LNPMZ	-2.390991	0.1521	-3.653730	-2.957110	-2.617434	Unit root
LNINF	-4.100242	0.0032	-3.653730	-2.957110	-2.617434	Stationary
LNUNP	-1.931616	0.3140	-3.670170	-2.963972	-2.621007	Unit root
LNGDP	-5.459489	0.0001	-3.689194	-2.971853	-2.625121	Stationary

Source: (Author, 2024)

Table 4.3 displays the Augmented Dicker Fuller test results as extracted from output attached in appendix I . The time series data has a unit root, which is the null hypothesis for the ADF test; however, the alternative hypothesis is that the data is stationary. The variables showed a unit root at the level of unemployment (p value 0.3140 > 0.0500) and maize production for food security (p value 0.1521 > 0.0500). The crucial levels of 1%, 5%, and 10% were exceeded by the ADF T-statistic values. This implied that the null hypothesis—that there is a unit root—was accepted over the alternative hypothesis of stationarity. Because of this, the time series data was not at level stationary, and as a result, the gross domestic product (p value 0.0001> 0.0500) and inflation (p value 0.0032> 0.0500) showed stationarity at level.The ADF T-statistic values were below the threshold values of 1%, 5%, and 10%. This implied that the unit root null hypothesis was disproved and that the

alternative hypothesis that there is a stationarity. As a result, the time series data was stationary at level.

Table 4.4: Unit Root Test - ADF at First Difference

			Number of observations = 30			
Variables	**ADF T-statistic**	**Prob**	**Critical values**			**Conclusion**
			1%	5%	10%	
DLNPMZ	-7.310343	0.0000	-3.661661	-2.960411	-2.619160	stationary
DLNUNP	-5.332608	0.0088	-3.670170	-2.963972	-2.621007	Stationary

Source: (Author, 2024)

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. Food security through maize production (LNPMZ; p value 0.0000 < 0.0500) and unemployment (LNUNP; p value 0.0088 < 0.0500). As a result, the null hypothesis was replaced with the alternative hypothesis—that the two variables had no unit root—and it was determined that the time series data was stationary at first difference.

4.5 Phillips-Perron Unit Root Test

Many time series data sets exhibit non-stationarity, implying that both their variance and mean fluctuate over time (Gujarat, 2022). Checking for unit root is a vital step prior to conducting statistical analyses, as it safeguards against inaccurate outcomes, given that numerous statistical models and methods assume data stationarity (Maniagi, 2018). The Phillips–Perron Unit root test was administered in checking for unit root. This test incorporates lagged values to address potential serial correlation within the disturbance term. As elucidated by Aljandali and Tatahi (2018), the null hypothesis of this test posits the

existence of a unit root. In accordance with the Phillips-Perron test, the T-statistic must exceed both the 1%, 5% and 10% critical values, irrespective of sign, while the p-value must surpass 0.05 for the null hypothesis to be retained. The ensuing table presents Phillips-Perron test outcomes across varying levels.

Table 4. 5: Phillips-Perron Results at levels

Variables	**Adj T-statistic**	**Prob**	**Critical Values**			**Conclusion**
			1%	5%	10%	
LNPMZ	-2.3909	0.1521	-3.6537	-2.9571	-2.6174	Unit root
LNINF	-4.0952	0.0033	-3.6537	-2.9571	-2.6174	Stationary
LNUNP	-0.0590	0.9455	-3.6617	-2.9604	-2.6192	Unit root
LNGDP	-5.4725	0.0001	-3.6892	-2.9719	-2.6251	Stationary

Source: (Author, 2024)

Table 4.5 indicates that Maize production for food security was unit root at level, had a p- value of 0.1521> 0.05, and had a Phillips-perron T-statistic of (-2.390991) less than 1% (- 3.6537), 5% (-2.9571), and 10% (-2.6174) critical values, respectively. Inflation was stationary at level (p-value 0.0033<0.05), and the Phillips–Perron T-statistic (-4.0952) greater than 1% (-3.6537), 5% (-2.9571), and 10% (-2.6174) critical values, respectively. Unemployment was non-stationary at level due to the presence of a unit root (p-value 0.9455>0.05), and the Phillips-perron T-statistic (-0.059044) was less than 1% (-3.6617), 5% (-2.9604), and 10% (-2.6192) critical values, respectively. Gross Domestic Product was stationary at level (p-value 0.0001<0.05), and the Phillips-perron T-statistic (-5.4725) greater than 1% (-3.689), 5% (-2.9719), and 10% (-2.6251) critical values, respectively.

Maize production for food security (LNPMZ) and Unemployment (LNUNP) rate underwent

first difference and were found to be stationary, there p-values were (0.0000<0.05) and (0.0027<0.05) respectively as per Table 4.5.

Table 4. 6: Phillips-Perron Results at 1st Difference

Variables	Adj T-statistic	Prob	Critical Values			Conclusion
			1%	5%	10%	
DLNPMZ	-15.4354	0.0000	-3.6617	-2.9604	-2.6192	Stationary
DLNUNP	-6.6270	0.0027	-4.2967	-3.5684	-3.2183	Stationary

Source: (Author, 2024)

4.6: ARDL BOUNDS COINTEGRATION TEST

Given the mixed integrated order of the variable, the study employed the F-bound test (Tursoy and Faisal, 2018). The bounds test assessed whether a cointegrating equation existed among the variables. if the F-statistic surpasses the 5% critical value or the lower bound I(0) and upper bound I(1),in line with the criteria for the bounds cointegration test, the null hypothesis is rejected .This signifies the presence of cointegration and a sustained long-term relationship between the series (sam, Mcnown, and Goh ,2019). This indicates that the series are interconnected and can undergo a linear combination. Furthermore, it implies that if short–term disturbance impact a particular series, they will ultimately converge (Sam et al., 2019). As a result, the Vector Error Correction Model (VECM) or the autoregressive Distributed Lag (ARDL) model should be employed to estimate both short-run and long-run models.

According to Adom, Bekeo, and Akoena (2012), the null hypothesis is not rejected when the F-statistic is less than the corresponding 5% critical values of I(0) and I(1), showing the absence of a cointegration. As a result, the researcher should only estimate short-run relationships. Thus, the researcher can either adopt a vector autoregressive (VAR)Model or regression analysis.

Table 4.7, demonstrates that the f-statistic was below I(0) and I(1)'s critical values at 5%, which are 3.47 and 4.45, respectively. Therefore, the absence of a long-term link between the variables under consideration is shown by the researcher's failure to reject the null hypothesis at the 5% level of significance.

Table 4. 7: F-Bounds Cointegration Test

F-Bounds Test		**Null Hypothesis: No level relationship**		
Test statistic	value	Sign if	I(0)	I(1)
		Asympototic :n=1000		
F-statistic	2.665597	10%	3.47	4.45
K	3	5%	4.01	5.07
		2.5%	4.52	5.62
		1%	5.17	6.36
Actual Sample size	23	Finite sample :n=35		
		10%	3.8	4.888
		5%	4.568	5.795
		1%	6.38	7.73
		Finite Sample:n=30		
		10%	3.868	4.965
		5%	4.683	5.98
		1%	6.643	8.313

Source :Author ,2024

4.7: Multivariate Regression Analysis

The Bounds cointegration test displayed the absence of a long –term relationship among the variables being studied, prompting the researcher to resort to regression analysis to examine a potential short-term relationship regarding how the explanatory variables impact on Kenya's Maize Production for food security. To render the model feasible and capture dynamic effects, the lagged value of maize production for food security was incorporated as an independent variable. table 4.8 below displayed the outcome of the regression analysis.

Table 4.8: Regression Result

Dependent Variable: DLNPMZ Method: Least Squares
Sample (adjusted): 2 33
Included observation: 30 after adjustments:

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNINF	-0.153125	0.037106	-4.126669	0.0002
DLNUNP	-0.261843	0.107761	-2.429842	0.0036
LNGDP	0.136665	0.030573	4.470044	0.0001
C	14.66542	0.204282	71.78995	0.0000

R-squared	0.588279	Mean dependent var	14.87371
Adjusted R-squared	0.529234	S.D. dependent var	0.193732
S.E. of regression	0.146363	Akaike info criterion	-0.881888
Sum squared resid	0.356975	Schwarz criterion	-0.695062
Log likelihood	17.22832	Hannan-Quinn criter.	-0.822121
F-statistic	8.269651	Durbin-Watson stat	1.785930
Prob(F-statistic)	0.000500		

Source:Author,2024

The regression model was fit and statistically significant at the 5% level of significance, according to table 4.8, where the p-value for the F-statistic was 0.000500<0.5 and the measure of goodness of fit, R^2 was 0.588279. Furthermore, R^2 value of 0.588279 showed that the variance in regressor predicted 58.8279% of variance in the dependent variable. Therefore, other macroeconomic variables that were not captured in the study accounted for 41.1721% variance in Maize production in Kenya.

Prob F(0.000500) is less than 0.05 thus implying that the regression was statistically significant in showing the relationship between the independent variable (Inflaton, Unemployment and gross domestic product).and Maize Production in Kenya for food security. Additionally, all the independent variables (LNINF, LNUNP, and LNGDP) had a statistically significant effect on the Maize production for food security in Kenya.

The following is the regression equation obtained;

$LNPMZ_t=f(LNINF_t,LNUNP_t,LNGDP_t)$….....(i)

In expansion equation (i) becomes

$LNPMZ_t=B_0+B_1\ LNINF_t,+B_2\ LNUNP_t,+B_3LNGDP_t,+U_3$.....(ii)

$LNPMZ_t=14.66542-0.153125LNINF_t - 0.261843LNUNP_t, +0.136665LNGDP_t, +U_t$…(iii)

Where, $LNPMZ_t$ is the Maize Production for food security, B_0 is the intercept, $LNINF_t$ is the inflation, $LNUNP_t$ is the Unemployment rate , $LNGDP_t$ is the Gross Domestic Product and U_t is the stochastic term, t is the time,B_1,B_2 and B_3 are regression estimate parameters which represent the slopes of LNINF, LNUNP and LNGDP showing the changes in Maize

Production for food security in Kenya; LNPMZ when LNINF, LNUNP and LNGDP changes with one unit.

4.8 Results and Discussions

The primary objective of the study was to determine the effect of selected macroeconomic factors on Kenyan's maize production for food security from 1990 to 2022, with a particular focus on the influence of selected macroeconomic factors. The specific objectives of the study were as follows: To examine the effect of inflation on Kenya's maize production for food security. Additionally, it aims to establish the effects of unemployment on Kenya's maize production for food security and to assess the effect of gross domestic product on Kenya's maize production for food security.

The study incorporated three independent variables, namely inflation, Unemployment, and gross domestic product. 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 4.8. Based on the regression analysis findings, the model exhibited a probability value of 0.000500, which is below the conventional significance level of 0.05, indicating statistical significance at a 5% level. Based on the Durbin-Watson value of 1.785930 (Garson, 2012), it may be concluded that there is no presence of autocorrelation issue. The coefficient of determination (R^2) was found to be 0.588279, suggesting that the independent variables in the model explain about 58.8279% of the variability in the maize production performance in Kenya. The remaining 41.1721% of the variation is attributed to unaccounted factors that were not considered in this particular study.

4.8.1. The Effect of inflation on Kenya's maize production for food security.

The initial specific goal of the study was to examine the effect of inflation on Kenya's maize

production for food security. Based on the regression Results as shown in Tables 4.8, the

hypothesis that there is no significant effect of inflation on Kenya's maize production for food security. Inflation was discovered to be a macroeconomic factor affecting Kenya's maize production for food security with a p-value of 0.0002 < 0.05 showing that the coefficient is statistically significant and has a negative coefficient of -0.153125, implying that a one-percentage increase in inflation decreases the performance of Kenyan's maize production for food security by 15.31%, when all other factors are held constant.

The finding agree with Simatele (2016) the study applied Heckeman selection model to estimate price elasticities and used these to estimate effects of policies on the production of several food crops in Zambia. The study used a four year panel post-harvest data. Study noted that the continual increase in exchange rate may have had a negative effect on maize production.

Dercon and Krishnan (2019) agrees with the study .The study conducted in Zambia found that high inflation rates led to decrease in maize production due to increased production costs and reduced farmers 'purchasing power.

4.8.2. The effect of Unemployment on Kenya's Maize Production for food security.

The Determining the impact of unemployment on Kenya's maize production for food security was the study's second goal. This was achieved by stating in the study's second hypothesis that there is no statistically significant impact of unemployment on Kenya's output of maize for food security. Kenya's output of maize for food security was significantly and negatively impacted by unemployment. The t-statistics value of -2.429842 indicates that unemployment has a negative and significant impact on Kenya's maize production performance for food security, as per the regression results in Table 4.88 .The coefficient of Unemployment was -0.261843 implying that 1% increase in the Unemployment would lead to 26.18% decrease in the Maize production in Kenya.

Barret (2010) concurs with the study and says that availability, access, and usage are the three key ideas related to food security.Food availability: As previously noted, South Africa's unemployment rate is presently 25.2% (Taborda 2014).According to Altman and Ngandu (2010), household income will be lower and food insecurity will be higher the fewer jobs there are, or the higher the unemployment rate. Thus, employment levels affect food insecurity in households.

Altman and Ngandu (2022) discovered that if reliance is still placed on wage income, achieving household food security will still be difficult, even if unemployment is half. For this reason, they propose that more policy attention is required to ensure food security for low-income households. Despite the fact that everyone in South Africa has the constitutional right to food and water access (Act 108 of 1996), it is evident from the foregoing that the nation's policies are not succeeding in achieving food security at the household level.

4.8.3. Effect of Gross Domestic Product on Kenya’s maize production for food security.

The third goal of this study was to assess the effect of Gross Domestic Product on Kenya’s maize production for food security. From the findings, gross domestic product was established to positively influence Kenya’s maize production for food security. It was found that 1% increase in GDP increases Kenya’s maize production for food security by 13%.

This study’s finding agrees to the findings of Agboola (2018) who found out that food

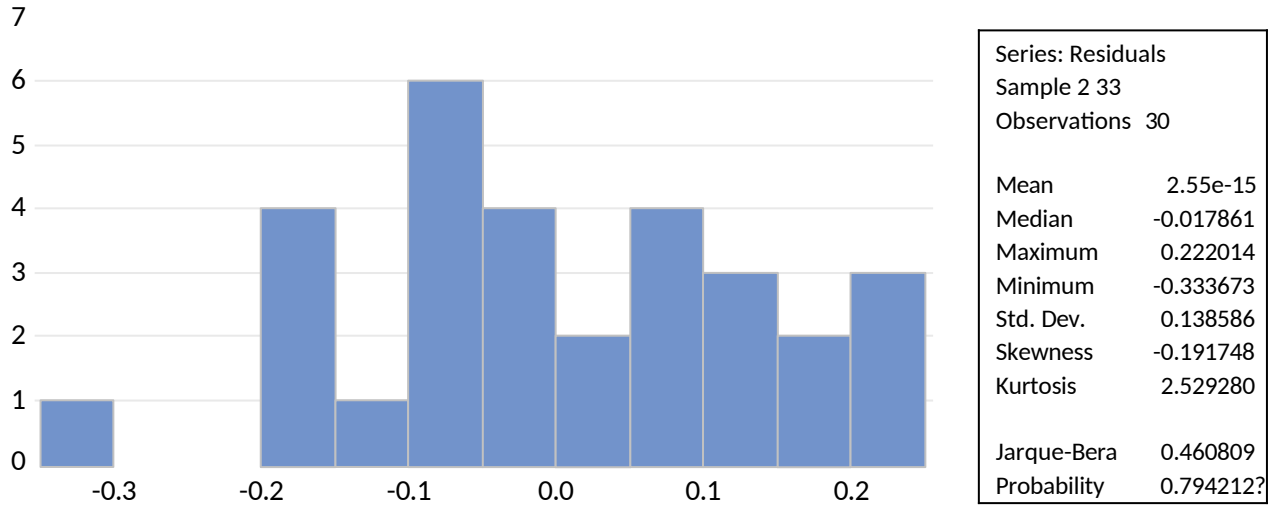
insecurity in African countries causes a reduction in growth in the long run. Using panel data for 128 nations' sought to establish how food security affects growth in SSA nations for time period 1970/74-2000/09. The results were achieved by means of carrying out a normal regression model to Timmer (2004) agrees that a There is a direct correlation between economic progress and food security. The author's attention has been drawn to the Asian viewpoint on food security, which views rice as the primary crop product. overall stabilization of food prices

by the Asian government generate economic growth as a long-term strategy for achieving food security and economic growth.

4.9 Post Estimation Diagnostic Tests

4.9.1. Normality Test

The Jarque-Berra test was applied in testing if the regression residual were distributed normally. The null hypothesis assumes residuals are distributed normally, p-value>0.05. The alternative hypothesis assumes that regression residuals do not fall under normal distribution, p-value<0.05. Figure 4.1 illustrates Jarque-Berra test output for no



0

Figure 4. 1: Jarque-Berra Tests for Normality

Source: (Author, 2024)

Figure 4.1's findings indicated normal distribution of the regression residuals were normally distributed because the Jarque-Berra p-value of 0.794212>0.05 (Aljandali and Tatahi, 2018).

4.9.2: Breusch -Godfrey Autocorrelation Test

The Breusch-Godfrey test was used in the study to examine the regression model for autocorrelation, which happens when the lagged values of the error term have an impact on the current values of the error term. The Breusch-Godfrey test's null hypothesis is that

autocorrelation does not exist in the regression model; H0: p-value>0.05; the alternative hypothesis is that autocorrelation does exist; H1: p-value<0.05. Table 4.9 displays the result for Breusch-Godfrey Test for autocorrelation.

Table 4. 9: Breusch- Godfrey Autocorrelation Test

Breusch- Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	5.581188	Prob.F(2,24)	0.7910
Obs*R-squared	9.523569	Prob.Chi-Square (2)	0.0565

Source: (Author, 2024)

Table 4.9's Breusch-Godfrey test findings show that the p-value for the Chi-square test was 0.0565>0.05, indicating that the researcher accepted the null hypothesis that the model had no autocorrelation.

4.9.3. Multicollinearity

Significant correlations between two or more predictor variables are usually the cause of multicollinearity. One utilizes the variance inflation factor to assess multicollinearity. When the variance inflation factor is greater than 10, multicollinearity is considered to exist. In Laurens (2018). Multicollinearity does not exist if the centered VIF value is less than 10.

Table 4.10: Test for Multicollinearity using Variance Inflation Factors

Sample: 1 33

Included observations: 30

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
LNINF	0.001759	12.34648	1.168876
DLNUNP	0.020700	41.10495	1.028177
LNGDP	0.000935	2.687085	1.17485
C	0.041731	58.44137	NA

Source: (Author, 2024)

Multicollinearity does not occur since all of the centered values of VIF in Table 4.10, the test results, were less than 10.

4.9.4. Heteroscedasticity

The Glejser test was employed in the present investigation to ascertain if the model's error components exhibited a constant variance. The absence of heteroscedasticity or homoscedasticity, which suggests that the variance is constant, is stated in the test's null hypothesis. In the event that the p-value exceeds 5%, the null hypothesis is maintained. Heteroscedasticity is a common occurrence when the variance of the error term varies over several values of the independent variable. result. Table 4.11 presents the findings.

Table 4.11: Breusch-Pagan-Godfrey Test for Heteroscedasticity

null hypothesis: Homoskedasticity

F-statistic	0.561218	Prob. F(3,36)	0.6454
Obs*R-squared	1.824529	Prob. Chi-Square(3)	0.6096
Scaled explained SS	1.047881	Prob. Chi-Square(3)	0.7897

Source: (Author, 2024)

Since the F-statistics probability in Table 4.11 was more than 0.05, the constant variance null hypothesis was upheld. Heteroscedasticity is thus absent. Thus, the existence of homoscedasticity is implied.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the finding from the preceding chapters. 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 selected macroeconomic factors on Kenya's maize production for food security. The Macroeconomic Variables employed in this study were; Inflation, Unemployment and Gross domestic product. 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.

Breusch-Godfrey serial correlation Langrage Multiplier test for residual autocorrelation showed absence of autocorrelation at the specified lag length of two, Breusch –Pagan - Godfrey 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 study found that Unemployment and Inflation had a negative and significant relationship on Kenya's maize production for food security and Gross Domestic product had a positive influence on Kenya's maize production for food security.

5.2.1 Effect of inflation on Kenya's Maize Production for Food Security.

The first aim of this study was majorly to determine the effect of inflation on Kenya's maize production for food security. From the findings, inflation reduces the Kenya's maize production for food security. This is clearly shown by the coefficient value of (-0.153125) 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 maize production and industrial sectors in developing and developed nations.

The findings concur with the findings of Simatele (2016) and Dercon and Krishnan (2019), who discovered a negative and significant linkage between inflation and Kenya;s maize production for food security.

5.2.2 Effect of Unemployment on Kenya's Maize Production for food security.

The study's second aim was to establish the effect of Unemployment on Kenya's maize production for food security. Unemployment on Kenya's Maize Production for food security. The results revealed that Unemployment and Kenya's Maize Production for food security have an inverse relationship, hence the null hypothesis is accepted .Unemployment causes a decrease in Kenya's maize production for food security. As shown by a negative and significant coefficient of (-0.261843) from the Regression model. This finding can be attributed to the fact that Unemployment and capital accumulation through an indirect channel can promote agricultural sector growth and hence spur economic growth.

5.2.3 Effect of Gross Domestic Product on Kenya's Maize Production for food security

The third goal of this study was to assess the effect of Gross Domestic Product (GDP) on Kenya's Maize production for food security. Gross Domestic Product on Kenya's Maize Production for food security. From the findings, Gross Domestic Product was established to

positively influence Maize Production in Kenya. And hence it was found that 1% increase in Gross Domestic Product increases Kenya's Maize Production for food security. Performance by 13.7%. Gross Domestic Product 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.

Timmer (2020) agrees that there are multiple calculated approaches to achieving food security. First, there is the economic growth rate and distribution, which is sometimes referred to as pro-poor growth. The general food price stability that Asian nations have implemented to foster economic growth is the first element of the food security plan. This is a long-term approach to achieve both food security and prosperity. The third tactic, domestic price stability, is more economically sound and will boost the effectiveness of the private marketing industry. expansion. The Asian culinary perspective has been the author's main focus. defense, Since rice is grown by small-scale farmers in Asia and is a staple food, it serves as the study's main crop commodity. Thirdly, because the world market for rice is thought to be unstable, Asian nations are taking precautions to shield their farmers and consumers from unstable world prices.

5.3 Conclusion

From the findings, there is a connection between Inflation, Unemployment and Gross domestic product on Kenya's Maize Production for food security. This shows that, throughout the time period under study, inflation exhibited a statistically significant

negative linkage with Kenya's Maize production for food security. Kenya, on the other hand, Unemployment also had a statistically significant negative linkage with Kenya's maize production for food security and Gross Domestic Product had a statistically significant

positive relationship with Kenya's Maize Production for food security. This therefore led to a conclusion that, Inflation, Unemployment and Gross Domestic Product have a statistically significant effect on Kenya's Maize Production for food security refuting the null hypothesis.

5.4 Recommendations

The study's findings revealed a statistically significant relationship between Kenya's maize production for food security and Inflation. Inflation was found to negatively and moderately lower the Kenya's Maize production for food security. 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 revealed that Unemployment has a negative effect on Kenya's maize production for food security. Unemployment leads to a reduction in the overall maize production in Kenya. The recommendation for Unemployment is that the government should allocate more budgetary resources to education sector and agricultural sector for awareness about the best way to get maize production levels increased. The government should also work on infrastructure such as roads, irrigation, storage spaces after post-harvest so that maize can remain in its fit condition.

The study shows that GDP had a significant positive effect on Kenya's maize production for food security. From these findings, the government should ensure that funds from national income are allocated efficiently and effectively to projects and initiatives that have a clear

positive impact on the maize production in Kenya. Such as fertilizer prices, infrastructure, technology and capacity building. The government should also improve rural infrastructure including storage facilities, road and energy supply to enhance productivity and reduce post-harvest losses.

Farmers Instead of using unpaid family labor and animal draught power, farmers should employ mechanical power, which is quicker and more effective. In order to apply the necessary amounts of fertilizer to boost maize yields, farmers need utilize government-subsidized fertilizer, which is less expensive than purchasing from commercial stores. In order to improve maize output and reduce the cost of growing maize, farmers should also employ dry planting and little tillage.

Since that they are more suited to absorb new technology than older individuals, young people should be encouraged to completely embrace maize farming. Furthermore, since farmers with either a university degree or a postgraduate degree more readily adopt new technologies than those with lower education levels, intentional efforts must be made by the national and county governments to entice people with these levels of education into the field of maize farming.

5.5 Suggestions for Further Research

The study focused on the Kenya's Maize production for food security. Therefore comparable research ought to be carried out 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, need to be included in future research to determine how each of them affect performance of Maize production in Kenya.

REFERENCE

Adepoju, A. A., Adenuga, G. O., & Ogundunmade, T. P. (2022). Regression Analysis and Spatial Distribution of Drought Indices on Maize Production in the Northern Part of Nigeria.

Adzima, A. F., Iswoyo, H., Jamil, M. H., & Pati, S. (2022). Normalized Difference Vegetation Index Analysis to Evaluate Corn Cultivation Technology Based on Farmer Participation. *Indonesian Journal of Geography*, *54*(2), 247-253..

Agboola, S., Ng, D., & Mills, D. (2005). Characterisation and functional properties of Australian rice protein isolates. *Journal of cereal science*, *41*(3), 283-290.

Aparicio, G., & Pinilla, V. (2019). International trade in wheat and other cereals and the collapse of the first wave of globalization, 1900–38. *Journal of Global History*, *14*(1), 44-67.

Asongu, S. A., Agboola, M. O., Alola, A. A., & Bekun, F. V. (2020). The criticality of growth, urbanization, electricity and fossil fuel consumption to environment sustainability in Africa. *Science of the Total Environment*, *712*, 136376.

Babama'aji, R. A., Shaba, H. A., Adepoju, M. O., Yusuf, M. J., Jantiku, J., Eshiet, R. C., ... & Nwodo, N. (2022). Mapping and Comparison of Maize Products Value Chains in Nigeria and Rwanda. *European Journal of Agriculture and Food Sciences*, *4*(3), 57-65.

Byerlee, D., & Heisey, P. W. (2019). Past and potential impacts of maize research in sub-Saharan Africa: a critical assessment. *Food Policy*, *21*(3), 255-277.

Chen, B., & Villoria, N. B. (2019). Climate shocks, food price stability and international trade: evidence from 76 maize markets in 27 net-importing countries. *Environmental*

Research Letters, *14*(1), 014007.

Chipili, J. M. (2021). Inflation Dynamics in Zambia-Research Report.

Dehghanisanij, H., Emami, S., Achite, M., Linh, N. T. T., & Pham, Q. B. (2021). Estimating yield and water productivity of tomato using a novel hybrid approach. *Water*, *13*(24), 3615.

Delgado, L., Nakasone, E., & Torero, M. (2021). *Impacts of market-based contractual arrangements with farmers in Guatemala and Honduras*. Intl Food Policy Res Inst.

Das, P. (2019). Econometrics in theory and practice. *Springer*, *10*, 978-981.

Erinle, K. O., Ogwu, M. C., Evivie, S. E., Zaheer, M. S., Ogunyemi, S. O., & Adeniran, S. O. (2021). Impacts of COVID-19 on agriculture and food security in developing countries: Potential mitigation strategies. *CABI Reviews*, (2021).

Ekananda, M. (2022). Role of macroeconomic determinants on the natural resource commodity prices: Indonesia futures volatility. *Resources Policy*, *78*, 102815.

Felicia, A. O. (2015). Economic Analysis of Maize Production in Osun State: A Case Study of Ilesa East and West of Osun State. *Economic Analysis*, *6*(9).

Filintas, A. (2021). Soil moisture depletion modelling using a TDR multi-sensor system, GIS, soil analyzes, precision agriculture and remote sensing on maize for improved irrigation-fertilization decisions. *Engineering Proceedings*, *9*(1), 36.

Faiz, M. A., Zhang, Y., Zhang, X., Ma, N., Aryal, S. K., Ha, T. T. V., ... & Naz, F. (2022). A composite drought index developed for detecting large-scale drought characteristics. *Journal of Hydrology*, *605*, 127308.

Falkendal, T., Otto, C., Schewe, J., Jägermeyr, J., Konar, M., Kummu, M., ... & Puma, M. J.

(2021). Grain export restrictions during COVID-19 risk food insecurity in many low- and middle-income countries. *Nature Food*, *2*(1), 11-14.

Firdaus, M., Kamello, T., & Saidin, O. K. (2021, June). Management of agricultural land to support sustainable agriculture in North Sumatra. In *IOP Conference Series: Earth and Environmental Science* (Vol. 782, No. 3, p. 032044). IOP Publishing.

Grote, U., Fasse, A., Nguyen, T. T., & Erenstein, O. (2021). Food security and the dynamics of wheat and maize value chains in Africa and Asia. *Frontiers in Sustainable Food Systems*, *4*, 617009.

Hanck, Christoph, Martin Arnold, Alexander Gerber, and Martin Schmelzer. "Introduction to Econometrics with R." *University of Duisburg-Essen* (2019): 1-9.

Huang, H., Han, Y., & Jia, D. (2019). Impact of climate change on the blue water footprint of agriculture on a regional scale. *Water Supply*, *19*(1), 52-5

Hasan, A. M., & Halid, A. (2021, June). Corn processed product development strategy in SMES industry in Gorontalo Province (Limboto Lake Flavour Shirmp Corn Stick at

SMES Barakati). In *IOP Conference Series: Earth and Environmental Science* (Vol. 782, No. 2, p. 022034). IOP Publishing.

Hepburn, J., Omari-Motsumi, K., Smaller, C., & Zoundi, Z. (2021). *How Could Trade Policy Better Address Food System Shocks?*. International Institute for Sustainable Development.

Jijin, P., Mishra, A. K., & Nithin, M. (2022). Macroeconomic determinants of remittances to India. *Economic Change and Restructuring*, *55*(2), 1229-1248.

Komarek, A. M., Koo, J., Haile, B., Msangi, S., & Azzarri, C. (2018). Trade-offs and synergies between yield, labor, profit, and risk in Malawian maize-based cropping systems. *Agronomy for sustainable development*, *38*, 1-10.

Liang, L., Qin, K., Jiang, S., Wang, X., & Shi, Y. (2021). Impact of Epidemic-Affected Labor Shortage on Food Safety: A Chinese Scenario Analysis Using the CGE Model. *Foods*, *10*(11), 2679.

Magnus, J. R., & Neudecker, H. (2019). *Matrix differential calculus with applications in statistics and econometrics*. John Wiley & Sons.

Moretti, L. G., Crusciol, C. A. C., Bossolani, J. W., Rossi, R., & Moreira, A. (2020). Agricultural repurposing of nickel slag residue. *Journal of Plant Nutrition*, *44*(8), 1141-1150.

Mousabeygi, F., Rezaei, Y., & Akhavan, S. (2021). Assessment of maize water status using a consumer-grade camera and thermal imagery. *Water Supply*, *21*(6), 2543-2552.

Muriuki, S. W., Mung'atu, J. K., & Waititu, A. G. (2018). Structural Vector Autoregressive (SVAR) Analysis of Maize Prices and Extreme Weather Shocks. *International Journal of Data Science and Analysis*, *4*(5), 79.

Murray-Tortarolo, G. N., Jaramillo, V. J., & Larsen, J. (2018). Food security and climate change: the case of rainfed maize production in Mexico. *Agricultural and Forest Meteorology*, *253*, 124-131.

Mujeyi, A., Mudhara, M., & Mutenje, M. (2021). The impact of climate smart agriculture on household welfare in smallholder integrated crop–livestock farming systems: evidence from Zimbabwe. *Agriculture & Food Security*, *10*(1), 1-15.

Njoroge, R., Otinga, A. N., Okalebo, J. R., Pepela, M., & Merckx, R. (2018). Maize (Zea mays L.) response to secondary and micronutrients for profitable N, P and K fertilizer use in poorly responsive soils. *Agronomy*, *8*(4), 49.

Nmadu, J., Yisa, E., Mohammed, U., Sallawu, H., Nmadu, Y., & Nmadu, S. (2022). Structural Analysis and Forecast of Nigerian Monthly Inflation Movement between 1996 and 2022. *STUDIES*.

Odongo, M. T., Misati, R. N., Kamau, A. W., & Kisingu, K. N. (2022). Climate Change and Inflation in Eastern and Southern Africa. *Sustainability*, *14*(22), 14764.

Ogunniyi, A. I., Omotoso, S. O., Salman, K. K., Omotayo, A. O., Olagunju, K. O., & Aremu, A. O. (2021). Socio-economic drivers of food security among rural households in Nigeria: Evidence from smallholder maize farmers. *Social Indicators Research*, *155*, 583-599.

Olujenyo, F. O. (2008). The determinants of agricultural production and profitability in Akoko Land, Ondo-State, Nigeria. *Journal of social Sciences*, *4*(1), 37-41.

Oseni, T. O., & Masarirambi, M. T. (2011). Effect of climate change on maize (Zea mays) production and food security in Swaziland. *change*, *2*(3).

Patil, J., Linga, V., Vijayakumar, R., Subaharan, K., Navik, O., Bakthavatsalam, N., ... &

Sekhar, J. (2022). Biocontrol potential of entomopathogenic nematodes for the sustainable management of Spodoptera frugiperda (Lepidoptera: Noctuidae) in maize. *Pest Management Science*, *78*(7), 2883-2895.

Peixoto, P., Martinho, V. J. P. D., & Mourao, P. (2022). Corruption and Inflation in Agricultural Production: The Problem of the Chicken and the Egg. *Economies*, *10*(11), 268.18

Salau, S. A. (2013). Determinants of technical inefficiency among maize-based farming households in Niger state. *Ethiopian Journal of Environmental Studies and Management*, *6*(5), 543-550.

Sassenrath, G. F., Lingenfelser, J., & Lin, X. (2023). Corn and Soybean Production–2022 Summary. *Kansas Agricultural Experiment Station Research Reports*, *9*(2), 10.

SEED, U. O. C. (2018). LEVELS OF CROP DIVERSITY IN. *Farmers, Gene Banks and Crop Breeding:: Economic Analyses of Diversity in Wheat, Maize, and Rice*, *16*, 217.

Shaheb, R. (2020). *A study on the effect of tyre inflation pressure on soil properties, growth and yield of maize and soybean in Central Illinois* (Doctoral dissertation, Harper Adams University).

Siyal, A. L., Hossain, A., Siyal, F. K., Jatt, T., & Iram, S. (2020). Use of Radioisotopes to Produce High Yielding Crops in Order to Increase Agricultural Production. 2022, 4, x.

Ten Berge, H. F., Hijbeek, R., Van Loon, M. P., Rurinda, J., Tesfaye, K., Zingore, S., ... & van Ittersum, M. K. (2019). Maize crop nutrient input requirements for food security in sub-Saharan Africa. *Global Food Security*, *23*, 9-21.

Tetteh, B., Baidoo, S. T., & Takyi, P. O. (2022). The effects of climate change on food

production in Ghana: evidence from Maki (2012) cointegration and frequency domain causality models. *Cogent Food & Agriculture*, *8*(1), 2111061.

Vos, R., Glauber, J., Hernández, M., & Laborde, D. (2022). 10. COVID-19 and food inflation scares. *2YEARS*, 64.

Weinzettel, J., & Pfister, S. (2019). International trade of global scarce water use in agriculture: Modeling on watershed level with monthly resolution. *Ecological economics*, *159*, 301-311.2

Wu, F., & Guclu, H. (2013). Global maize trade and food security: Implications from a social network model. *Risk analysis*, *33*(12), 2168-2178.

Wu, H., Jin, R., Liu, A., Jiang, S., & Chai, L. (2022). Savings and losses of scarce virtual water in the international trade of wheat, maize, and rice. *International Journal of Environmental Research and Public Health*, *19*(7), 4119.

APPENDIX I: APPROVAL OF PROPOSAL

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
Fax: 056-30153
E-mail: directordps@mmust.ac.ke
Website: www.mmust.ac.ke

P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

23rd August 2023

Shilwatso Husan
ECO/G/01-70012/20
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms Shilwatso

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled '***Effects of selected macro-Economic Factors on Kenyan's Maize Production for Food Security*** and appointed the following as supervisors:

1. Dr. Reuben Ruto - SOBE, MMUST
2. Dr. Edwin Simiyu - SOBE, MMUST

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

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

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

Yours Sincerely,

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

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

APPENDIX II: RESEARCH PERMIT

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **779901**

Date of Issue: **15/December/2023**

RESEARCH LICENSE

This is to Certify that Ms.. Husna Shilwatso Juma of Masinde Muliro University of Science and Technology, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Vihiga on the topic: EFFECTS OF SELECTED MACROECONOMIC FACTORS ON KENYAN'S MAIZE PRODUCTION FOR FOOD SECURITY for the period ending : 15/December/2024.

License No: **NACOSTI/P/23/31732**

779901

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

Research Permit

APPENDIX III: MAP OF KENYA

Figure 5.1: Map of Kenya

Table 4.12: Data collected for analysis from World Bank databases and Republic of Kenya Economic Survey and Food and Agriculture Organization.

YEAR	INF	UNP	GDP	PMZ
1990	17.78181		4.192051	2289600
1991	20.0845	3.276	1.438347	2400000
1992	27.33236	3.288	-0.79949	2430000
1993	45.97888	3.256	0.353197	2089000
1994	28.81439	3.21	2.632785	3060000
1995	1.554328	3.171	4.406217	2698863
1996	8.864087	3.156	4.146839	2160000
1997	11.36185	3.184	0.474902	2214000
1998	6.722437	3.131	3.290214	2464101
1999	5.742001	3.125	2.305389	2322140
2000	9.980025	3.128	0.599695	2160000
2001	5.738598	3.07	3.779906	2790000
2002	1.961308	3.09	0.54686	2408596
2003	9.815691	3.042	2.932476	2710848
2004	11.62404	2.997	5.1043	2607139
2005	10.31278	2.968	5.906666	2905559
2006	14.45373	2.942	6.472494	3247200
2007	9.75888	2.919	6.85073	2928793
2008	26.23982	2.976	0.232283	2367237
2009	9.234126	2.92	3.30694	2439000
2010	3.961389	2.846	8.058474	3464541
2011	14.02249	2.859	5.121106	3376862
2012	9.377767	2.844	4.56868	3749880
2013	5.717494	2.831	3.797848	3592688
2014	6.878155	2.796	5.020111	3513171
2015	6.582174	2.774	4.967721	3825000
2016	6.297158	2.76	4.213517	3339000
2017	8.005723	3.52	3.837958	3186000
2018	4.68982	4.245	5.647946	4013777
2019	5.23586	5.01	5.114159	3582000
2020	5.404815	5.616	-0.27277	3789000
2021	6.110909	5.644	7.590489	3303000
2022	7.656875	5.502	4.846635	3087000

Source: (World Bank database and Food and agriculture Organization, 2024)