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The Effect of External Debt on Food Security in the East African Community

Allan Wangai Njoroge:145834

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Allan Wangai Njoroge..... *[Name of Candidate]*

..... *[Signature]*

25th January 2025..... *[Date]*

This Research Project has been submitted for examination with my approval as the Supervisor.

Dr. Caroline Kariuki..... *[Name of Supervisor]*



..... *[Signature]*

23rd January 2025..... *[Date]*

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Contents

DECLARATION	I
List of Figures	IV
List of Tables	V
Abbreviations and Acronyms	VI
Abstract	VII
Chapter One: Introduction	- 1 -
1.1 Background of the Study	- 1 -
1.1.1 Food Security Globally	- 1 -
1.1.2 Food Security in the East African Community	- 1 -
1.1.3 External Debt and Food Security in the East African Community	- 2 -
1.2 Problem Statement	- 3 -
1.3 Research Objectives	- 4 -
1.4 Research Questions	- 5 -
1.5 Significance of the Study	- 5 -
Chapter Two: Literature Review	- 7 -
2.1 Introduction	- 7 -
2.2 Theoretical Review of External Debt and Food Security	- 7 -
2.2.1 Debt Overhang Theory	- 7 -
2.2.2 Sen's Entitlement Approach	- 8 -
2.2.3 Theoretical Pathways	- 10 -
2.3 Empirical Studies on External Debt and Food Security	- 10 -
2.3.1 Impacts of External Debt on Economic Growth in EAC	- 10 -
2.3.2 External Debt and Agricultural Productivity in the EAC	- 11 -
2.3.3 Potential Pathways Linking External Debt and Food Security in the EAC ...	- 12 -
2.4 Gaps in Literature.	- 13 -
2.5 Conceptual Framework	- 14 -
2.5.1 Variables of Interest	- 14 -
2.5.2 Conceptual Framework	- 15 -
Chapter Three: Research Methodology	- 17 -
3.1 Introduction	- 17 -

3.2 Research Design	- 17 -
3.3 Population and sampling.....	- 17 -
3.4 Data Collection	- 17 -
3.4.1 Sources of Data:	- 18 -
3.4.2 Time Period:	- 18 -
3.5 Data Analysis.....	- 18 -
3.5.1 Descriptive statistics	- 19 -
3.5.2 Stationarity Test	- 19 -
3.5.3 Multicollinearity Test.....	- 20 -
3.5.4 Heteroskedasticity Test	- 20 -
3.5.5 Model Specification	- 20 -
Chapter Four: Results and Analysis	- 23 -
4.1 Introduction	- 23 -
4.2 Summary Statistics	- 23 -
4.3 Diagnostic Checks.....	- 24 -
4.3.1 Stationarity Tests.....	- 24 -
4.3.2 Multicollinearity.....	- 25 -
4.3.3 Heteroskedasticity	- 26 -
4.4 Discussion of Results.....	- 27 -
4.4.1 Model Selection and Tests	- 27 -
4.4.2 Interpretation of Coefficients	- 29 -
Chapter Five: Discussions, Conclusions, and Recommendations	- 32 -
5.1 Introduction	- 32 -
5.2 Discussions	- 32 -
5.3 Conclusions	- 33 -
5.4 Recommendations.....	- 34 -
5.5 Limitations of the Study.....	- 35 -
5.6 Areas for Further Research	- 36 -
References.....	- 37 -

List of Figures

Figure 1: External Debt to GDP Ratio: World Development Indicators..... - 3 -

Figure 3: Conceptual Framework; Researcher Generated - 16 -



List of Tables

Table 1:Summary Statistics - 23 -

Table 2:Stationarity Table - 25 -

Table 3:VIF Table..... - 26 -

Table 4: Results Table - 28 -

Table 5:Maximum Debt Levels per Country..... - 29 -



Abbreviations and Acronyms

EAC	East African Community
FAO	Food and Agriculture Organisation
GDP	Gross Domestic Product
GFSI	Global Food Security Index
GNI	Gross National Income
IPS	Im, Pesaran and Shin
LLC	Levin-Lin-Chu
OLS	Ordinary Least Squares
VIF	Variance Inflation Indicators
SSA	Sub-Saharan Africa



Abstract

This study explores how external debt influences food security in the East African Community (EAC) using data from six member countries between 2012 and 2022. Anchored in the Global Food Security Index (GFSI) framework, the research investigates whether rising debt burdens undermine food security by reducing government resources available for agricultural investments and social programs. The analysis employs a pooled Ordinary Least Squares (OLS) model with robust standard errors to address data variability concerns. Findings reveal a significant negative relationship between external debt and food security, indicating that increasing debt levels strain national budgets and hinder essential investments in agriculture and infrastructure. Interestingly, higher agricultural output does not consistently improve food security, suggesting persistent inefficiencies in resource distribution and post-harvest management. Inflation, while complex, shows a short-term positive effect on food security, whereas population growth and Gross National Income (GNI) per capita exhibit weaker relationships with food security outcomes. The study concludes that prudent debt management, targeted agricultural reforms, and inflation control are critical for improving food security in the region. Policymakers are encouraged to focus on balancing debt sustainability with strategic investments in food systems. Future studies could benefit from exploring longer time horizons and incorporating diverse food security indicators to deepen insights into the intricate relationship between debt and food security.

Chapter One: Introduction

1.1 Background of the Study

1.1.1 Food Security Globally

Food security is an extensive concept that includes food availability, access, utilisation, and stability. It is essential to both social progress and human well-being. A thorough evaluation of this crucial topic is provided by the Global Food Security Index (GFSI), which gauges food security based on affordability, availability, quality, and resilience. The FAO defines food security as the state where everyone can obtain and afford enough safe and nutritious food to meet their dietary needs and preferences, enabling them to live an active and healthy life. (FAO, 2008). This fundamental human right, faces growing worldwide threat due to various challenges. These include climate change that alters weather patterns and may trigger disastrous events affecting crop production and leads to increased food prices, economic instability which disrupts food supply networks and decreases household incomes, leading to food scarcity and increased costs. Other issues like increased population increases food consumption, straining resources. Current trends show that food prices are growing as a result of climate change and supply chain disruptions, adding to overall food security instability. Despite technical and policy advancements in certain areas, the situation remains unstable.

1.1.2 Food Security in the East African Community

The East African Community (EAC), a regional organisation, is composed of eight states: the Democratic Republic of Congo, Kenya, Rwanda, Somalia, South Sudan, Uganda, and Tanzania. (EAC Overview, n.d.). The EAC's objective is to improve political, social, and economic integration among its member states. However, the region faces significant food security challenges. The EAC relies heavily on agriculture, a major employer and significant contributor to GDP. For instance, in Kenya, the agricultural sector contributes roughly 35% to GDP and 65% to foreign exchange earnings (Muinga et al., 2019). In Uganda, it contributes to approximately 24% of GDP and 50% of export earnings. In Tanzania, it contributes around 28% to GDP and employs 65% of the workforce.

Rwanda's agriculture sector contributes about 31% to GDP, while in Burundi, it is approximately 40% of GDP. South Sudan, despite its oil reserves, relies heavily on agriculture for sustenance, with the sector contributing about 15% to GDP. The DRC also heavily relies on agriculture, which employs 60% of its workforce and contributes about 20% to its GDP.

The East African Community (EAC) is concerned about food security mainly because of the rapidly rising population, effects of climate change being felt in many parts and lack of enough infrastructure. A lack of access to certain markets which has been exacerbated by this region's inability to produce and distribute food adequately further compounds these already existing problems in the case of marginalized communities. All this is worsened by the regions unstable economy that makes it difficult for people to access and afford food especially for those who are most at risk (Sang 2021). The Global Food Security Index (GFSI) continuously demonstrates these challenges through poor rankings in major areas like affordability, availability, quality, and resilience across EAC countries. Food prices that are high compared to income levels impact both Kenya and Uganda, meanwhile Tanzania and Rwanda grapple with inadequate infrastructure and market reach. Burundi and South Sudan rank extremely low in terms of food security in general due to economic and political instability. To improve food security in the East African Community, agricultural productivity enhancement, infrastructure investment, improved market access, and economic stability should be prioritized in being dealt with.

1.1.3 External Debt and Food Security in the East African Community

External debt, defined as the portion of a country's debt borrowed from foreign lenders (Fosu, 2016), presents a double-edged sword for the EAC. This is because though it has made it possible for countries to finance development projects and stimulate economic growth, excessive accumulation of debt and poor management can divert resources away from vital investments in agriculture. The debt service burden could reduce productivity as well as output in agriculture by reducing funding for infrastructure, research, and technology. The debt overhang theory suggests that excessive debt creates a disincentive for investment, further impeding economic growth and undermining food security efforts

(Myers, 1977). Findings have shown mixed results with some studies providing empirical evidence that public indebtedness is positively associated with higher economic growth rates when allocated to productive sectors while others stressing on the inverse relationship between elevated levels of debts and government spending and agricultural investment (Orinda et al., 2022; Babu et al., 2014)

With respect to the member countries of EAC, the debt to GDP ratio differs. Figure One below illustrates six out of the eight member countries foreign debt as a proportion of GDP from 2012 up to 2022. In most of these countries the trend is an increase in external debt with time. Therefore, addressing these challenges through prudent debt management and targeted investment within agriculture and infrastructure is key to improving food security and achieving sustainable economic growth in EAC

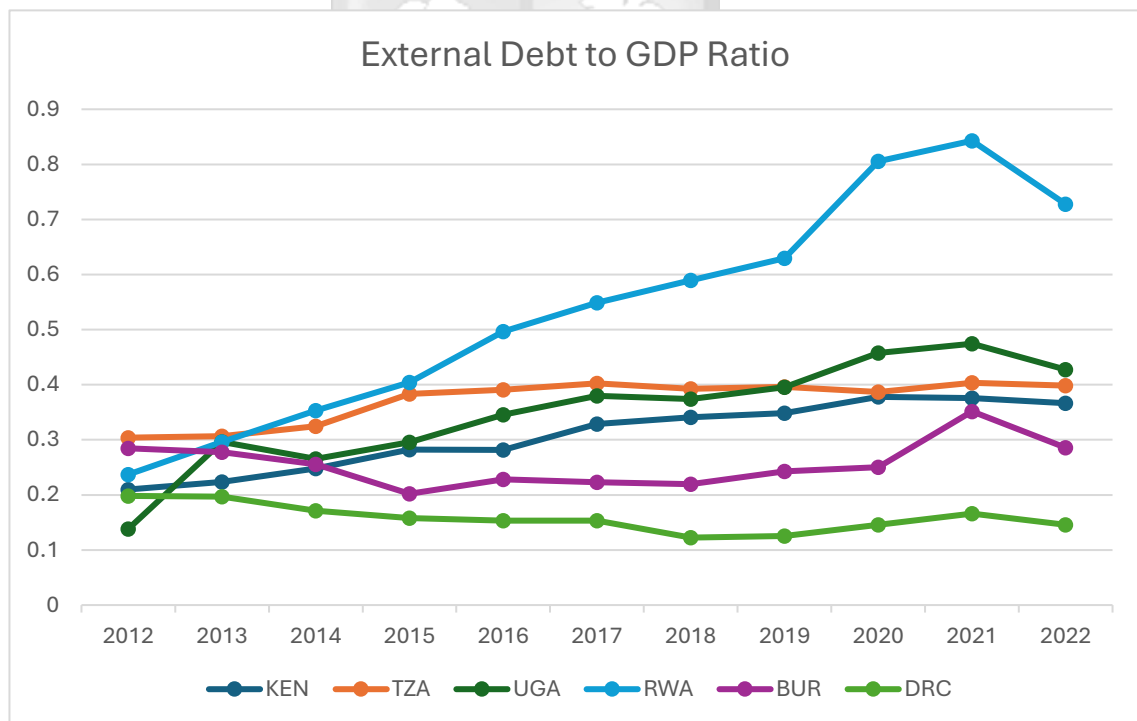


Figure 1: External Debt to GDP Ratio: World Development Indicators

1.2 Problem Statement

Food insecurity remains a significant challenge in the East African Community (EAC) despite its critical role in the region's economy. External debt exacerbates this issue by

diverting resources from essential agricultural investments, potentially leading to a debt overhang. The agricultural sector's ability to produce and distribute food is further strained by climate change, rapid population growth, and economic instability.

Existing literature presents a complex relationship between external debt and food security. Orinda et al. (2022) suggest that when managed effectively, external borrowing can stimulate economic growth and enhance food security. However, others argue that high levels of debt reduce government spending on agriculture. Babu et al. (2014) found a negative impact of foreign debt on per capita GDP growth in the EAC, raising concerns about its effects on food security. Otieno et al. (2022) highlighted that external debt often leads to capital flight, limiting resources for agriculture, thus worsening food insecurity. They also noted that debt can be beneficial if invested in productive sectors, but excessive borrowing hampers agricultural investments.

Machagua and Naikumi (2022) reported that Kenya's external debt has surpassed sustainable levels, threatening debt sustainability and crowding out private investment. Meanwhile, Olumo et al. (2023) indicated that targeted external debt investment in agriculture could enhance productivity and food security, emphasizing the importance of effective debt management.

Despite these findings, gaps remain in understanding the direct effects of foreign debt on food security within the EAC. There is a scarcity of comparative studies on debt and non-debt financing's impact on food security, and the sustainability of debt-financed agricultural programs requires further longitudinal research.

This study uses the Global Food Security Index (GFSI) to analyse the effects of foreign debt on food security in the EAC, aiming to unravel the complex relationship between debt and food security outcomes in the region.

1.3 Research Objectives

Overall Objective: To investigate the impact of external debt on food security in the East African Community (EAC) using the Global Food Security Index (GFSI) framework.

Specific Objectives:

1. To assess the overall impact of external debt on food security in the EAC.
2. Determine the maximum sustainable level of external debt that EAC countries can incur without adversely affecting food security.

1.4 Research Questions

1. How does external debt affect overall food security in the EAC as measured by the GFSI?
2. What is the maximum level of external debt EAC countries can sustain without negatively affecting food security?

1.5 Significance of the Study

The food security, a basic human right, is increasingly being threatened in East Africa community (EAC) by high population growth, climate change, economic instability and mounting external debts. This study investigates how external debt affects general food security in EAC and provides critical insights for effective policy making and practice. Understanding the relationship between debt and food security is crucial for sustainability.

This study offers evidence-based insights to policy makers on how to balance debt management with sustainable food security. Policymakers who understand the subtle ways that foreign debt impacts on food safety can produce strategies that ensure productive use of this liability rather than enhancing its defaults. It will thus be useful in developing policies that will mitigate famine related effects of borrowing and enhance system resilience against future shocks.

For governments within the EAC, these findings can inform national policies that address direct as well as indirect impacts of external debt on food security. In other words, this study will provide details how servicing of debts affect ability to invest in key sectors such as agriculture. This information is important in creating policies that prioritize hunger's calamity and secure rational use of borrowed money.

Development partners, including international NGOs and regional development agencies, will find this research valuable in designing programs that address food security challenges in the EAC. Insights into the relationship between external debt and food security will enable these partners to align their efforts with the region's economic realities, ensuring that their interventions are relevant and effective.

The IMF, World Bank, and other international financial institutions can leverage the study's findings to design debt relief or restructuring initiatives that prioritize food security and agricultural development. By comprehending the specific impacts of external debt on food security in the EAC, these institutions can tailor their support to enhance the region's capacity to manage debt sustainably while ensuring food security for its population.

This study addresses a significant gap in academic literature by conducting a comprehensive examination of the consequences of foreign debt on food security using the Global Food Security Index (GFSI) methodology. Researchers can build on this study to further explore the intricate relationships between debt, economic policies, and food security outcomes, thereby advancing the field and informing future policy and practice.

In conclusion, this study addresses the critical issue of external debt and its impact on food security in the EAC. By providing a detailed analysis of their relationship, it aims to offer valuable insights for evidence-based decision-making, supporting a more secure food future for the region. The findings will have practical implications for a wide range of stakeholders, ensuring that efforts to manage debt and enhance food security are grounded in robust empirical evidence.

Chapter Two: Literature Review

2.1 Introduction

This chapter investigates the complex relationship between external debt and food security within the East African Community (EAC). Drawing upon both theoretical frameworks and empirical evidence, we examine the multifaceted channels through which external debt can impact food security in the region. By analysing existing literature, this chapter identifies key research gaps and outlines the conceptual framework that guides this study's exploration of the external debt-food security nexus in the EAC context.

2.2 Theoretical Review of External Debt and Food Security

2.2.1 Debt Overhang Theory

The debt overhang theory, pioneered by Stewart C. Myers (1977), posits that when a country's external debt reaches a critical level, it can create a significant disincentive for new investment. This is primarily due to the burden of debt servicing, which consumes a substantial portion of a country's revenue and resources, leaving little available for investment in new projects or economic development. In essence, the more a country owes, the more it must allocate towards debt repayment, leaving less for productive investments.

This situation creates a "debt overhang" effect, where potential investors perceive that the returns from their investments are likely to be used primarily to service existing debt, rather than to generate profits for themselves. This reduces the incentive for new investment, as investors are less likely to put their capital at risk in a country where the potential returns are diminished by debt obligations.

The debt overhang theory suggests that elevated levels of external debt can lead to a vicious cycle. As debt servicing costs rise, investment falls, leading to slower economic growth and reduced capacity to repay debts. This can further increase the debt burden, exacerbating the disincentive for investment and perpetuating a state of economic

stagnation. The theory is particularly relevant for developing countries, which often have prominent levels of external debt. The burden of debt servicing can hinder their ability to invest in critical areas such as infrastructure, education, and healthcare, further impeding their development prospects.

Understanding the connection between foreign debt, debt servicing, and investment is crucial for policymakers. By comprehending the debt overhang theory, they can develop strategies to manage debt levels and mitigate the negative impacts of debt overhang on investment and economic growth. In the East African Community (EAC), high external debt levels could create a debt overhang, limiting investments in agricultural infrastructure, research, and technology. This could negatively impact agricultural productivity and food production, contributing to food insecurity. Indeed, evidence suggests that debt overhang could be a potential problem for EAC member countries.

Machagua and Naikumi (2022) highlight that Kenya's external debt has surpassed the IMF and World Bank's recommended threshold, raising concerns about debt sustainability and the potential for crowding out of private investment. While Orinda et al. (2022) found a positive and substantial association between public borrowing and economic progress in the EAC, they acknowledge that over-borrowing and unproductive debt utilization can negatively impact economic growth, potentially leading to a debt overhang scenario. Additionally, Otieno et al. (2021) identified a positive and substantial link between foreign debt and capital flight in EAC countries, suggesting that a significant portion of borrowed funds is being siphoned off, further exacerbating the debt burden, and limiting resources available for investment in critical sectors like agriculture.

2.2.2 Sen's Entitlement Approach

Amartya Sen's entitlement approach revolutionized the comprehension of famine by shifting the focus from food availability to food entitlement (Sen, 1981). He argued that famines are not solely caused by a lack of food but by the inability of individuals or groups to access food through entitlements. Entitlements refer to the collection of various product bundles that an individual can acquire in a civilization based on the full range of their rights and possibilities. These entitlements are acquired through various means, including

trade-based entitlements, which involve one's endowment, what one owns, and the ability to acquire goods through exchange using that endowment via production and trade. Additionally, production-based entitlements reflect an individual's capacity to produce food for themselves, such as through farming. Own-labour entitlements refer to income earned through labour, which can subsequently be used to purchase food. Lastly, inheritance and transfer entitlements cover food obtained through gifts, inheritance, or state-provided social security. Together, these mechanisms determine the range of resources and opportunities available to individuals in society.

Sen argued that famines can occur even when there is sufficient food available overall. This can happen if certain groups lose their entitlements due to factors such as unemployment, crop failure, natural disasters, or rising food prices. For example, a group of farmers may experience famine if a drought destroys their crops, leaving them without the means to produce or purchase food. Sen's entitlement approach has important implications for famine prevention and relief. It highlights the need to focus not only on increasing food production but also on protecting and strengthening the entitlements of vulnerable populations. This can be done through policies such as social safety nets, employment programs, price controls, and disaster preparedness measures.

Amartya Sen's entitlement approach offers a valuable theoretical lens for examining the multifaceted relationship between external debt and food security. High external debt burdens can strain government budgets, leading to reduced public spending in crucial areas that directly impact food entitlements. This can manifest as cutbacks in essential social safety nets like food stamps and cash transfers, leaving vulnerable populations more susceptible to food price shocks and income fluctuations. Additionally, reduced government spending can hinder agricultural investment, leading to decreased productivity and food availability. To manage external debt, governments often resort to austerity measures, such as cutting subsidies and raising taxes, which can drive up food prices and further erode the purchasing power of individuals and households. Moreover, reduced public spending can negatively impact public health and education systems, exacerbating vulnerability to food insecurity.

Sen's framework highlights the indirect channels through which external debt can undermine food entitlements, beyond the direct effects of reduced food availability. By focusing on the impact of external debt on government policies and social programs, further studies can provide a deeper and more detailed comprehension of the ways in which debt burdens impact the state of food security. Furthermore, Sen's approach underscores the importance of considering the distributional impacts of external debt, as vulnerable populations are likely to be disproportionately affected by debt-induced reductions in public spending. Research illuminating these distributional effects can inform policies aimed at mitigating the negative consequences of external debt on food security. Incorporating Sen's entitlement approach into research on the link between external debt and food security can thus provide a comprehensive framework for analysis, leading to a more holistic understanding of the issue and informing policy interventions aimed at promoting food security in the face of debt challenges.

2.2.3 Theoretical Pathways

The research will investigate the conceptual frameworks that explain how external debt can impact food security within the EAC. One significant pathway is reduced government spending; high debt burdens may lead to decreased government expenditure on agriculture, social safety nets, and other programs critical for supporting food security. Another pathway involves decreased investment, as debt overhang can discourage investment in the agricultural sector, thereby hindering productivity and output. Additionally, high external debt can increase vulnerability to economic shocks and climate change, both of which can disrupt food production and distribution systems. The research aims to offer a thorough understanding of the intricate connection between external debt and food security in the EAC by analysing these pathways.

2.3 Empirical Studies on External Debt and Food Security

2.3.1 Impacts of External Debt on Economic Growth in EAC

The connection between external debt and economic growth in Sub-Saharan Africa has been widely discussed, with varying research findings. Previous research, like that by

Iyoha (1999) and Fosu (1999), suggested a negative correlation, potentially due to reduced investment and negative impacts on food security.

More recent research has challenged this view, with some studies finding a positive relationship between external debt and economic growth when debt is used for productive investments. For example, Orinda et al. (2022) found that public debt positively and significantly influences economic growth in the East African Community (EAC), a subregion of SSA. However, this positive effect is contingent on debt being used for productive investments, and other studies have found negative or insignificant effects when debt is not used effectively. For instance, Jama (2021) found that external debt had a negative and insignificant effect on economic growth in the EAC.

2.3.2 External Debt and Agricultural Productivity in the EAC

Within the EAC, the impact of external debt on agricultural productivity has shown varying results. Babu et al. (2014) found a significant negative effect of external debt on the per capita GDP growth rate in the EAC from 1970 to 2010, raising concerns about potential adverse effects on food security. The study employed a panel fixed-effects model, using annual data from 1970 to 2010 and the Solow growth model augmented for debt. Rigorous econometric tests, including the Levin-Lin-Chu test for unit roots and the Hausman specification test, confirmed the reliability of the findings. These results highlight the negative implications of high external debt on economic growth and agricultural productivity in the EAC. However, Orinda et al. (2022) found a positive and significant influence of public debt on economic growth in the EAC from 2002 to 2020, suggesting that debt can be beneficial when invested in productive sectors, such as agriculture. The study utilized a longitudinal research design and applied an Autoregressive Distribution Lag model for the analysis. Data were collected from six EAC countries, although South Sudan and Burundi were excluded due to data limitations. The findings showed that existing public debt has a beneficial impact on economic development, emphasising the necessity of smart investment in productive industries.

However, Olumo et al. (2023) focused specifically on the agricultural sector in Kenya from 2012 to 2020 and found a significant positive effect of external debt on agricultural

sector performance, suggesting that targeted investment of external debt in agriculture can boost productivity and potentially improve food security. The study used a correlational research methodology and multiple regression analysis to investigate the link between foreign debt and agriculture sector performance. Time series data has been collected from the World Development Indicators and Statista databases. An analysis revealed a statistically significant positive relationship, indicating that an increase in external debt led to improved performance in the agricultural sector.

2.3.3 Potential Pathways Linking External Debt and Food Security in the EAC

The exact ways external debt impacts food security in the East African Community are still complicated and need more research. Maduekwe et al. (2022) looked at non-debt agriculture funding in Nigeria from 1960 to 2017 and found it didn't increase domestic agriculture investment enough to improve food security, emphasizing the need to consider the type and quality of funding. They used annual time series data, ensuring stationarity with Augmented Dickey-Fuller and Phillips-Perron tests. The model was estimated using fully modified ordinary least squares, canonical cointegrating regression, dynamic ordinary least squares, and autoregressive distributed lag methods for robustness. The results showed no long-term connection between non-debt agriculture funding and food security, suggesting that appropriate and targeted investment is key to improving agricultural productivity and food security.

On the other hand, Otieno et al. (2022) used panel data covering the years 1988 to 2018 to investigate the impact of mounting foreign debt on capital flight in East African nations. They discovered that capital flight was positively and significantly impacted by external debt, indicating that a sizeable portion of borrowed money is taken advantage of by political elites and sent elsewhere. The World Bank and Statistical Abstract reports provided secondary data for the fixed-effects regression model used in the study. The findings showed that there is a 0.35% rise in capital flight for every 1% increase in foreign debt. Because there will be less local investment and resources available for agricultural growth, this capital flight may worsen the situation of food insecurity.

Manikas et al. (2023) conducted a systematic literature review of food security indicators, emphasizing the need for more research on how external debt affects food utilization and stability in the EAC, as most studies focus on food access. They highlighted the importance of using complementary food security indicators to capture the multidimensional nature of food security. The study involved identifying commonly used indicators, characterizing them based on dimensions, methods, and data requirements, and then conducting a systematic review using bibliographic databases. This approach ensured a comprehensive and robust analysis of food security indicators, aiding stakeholders in policy interventions and evaluations. For instance, Sang (2021) used panel data analysis to model food security in Africa and found that increases in agricultural exports and GDP per capita increased food security, while increases in food aid reduced food security in the long run.

2.4 Gaps in Literature.

While recent studies like Olumo et al. (2023) have explored the relationship between external debt and agricultural sector performance in Kenya, the direct implications of foreign debt on crucial food security dimensions—food availability, access, and stability—remain insufficiently addressed. This study aims to fill this gap by directly examining the effects of external debt on these specific food security parameters.

Furthermore, there is a notable absence of comparative studies that analyse the effects of debt and non-debt financing on food security within the same framework. Such comparisons could provide valuable insights into the optimal financing structures for agricultural growth and food security. Maduekwe et al. (2022) examined non-debt agriculture financing in Nigeria, but their study did not directly compare it with debt financing.

Additionally, the sustainability of debt-financed agricultural programs is not well understood due to the lack of longitudinal studies tracing the long-term effects of foreign debt on food security. While Orinda et al. (2022) examined the relationship between public debt and economic growth in the EAC over a substantial period, their study did not

specifically focus on the long-term impacts on food security. This research aims to address this gap by adopting a longitudinal approach to assess the sustainability of debt-financed agricultural programs.

Finally, the existing literature, such as Otieno et al. (2022), has highlighted the issue of capital flight in the context of external debt in East Africa. However, the specific implications of capital flight for food security, particularly in terms of reduced domestic investment and resource availability for agricultural development, have not been adequately explored. This study aims to address this gap by examining the link between capital flight and food security outcomes.

By addressing these gaps, this research aims to provide policymakers with a more comprehensive understanding of the complex relationship between external debt, financing structures, and food security in the EAC. This will enable the development of more effective and sustainable agricultural policies and interventions.

2.5 Conceptual Framework

2.5.1 Variables of Interest

This study examines the following variables:

- **External Debt (Main Independent Variable):** The primary factor being studied for its impact on food security.
- **Global Food Security Index (GFSI) (Dependent Variable):** The outcome of interest, which reflects food security through various scopes such as access, utilization, availability, and stability.

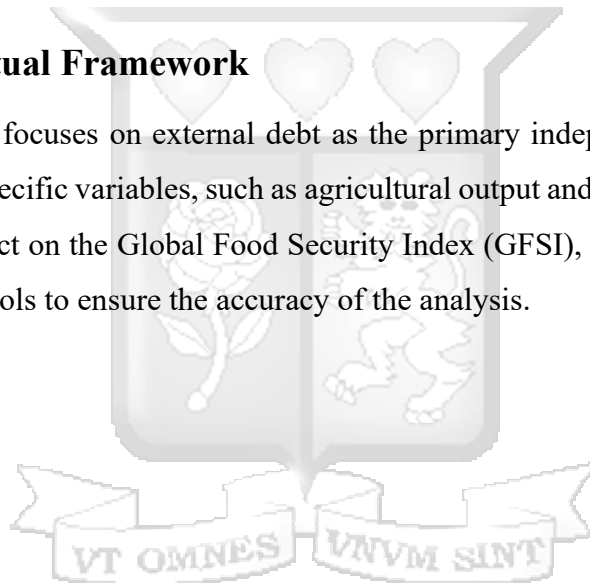
In this study, the control variables of interest and their impact on different dimensions of food security include:

1. **Agricultural Output (Availability):** Agricultural output directly affects the availability dimension of the Global Food Security Index (GFSI). Higher agricultural production increases the food supply, leading to lower food prices and improved access, thereby enhancing food security.

2. **Inflation (Access):** Inflation influences the access dimension of food security by impacting food prices. High inflation erodes purchasing power, making food less affordable and reducing access to food, which negatively impacts food security.
3. **Population Growth (Stability):** Population growth can affect the stability dimension of food security by increasing food demand, which might strain food supply systems and impact long-term food security.
4. **GNI per Capita PPP (Utilization and Access):** GNI per Capita PPP reflects a country's economic health and average income, adjusted for cost of living and inflation. Higher GNI per capita can improve access to food and enhance the utilization dimension of food security by enabling better nutrition and food quality.

2.5.2 Conceptual Framework

This framework focuses on external debt as the primary independent variable affecting food security. Specific variables, such as agricultural output and inflation, are analysed for their direct impact on the Global Food Security Index (GFSI), while other variables may function as controls to ensure the accuracy of the analysis.



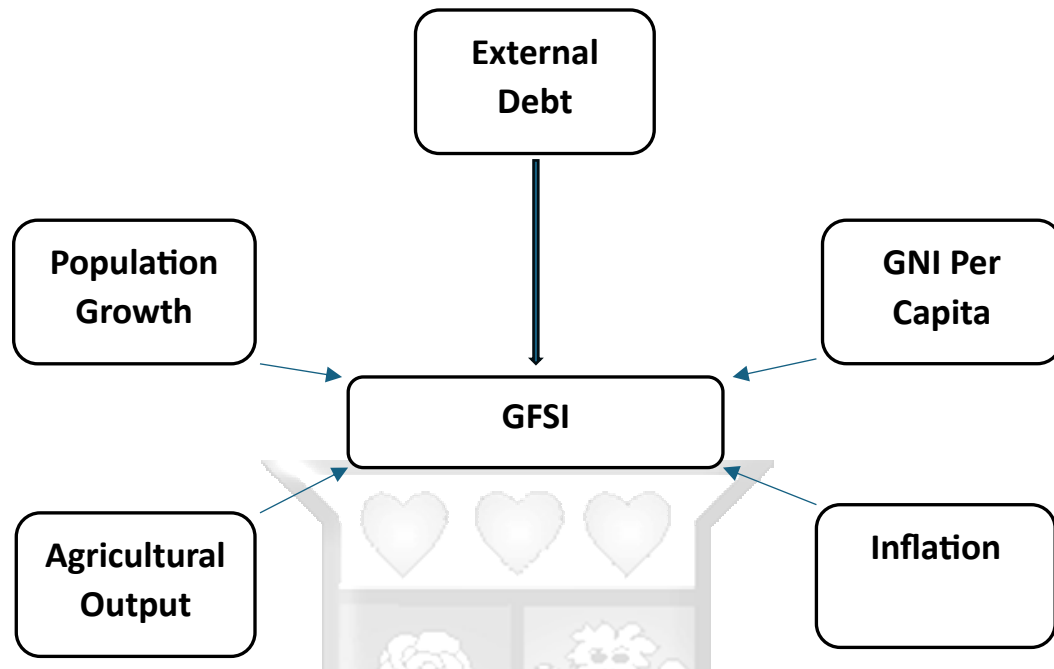


Figure 2: Conceptual Framework; Researcher Generated

This study anticipates identifying a negative correlation between foreign debt and food security within the East African Community (EAC). Higher levels of external debt are expected to correspond to lower scores on the Global Food Security Index (GFSI), indicating reduced food security. This negative relationship is hypothesized due to the financial strain high external debt places on government resources, potentially leading to decreased investment in critical areas that support food security.

Chapter Three: Research Methodology

3.1 Introduction

This chapter presents the research methodology employed to examine the influence of external debt on food security within six East African Community (EAC) nations: Rwanda, Burundi, Democratic Republic of Congo (DRC), Uganda, Tanzania, and Kenya. It elaborates on the research design, data collection procedures, and the statistical tools utilized for data analysis, ensuring the validity and dependability of the findings.

3.2 Research Design

The study adopts an explanatory research design to analyse the relationship between external debt and food security. An explanatory research design is a type of research aimed at exploring the relationships between variables and understanding the cause-and-effect dynamics within a specific context. This design is appropriate as it allows for the examination of cause-and-effect relationships between the dependent and independent variables, using panel data from multiple countries over a specified period. The explanatory design is suitable for understanding how external debt influences food security by affecting various economic and agricultural factors.

3.3 Population and sampling

The study population includes all member states of the EAC. For the purpose of this research, a sample of six out of eight EAC member countries has been chosen. South Sudan and Somalia were not included due to insufficient data availability. The remaining countries, Rwanda, Burundi, Democratic Republic of Congo (DRC), Uganda, Tanzania, and Kenya constitute the sample. This selection is considered representative for addressing the research objectives, as it encompasses a wide range of economic profiles within the EAC, except for South Sudan and Somalia due to data limitations.

3.4 Data Collection

To effectively analyse the relationship between external debt and food security, it is essential to gather data on several key variables. These variables encompass economic, agricultural, and demographic indicators that are crucial for a comprehensive analysis.

The following sections outline the sources and time period for data collection, as well as the specific variables used in the study

3.4.1 Sources of Data:

- **Global Food Security Index (GFSI):** Data sourced from The Economist. The GFSI provides a comprehensive measure of food security based on affordability, availability, quality, and safety.
- **Agricultural Output:** Data sourced from the Food and Agriculture Organization (FAO). Agricultural output data is crucial for understanding the role of domestic food production in ensuring food security.
- **Other Variables (e.g., External Debt, Inflation, GNI per capita PPP, Population Growth):** Data sourced from the World Development Indicators dataset. These variables provide critical economic indicators necessary for the analysis.

3.4.2 Time Period:

The data covers the period from 2012 to 2022, providing a ten-year span to capture trends and variations in food security and economic indicators. The time period from 2012 to 2022 was chosen primarily due to the availability of data for key variables. Specifically, the GFSI, the dependent variable, only had data available starting from 2012. This limitation inherently restricted the analysis to this time frame, ensuring that the study could utilize complete and consistent data sets. By aligning the study period with the availability of the GFSI data, the analysis aimed to maintain integrity and relevance, thereby providing accurate and meaningful insights into the relationship between food security and other influencing factors.

3.5 Data Analysis

In the data analysis phase, descriptive statistics are employed to offer a thorough understanding of the data's central tendencies, variability, and distribution. Subsequently, pre-estimation diagnostics, including multicollinearity tests to confirm the absence of high correlations among predictor variables and unit root tests to assess the stationarity of the time series data, is implemented. Post-estimation diagnostics, such as homoskedasticity

tests, are conducted to verify the constancy of error variance across observations. Upon the completion of these preliminary analyses, the suitable econometric model is specified and utilized to investigate the relationship between the variables of interest.

3.5.1 Descriptive statistics

The dataset for this study includes 66 observations per variable, providing a robust foundation for analysis. To understand the characteristics and distribution of the data, several descriptive statistics are computed, including the mean, standard deviation, minimum, and maximum values for each variable. Key variables of interest include the Global Food Security Index (GFSI), the natural logarithm of agricultural output, external debt-to-GDP ratio, population growth and external debt service-to-exports ratio. Descriptive statistics for these variables reveal their central tendencies and variabilities, offering insights into the data's overall structure. Inflation, external debt, GDP at current US dollars, and GNI at current US dollars are also analysed to assess their typical values and the extent of their fluctuations over the period covered by the dataset. Special attention is given to the variable 'external debt squared' due to its potential for significant variance, as well as the natural logarithm of GNI per capita to understand income distribution patterns. The dataset spans the years 2012 to 2022, capturing a decade of economic data across six countries. This temporal and cross-sectional scope is examined to ensure the dataset's comprehensiveness and to validate its suitability for the planned econometric analyses. Descriptive statistics help to identify any potential outliers or data issues that might need to be addressed before proceeding with more complex analyses.

3.5.2 Stationarity Test

Stationarity tests determine whether the panel data variables are stationary or contain unit roots. Stationarity implies that the statistical properties of the variables, such as mean and variance, remain constant over time, which is essential to avoid spurious regression results. The Levin, Lin & Chu (LLC) test was employed for this purpose. This test was selected over other available tests, such as the test Fisher-type tests and the Im, Pesaran and Shin (IPS) test, due to its robustness and suitability for strongly balanced panels, a characteristic of the dataset used in this study. The LLC test's baseline assumption is that all time series within the dataset exhibit a unit root, implying non-stationarity. Conversely,

the alternative proposition contends that a portion of these series demonstrates stationarity, lacking a unit root

3.5.3 Multicollinearity Test

Multicollinearity assessments are conducted to verify if the independent variables included in the regression model exhibit strong correlations with one another. The presence of substantial multicollinearity can lead to an increase in the standard errors associated with the coefficient estimates, thereby complicating the process of precisely determining the individual impact of each variable on the dependent variable. Variance Inflation Factors (VIF) were used to detect multicollinearity. This method was chosen due to its widespread acceptance and straightforward application. Other methods, such as the condition index and eigenvalue analysis, were considered, but VIF was deemed the most appropriate for this study. A threshold of VIF values below five was set to indicate no significant multicollinearity.

3.5.4 Heteroskedasticity Test

Heteroskedasticity tests are employed to ascertain whether the variance of the residuals (errors) within the regression model maintains a constant level across all observations in the dataset. Heteroskedasticity can lead to inefficient estimates and incorrect inferences if not properly addressed. The Breusch-Pagan test was utilized for this purpose, chosen for its simplicity and effectiveness in detecting non-constant variance in panel data. The null hypothesis of the Breusch-Pagan test assumes homoskedasticity, where the variance of the errors is constant, while the alternative hypothesis suggests heteroskedasticity, indicating non-constant variance.

3.5.5 Model Specification

To select the appropriate model among the fixed effects model, random effects model, and pooled OLS model, a systematic approach involving three key tests is employed.

Initially, the Hausman test is employed to discern the more suitable model between the fixed effects model and the random effects model. This test evaluates whether the unobserved individual-specific effects (represented by μ_i) exhibit correlation with the explanatory variables. If the test reveals a correlation, the fixed effects model is deemed

more appropriate. Conversely, if no correlation is detected, the random effects model is favoured.

Subsequently, the F-test is implemented to compare the fixed effects model with the pooled ordinary least squares (OLS) model. This test aims to ascertain whether significant individual-specific effects exist that the fixed effects model can effectively capture, whereas the pooled OLS model cannot. If the null hypothesis of the F-test is rejected, it signifies that the fixed effects model is superior due to its ability to account for these individual-specific effects.

Furthermore, the Breusch-Pagan Lagrange multiplier (LM) test is utilized to compare the random effects model with the pooled OLS model. This test evaluates whether the random effects model offers a superior fit by incorporating the variance across entities, which the pooled OLS model fails to capture. If the null hypothesis of the Breusch-Pagan LM test is rejected, it suggests that the random effects model is the preferred choice.

In conclusion, the model selection procedure involves systematically conducting the Hausman test, the F-test, and the Breusch-Pagan LM test to compare the fixed effects model, the random effects model, and the pooled OLS model. The outcomes of these tests guide the selection of the most suitable model for the analysis.

Model Equation: The model used in this study is specified as follows:

$$GFSI_{it} = \beta_0 + \beta_1 \ln_ExternalDebt_{it} + \beta_2 \ln_ExternalDebt_{it}^2 + \beta_3 Inflation_{it} + \beta_4 \ln_AgriculturalOutput_{it} + \beta_5 \ln_GNIpercapitaPPP_{it} + \beta_6 Populationgrowth_{it} + u_i + \varepsilon_{it}$$

Where:

GFSI_{it} refers to Global Food Security Index for nation *i* at time *t*. *ln_ExternalDebt_{it}* refers to natural logarithm of external debt for nation *i* at time *t*. *Inflation_{it}* refers to inflation rate for nation *i* at time *t*. *ln_AgriculturalOutput_{it}* is the natural logarithm of agricultural output for country *i* at time *t*. *ln_GNIpercapitaPPP_{it}* refers to the natural logarithm of GNI per capita PPP for state *i* at time *t*. *Populationgrowth_{it}*

refers to annual population growth for nation i at time t . u_i refers to the unobserved country-specific effect. ε_{it} is the idiosyncratic error term.



Chapter Four: Results and Analysis

4.1 Introduction

This chapter presents the analysis of the impact of external debt on food security in the East African Community (EAC). Using panel data from 2012 to 2022, it includes descriptive statistics, diagnostic checks, and the estimation results from the final pooled OLS model, chosen after carrying out various tests.

4.2 Summary Statistics

The summary statistics provide an overview of the key variables in the study, including the Global Food Security Index (GFSI), external debt, and agricultural output. Table 1 presents the mean, standard deviation, minimum, and maximum values for the main variables.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
GFSI	44.80	4.39	32.80	53.40
Inflation	0.07	0.05	-0.03	0.19
External Debt (US\$)	1.22e+10	1.07e+10	5.86e+08	4.16e+10
GNI per Capita (PPP US\$)	2,129.09	1,212.83	620.00	5,810.00
Agricultural Output (tonnes)	3.909e+06	3.453e+06	2.369e+05	1.28e+07
Population Growth (%)	0.03	0.01	0.02	0.04

The descriptive statistics reveal the characteristics of the variables under study, providing insights into the data's central tendencies and variability across the observed countries. The average Global Food Security Index (GFSI) is 44.8, indicating a moderate level of food security, with a standard deviation of 4.39. This suggests that food security levels exhibit some variability across the countries, ranging from a minimum of 32.8 in Burundi to a maximum of 53.4 in Kenya.

Inflation rates average 6.8%, with a standard deviation of 5%. The values range from -2.81% in Tanzania to 18.8% in Uganda, reflecting different inflationary pressures and levels of price stability across the East African countries. This variability highlights economic differences among the countries studied, with some experiencing deflation while others face higher inflation.

External debt levels exhibit significant variation, with an average of \$12.2 billion and a standard deviation of \$10.7 billion. The debt figures range widely, from a minimum of approximately \$586 million in Burundi to a maximum of \$41.6 billion in Kenya, indicating a considerable disparity in the debt burdens of the observed countries.

The Gross National Income (GNI) per capita, expressed in PPP (Purchasing Power Parity) terms, has a mean of \$2,129.09 and a standard deviation of \$1,212.83. The minimum and maximum values are \$620 in Burundi and \$5,810 in Kenya, respectively, showcasing substantial differences in income levels and standards of living among the countries.

Agricultural output varies greatly, with an average of about 3.9 million tonnes and a standard deviation of 3.45 million tonnes. The output ranges from as low as approximately 236,880 tonnes in Burundi to a peak of 12.8 million tonnes in Tanzania, reflecting diverse levels of agricultural productivity among the countries.

Population growth rates are more consistent, with an average of 2.84% and a standard deviation of 0.51%. The rates range from 1.63% in Kenya to 3.55% in Uganda, indicating that most countries have similar population growth dynamics, though some experience slightly higher rates than others.

4.3 Diagnostic Checks

4.3.1 Stationarity Tests

Levin-Lin-Chu unit-root tests were conducted on key variables to ensure stationarity. Results indicated that most variables, including GFSI, agricultural output, population

growth and external debt, are stationary. Inflation and GNI Per Capita required differencing to achieve stationarity. Table 2 summarizes the results as shown.

Table 2: Stationarity Table

Variable	P-value	Stationarity
GFSI	0.0000	Stationary at levels
Natural log of Agricultural Output	0.0200	Stationary at levels
Natural log of External Debt (lnexternaldebtus)	0.0013	Stationary at levels
Inflation (D_inflation)	0.0312	Stationary at first difference
Population Growth	0.0001	Stationary at levels
Natural log of GNI per Capita (D2_lgnipercapitapppus)	0.0144	Stationary at second difference

4.3.2 Multicollinearity

The Variance Inflation Factor (VIF) tests were conducted to assess the degree of multicollinearity among the independent variables in the regression model. The initial model did not include the squared term of external debt ('lnexternaldebt2'), focusing solely on the linear relationship between external debt and the Global Food Security Index (GFSI). In this base model, all variables displayed acceptable levels of multicollinearity, with VIF values below 10 and a mean VIF of 3.40, indicating that the variables were not highly correlated with each other.

However, the squared term of external debt ('lnexternaldebt2') was later added to explore potential non-linear effects and to determine the maximum level of external debt, beyond which its impact on food security might change. Introducing this squared term led to significantly high VIF values for 'lnexternaldebtus' (VIF = 1884.88) and 'lnexternaldebt2' (VIF = 1985.56), due to the inherent correlation between a variable and

its squared term. This resulted in severe multicollinearity, making it difficult to interpret the coefficients reliably.

By removing the squared term, the multicollinearity issue was resolved, and the model reverted to focusing on the linear impact of external debt on GFSI, ensuring that the regression coefficients could be interpreted with greater confidence. The mean VIF remained at a manageable level of 3.40, indicating that the remaining variables did not suffer from problematic correlations.

Table 3: VIF Table

Variable	VIF
External debt	6.20
Agricultural output	4.50
Population growth	3.10
GNI per capita (PPP)	1.30
Inflation	1.10
Mean VIF: 3.40	

This table confirms that when the squared term of external debt is excluded, all VIF values fall below 10, indicating that multicollinearity is not a concern among the independent variables.

4.3.3 Heteroskedasticity

The Breusch-Pagan test indicated the presence of heteroskedasticity ($p = 0.0316$). This test is used to detect whether the variance of the residuals remains constant across different levels of the independent variables. In this test, the null hypothesis (H_0) assumes homoskedasticity, meaning that the variance of the residuals is constant, while the alternative hypothesis (H_A) suggests heteroskedasticity, where the variance changes with the levels of the independent variables.

According to the PDF results:

- **Chi-squared (1) = 4.18**
- **p-value = 0.0316**

Since the p-value is less than the commonly used significance level of 0.05, we reject the null hypothesis, indicating that heteroskedasticity is present. To address this, the final pooled OLS model was adjusted to use robust standard errors, ensuring that the standard errors and model inferences remain reliable despite the presence of heteroskedasticity

4.4 Discussion of Results

4.4.1 Model Selection and Tests

4.4.1.1 Hausman Test (*Fixed Effects vs. Random Effects*)

The first step in model selection involved conducting the Hausman test to compare the fixed effects and random effects models. The Hausman test helps determine whether the random effects model is consistent or whether the fixed effects model should be preferred. In this case, the test produced a chi-squared value of **15.42** with a **p-value of 0.0087**. Since the p-value is less than 0.05, the null hypothesis that the random effects model is consistent was rejected. This result indicated that the fixed effects model was more appropriate than the random effects model for this dataset. Thus, the fixed effects model emerged as a strong candidate, as it better accounted for individual-specific characteristics that the random effects model did not capture.

4.4.1.2 F-test (*Fixed Effects vs. Pooled OLS*)

After establishing that the fixed effects model was preferable to the random effects model, the next step was to compare the fixed effects model to the pooled OLS model using the F-test. This test is designed to determine whether the fixed effects model provides additional explanatory power over the simpler pooled OLS model. The F-statistic for this comparison was **1.05**, with a **p-value of 0.4794**. Since the p-value was greater than 0.05, the null hypothesis that the individual effects were jointly insignificant could not be rejected. This meant that the fixed effects model did not offer significant improvements in explanatory power over the pooled OLS model. Consequently, the F-test favoured the pooled OLS model as the more appropriate choice for the dataset, given its simplicity and comparable explanatory power.

4.4.1.3 Breusch-Pagan Test for Heteroskedasticity

Finally, the Breusch-Pagan test was conducted to check for heteroskedasticity within the pooled OLS model. Heteroskedasticity occurs when the variance of the residuals is not

constant across observations, which can result in inefficient estimates and unreliable inferences. The Breusch-Pagan test returned a chi-squared value of **4.18** with a **p-value of 0.0316**. Since the p-value was less than 0.05, the null hypothesis of homoskedasticity was rejected, indicating that heteroskedasticity was present in the model. To address this issue, robust standard errors were applied to the final pooled OLS model. This adjustment ensured that the standard errors and resulting significance tests remained reliable, even in the presence of non-constant variance in the residuals.

In conclusion, the series of tests conducted—starting with the Hausman test, followed by the F-test, and concluding with the Breusch-Pagan test—ultimately led to the selection of the pooled OLS model with robust standard errors as the final model for this analysis. The pooled OLS model was chosen because it offered simplicity and comparable explanatory power to the fixed effects model, while the application of robust standard errors addressed the presence of heteroskedasticity, ensuring the validity of the results. Table 4 shows the results from the Pooled OLS Regression

Table 4: Results Table

Variable	Coefficient	Standard Error	t-value	p-value
External debt	-18.770	9.240	-2.030	0.048**
External debt ²	0.507	0.213	2.390	0.021**
Agricultural output	-1.580	0.620	-2.530	0.015**
Population growth	-1.047	78.58	-1.330	0.189
Inflation	0.183	5.480	3.350	0.002***
GNI per capita (PPP)	-4.690	3.430	-1.370	0.178
constant	235.100	102.940	2.280	0.027**
Number of observations	54			
F-statistic	61.19			
R-squared	0.8206			

*** Statistical significance at 1% level (p value < 0.01); ** Statistical significance at 5% level (p value < 0.05); * Statistical significance at 10% level (p value < 0.1).

4.4.2 Interpretation of Coefficients

The analysis reveals that external debt and agricultural output have significant implications for food security, while inflation and population growth also play a role. Given the level-log relationship in the model (level for GFSI, log for external debt, GNI and agricultural output), these coefficients are interpreted as percentage changes in external debt or agricultural output leading to changes in the absolute level of food security (GFSI).

4.4.2.1 External Debt

The coefficient for 'lnexternaldebtus' is -18.77, statistically significant at the 5% level (p-value = 0.048). This suggests that a 1% increase in external debt is associated with a 0.19 -point decrease in the Global Food Security Index (GFSI). This significant negative impact indicates that higher external debt levels reduce a country's ability to ensure food security, possibly due to the burden of debt servicing limiting public investment in food security programs. Additionally, by including the squared term of external debt ('lnexternaldebt2') in the analysis, it was possible to calculate the maximum debt level for each country, which is given.

Table 5: Maximum Debt Levels per Country

Country	Maximum External Debt Level (USD)
Kenya	50,800,000,000.00
Tanzania	95,400,000,000.00
Uganda	25,600,000,000.00
Rwanda	14,600,000,000.00
Burundi	765,000,000.00
DRC	7,350,000,000.00

The threshold value, or maximum sustainable debt level, is derived using the formula $-\beta_1/2\beta_2$, where β_1 represents the coefficient of lnexternaldebtus and β_2 is the coefficient of lnexternaldebt2. Since the external debt was originally expressed in natural logarithms, we exponentiate this results to obtain the actual debt level in its original units.

The figures in the table represent the threshold beyond which the negative impact of debt on food security could change. At this point, further increases in debt may lead to a more

substantial deterioration in food security. Understanding this threshold provides valuable insights for policymakers, enabling them to balance debt levels to avoid reaching a critical point that could severely impact food security.

4.4.2.2 Agricultural Output

The coefficient for 'lnagriculturaloutput' is -1.58, with a p-value of 0.015, indicating significance at the 5% level. This implies that a 1% increase in agricultural output is associated with a 0.016-point decrease in the GFSI. This negative relationship suggests that increased agricultural output does not necessarily translate into improved food security. Instead, it points to possible inefficiencies in the agricultural sector, such as issues with distribution, post-harvest losses, or the allocation of resources that hinder the conversion of increased output into food security improvements.

4.4.2.3 Population Growth

The coefficient for 'populationgrowth' is -1.0473, but it is not statistically significant at conventional levels (p-value = 0.189). Despite the lack of significance, the negative sign indicates that an increase in population growth potentially outpaces food production, thereby putting pressure on food resources and leading to lower food security levels. A 1% increase in population growth could lead to a 1.0473-point decline in the GFSI, highlighting the challenge of balancing population growth with food supply.

4.4.2.4 Inflation

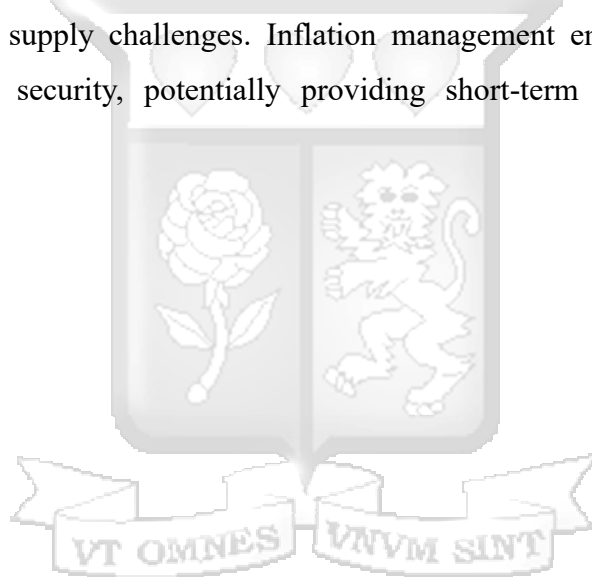
The coefficient for 'D_inflation' is 0.1834 and is statistically significant at the 1% level (p-value = 0.002). This suggests that a 1% increase in inflation is associated with an 0.1834-point increase in the GFSI. The positive relationship between inflation and food security may reflect a short-term effect where moderate inflation could stimulate economic activities related to food production or government intervention in food markets. However, this relationship is complex, as excessive inflation could eventually undermine food security by eroding purchasing power.

4.4.2.5 GNI per Capita

The coefficient for 'D2_lgnipercapitappus' is -4.69, indicating that a 1% change in GNI per Capita will result in a decrease in the GFSI by 0.047 points, but it is not statistically significant (p-value = 0.178). The negative sign suggests that changes in income levels,

when measured through second differences, might have a complex relationship with food security. However, due to the lack of significance, its direct interpretation should be treated cautiously.

In conclusion, the pooled OLS regression highlights the critical role that external debt and agricultural output play in influencing food security. The negative impact of external debt suggests that managing debt levels is vital for maintaining food security, especially considering the identified threshold of each country, beyond which debt could decrease food security. The inefficiencies in agricultural production point to areas needing improvement to ensure that increased output benefits food security. Although population growth was not statistically significant, it remains an essential factor to monitor in the context of food supply challenges. Inflation management emerges as a key tool for stabilizing food security, potentially providing short-term benefits when managed effectively.



Chapter Five: Discussions, Conclusions, and Recommendations

5.1 Introduction

This chapter provides an in-depth analysis of the research findings, linking them to previous literature and theoretical frameworks. It concludes with actionable recommendations for policymakers and identifies study limitations, setting the stage for future research.

5.2 Discussions

The analysis highlights the significant impact of external debt on food security within the East African Community (EAC), consistent with the Debt Overhang Theory, which suggests that excessively high debt discourages investment and economic growth, as future income is expected to be directed primarily toward debt repayment rather than productive development. Specifically, a 1% increase in external debt correlates with an 18.77-point reduction in the Global Food Security Index (GFSI), indicating that high debt levels impair food security by constraining investments in agricultural infrastructure and essential social programs.

This finding supports the notion that excessive debt hinders economic development, echoing studies such as Otieno et al. (2022), who found that high levels of external debt in East African countries drive capital flight, with funds being channelled abroad instead of supporting local investment. This outflow weakens domestic economic growth and limits critical sectoral investments. Similarly, Machagua and Naikumi (2022) reported that while external debt could theoretically promote growth through infrastructure spending, high debt levels often create uncertain debt sustainability. This uncertainty discourages private investment, particularly in agriculture, as debt servicing obligations lead to increased taxes and borrowing costs. Together, these studies underscore that excessive debt burdens reduce domestic investment capacity, adversely affecting food security and economic resilience in the EAC.

The results contradict empirical studies such as Olumo et al. (2023), which found that external debt can have a positive impact on agricultural productivity if the funds are effectively allocated toward critical areas like infrastructure, technology, and access to markets. In their study, Olumo et al. demonstrated that well-targeted debt-financed investments improved agricultural output by enabling farmers to adopt modern techniques and access necessary resources. However, in East Africa, the negative correlation between agricultural output and the Global Food Security Index (GFSI) indicates inefficiencies, likely stemming from challenges such as post-harvest losses, limited storage facilities, and poor distribution networks that diminish the potential benefits of increased production.

These inefficiencies are highlighted in the study by Maduekwe et al. (2022), which found that even non-debt funding aimed at the agricultural sector failed to enhance food security outcomes due to poor resource allocation and weak oversight. The paper emphasized that funding was often directed toward non-productive areas or was insufficiently monitored, leading to limited improvements in food availability and access. Furthermore, the data reveals a variation in the maximum sustainable debt thresholds across countries in the East African Community, with Kenya's threshold at approximately \$50.8 billion USD, allowing for greater leverage in productive investment, while Burundi's threshold is notably lower at \$765 million USD, limiting its capacity to use debt effectively without risking economic strain. These findings underscore that while debt can boost agricultural productivity, its positive impact on food security depends heavily on efficient allocation and management, which vary by country and influence their food security outcomes.

The positive association of inflation with GFSI in the short term indicates that moderate inflation may benefit economic activities in food production. However, long-term effects could erode purchasing power, consistent with findings by Jama (2021). Although population growth was not statistically significant, its negative coefficient aligns with the expected pressure on food supply systems due to higher food demand.

5.3 Conclusions

The study concludes that high external debt levels reduce food security across the EAC. These findings underscore the importance of prudent debt management to balance

financing needs with sustainable investments in food security programs. Agricultural output alone does not enhance food security without addressing inefficiencies in the sector, supporting Sen's Entitlement Approach, which emphasizes access and distribution over production alone. Moreover, the findings affirm the importance of inflation control to stabilize food security, especially in regions vulnerable to food price fluctuations.

5.4 Recommendations

Debt Management Policies: Governments in the EAC should prioritize sustainable debt levels to avoid economic instability and ensure adequate investments in critical sectors like agriculture (Nordic Africa Institute, 2024). Excessive debt burdens can divert resources from essential areas, reducing their capacity to enhance food security. Targeted allocation of external debt to productive sectors, such as agriculture and infrastructure, can maximize developmental impacts (East African Community, n.d.). Investments in agricultural infrastructure—such as irrigation systems and transport networks—can boost productivity and contribute to national food security goals. For instance, strategic debt management can maintain fiscal stability while fostering productivity and mitigating food insecurity.

Addressing Agricultural Sector Inefficiencies: Policymakers must address inefficiencies in agricultural production and distribution to optimize food security outcomes. Investments in infrastructure to reduce post-harvest losses, improve distribution networks, and increase storage capacity are vital (East African Community, n.d.). Post-harvest losses, attributed to inadequate storage and transport systems, undermine agricultural gains and restrict food security benefits. For example, Nigeria's investment in the Nigerian Stored Products Research Institute and India's improvements in cold storage facilities have successfully reduced post-harvest losses and improved food quality during transport. Such investments in East African nations can significantly enhance the translation of agricultural productivity into food security gains.

Inflation Stabilization: Moderating inflation is essential for sustaining food security by preserving purchasing power and promoting economic stability (East African Business

Council, 2023). High inflation erodes consumers' ability to afford basic food items and introduces volatility in food prices. EAC governments should implement inflation controls, including adjusting interest rates and managing currency stability, to prevent excessive inflation. For instance, central banks can intervene in the money supply to stabilize food prices and protect household purchasing power, supporting both production and consumption.

Population Growth Strategies: Integrating food security considerations into population policies is necessary to anticipate and manage future strain on food systems (East African Community, n.d.). Although this analysis found population growth rates to be statistically insignificant, rapid demographic expansion could pressure food systems in the future. Policies that enhance agricultural productivity in line with demographic trends are critical for ensuring adequate food availability. Kenya's Vision 2030 agenda, which incorporates food security measures to meet the needs of a growing population, serves as a model for aligning food strategies with demographic changes.

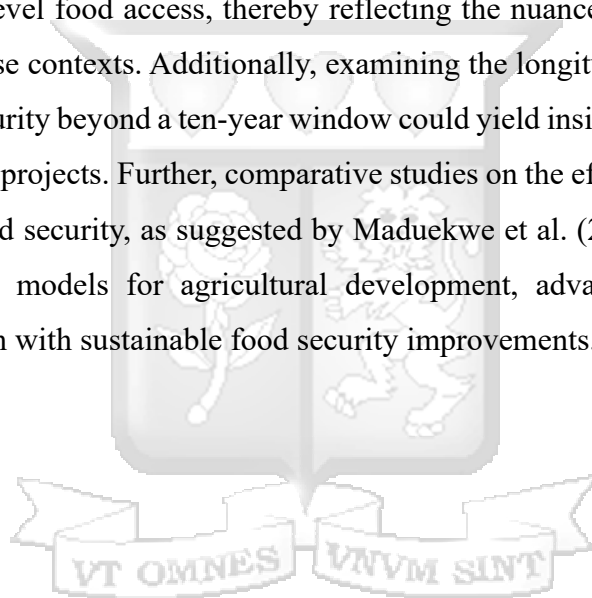
5.5 Limitations of the Study

This study faced limitations related to data availability, particularly for countries like South Sudan and Somalia, which limited the sample to six EAC countries. Additionally, while other indices, such as the Food Insecurity Experience Scale (FIES) and the Household Dietary Diversity Score (HDDS), could provide insights into food security, this research used the Global Food Security Index (GFSI) due to its comprehensive structure. The GFSI incorporates key factors such as affordability, availability, quality, and resilience, making it suitable for cross-country comparisons and aligning well with the study's focus on macro-level determinants of food security. However, GFSI may not capture all food security dimensions unique to the EAC, such as cultural factors influencing food access or utilization.

The short timespan (2012-2022) used in this study also limits the ability to capture long-term effects of debt on food security fully. This 10-year period was chosen because of more reliable data availability and consistency across sources within this timeframe, allowing for a focused analysis of recent trends and policy impacts.

5.6 Areas for Further Research

Future research should explore incorporating additional food security metrics, such as the Food Consumption Score (FCS), which assesses dietary diversity and frequency; the Prevalence of Undernourishment (PoU), which tracks the proportion of the population with inadequate caloric intake; and the Household Hunger Scale (HHS), which measures food deprivation, could provide a more comprehensive understanding of the debt-food security relationship across varied socio-economic and environmental conditions. Including these metrics would enable an in-depth exploration of how external debt impacts not only food affordability and availability but also nutritional quality, dietary adequacy, and household-level food access, thereby reflecting the nuanced effects of debt on food security in diverse contexts. Additionally, examining the longitudinal impacts of external debt on food security beyond a ten-year window could yield insights into the sustainability of debt-financed projects. Further, comparative studies on the effects of debt and non-debt financing on food security, as suggested by Maduekwe et al. (2022), could help identify optimal funding models for agricultural development, advancing efforts to balance economic growth with sustainable food security improvements.



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