Addis Ababa University

College of Business and Economics

Department of Economics

The Impact of Countries' Policy and Institutional Frameworks on Food Insecurity: Evidence from Sub-Saharan Africa Using Dynamic Panel Data

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Table of Contents

Acronyms

CPIA	Country Policy and Institutional Assessment
FAO	Food and Agriculture Organization
FDI	Foreign Direct Investment
FSR	Food Security and Resilience
GDP	Gross Domestic Product
GMM	Generalized Method of Moment
HDI	Human Development Index
IDA	International Development Association
IRAI	International Resource Allocation Index
LM	Lagrange Multiplier
MPS	Macroeconomic Policy Stability
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OLS	Ordinary Least Squares
PFM	Public Finance Management
POU	Prevalence of Undernourishment
SDG	Sustainable Development Goals
UN	United Nations
WB	World Bank
WFP	World Food Program

Abstract

Food insecurity remains a critical global challenge, especially in sub-Saharan Africa. This study investigates the impact of policy and institutional factors on food insecurity in the region. Using comprehensive panel data from 38 countries over 2005-2021, various econometric techniques are employed, with system GMM chosen as the final analysis tool. The findings reveal significant negative relationships between strong policy and institutional components and food insecurity. Factors such as equity on public resource, fiscal policy, macroeconomic management, public sector management, and structural policy play a crucial role in reducing undernourishment. This study highlights the urgency of addressing food insecurity and emphasizes the need for targeted interventions based on specific policy and institution factors. It contributes to existing literature and underscores the importance of effective policies to achieve sustainable food security in sub-Saharan Africa.

Key words: Countries Policy and Institutional Assessment, Food insecurity, Policy and Institution, System GMM, Sub-Saharan Africa, Prevalence of undernourishment, Panel data

1. Introduction

1.1 Background of the study

No poverty, zero hunger, and good health and well-being are three prominent Sustainable Development Goals (UN SDGs) set by the UN to be achieved by 2030. However, although, sustainable development goal number two (SDG2) targets a world that is free from hunger by 2030, more than 811 million people are said to be hungry today, and 2 billion are expected to be undernourished by 2050 (Global SDG Awards, 2018). In addition, the World Bank report 2022 reveals that recent crises have exacerbated the global challenge of extreme poverty eradication by 2030. The report says, based on the current trends, approximately 574 million people, equivalent to nearly 7 percent of the global population, are projected to continue living on less than $2.5 a day in 2030. The implication of this finding is that the persistent of extreme poverty poses a significant hurdle, particularly in regions such as sub-Saharan Africa, conflict-affected areas, and rural areas, where it is particularly challenging to achieve meaningful progress. This underscores the urgent need for targeted interventions and focused efforts to address poverty and improve food security in these vulnerable regions.

According to previous publications by FAO in various years, and literature such as by Sassii, M., Sassi, and Acocella.(2018), there are many reasons that can intensify food insecurity, and the reasons may vary depending on the specific context, of which some common factors are poverty through limiting people's ability to access food; climate change, by affecting food production and availability, and in turn lead to food insecurity; conflict and displacement through disrupting food system, limiting access to food, and leading to food insecurity; Economic shocks such as price increases or job loss which can make it difficult for people to access food; Natural disasters through disrupting the food system can lead to food insecurity; gender inequality when

women and girls are disproportionately affected by food insecurity due to discrimination and unequal access to resources; lack of access to education through limiting people's ability to access information and resources related to food production and consumption; poor infrastructure, such as lack of roads and transportation systems can limit access to food and exacerbate food insecurity (https://www.fao.org/3/x8406e/X8406e01.htm).

The rapid increase in population is another factor that intensify poverty, hunger, and food insecurity. To understand the magnitude of food insecurity one must consider both the continued rapid growth in world population and the number of individuals below the poverty line (Ihuoma, 2015). Although, food insecurity is the problem of all, most of the countries with fast growing number of populations are more victims. We can take Sub Saharan Africa as an example the region which has the highest population growth rate in the world and where food insecurity is severe. Studies shows that by 2050 the population of the region is expected to be more than double (The Economist, 2020). In fact, this area is also projected to hold the largest proportion of food insecure people where according to World vision report of 2022 one in five people is undernourished. FAO (2005) highlights that countries experiencing rapid population growth relative to their economies may face significant challenges in increasing per capita food production. This situation can lead to increased poverty levels and limited resources available to combat poverty. The implication is that a mismatch between population growth and economic capacity can hinder efforts to enhance food production and exacerbate poverty, underscoring the need for sustainable strategies to address this issue effectively. That is why these days the government policies of any nations have centered on issues like population, poverty, and food insecurity.

The food insecurity issue has two dimensions namely the demand and supply of food. Although increasing the agricultural production with the help of a well-managed distribution

system the supply of food to people can be enhanced, the problem of insufficient food supply shall arise as long as the demand for food continuously increases (Misselhom, A., Aggarwal et al, 2012). Food insecurity in Sub Saharan Africa can be best example for this as the problem remains, due to unceasingly increase in demand for food. Various studies such as by Mwaniki, A. (2006) also have emphasized upon the relation of food insecurity with the resource constraints. According to Mwaniki people in developing nations are spending larger proportion of their income on food without considering its nutritional values. Therefore, the problem of food insecurity is not only associated with food availability or accessibility, but its proper utilization and stability are also issues of great concern. Of course, meeting the food needs of growing affluent human population with limited resources is a major challenge but it should also be noted that there are other important factors that needs to be considered as far as the cause of food insecurity are concerned. Of which working on Countries Policy and Institution, through its components of building human resource, improving debt policy, ensuring equity of public resource use, promoting pro-poor fiscal policy, improving macroeconomic management, enhancing public sector management, working on social protection, strengthening structural policy, ensuring environmental sustainability, and creating effective resource allocation, can be part of mitigation strategies regarding the prevalence of severe food insecurity in the region. Therefore, this study aims to empirically investigate how those ten major institutional and Policy framework components are affecting Food insecurity in Sub-Saharan Africa. The important explanatory variables that are used as policy and institutional framework components and as determining factors are building human resources, debt policy, equity on public resource management, fiscal policy, macro-economic management, environmental sustainability, public sector management, social protection, structural policy, and resource allocation.

On the other note, given that there are many ways in which food insecurity can be defined, for this specific study the researcher uses the simple definition of food Insecurity by FAO which is a 'lack of regular access to enough, safe and nutritious food for normal growth and development and an active and healthy life' (FAO, 2023). It should also be noted that the prevalence of undernourishment is a proxy variable that has been used for this specific study, where the prevalence of undernourishment (POU) can be defined as "the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life" (The World Bank, 2023). The prevalence of undernourishment is from under the category of 'access', which is part of one of four main food security frameworks (availability, access, utilization, and stability) that have been set by FAO (FAO, Food security indicators, 2014) and it is measured in percent. For example, data showing as 2.5 may signify a prevalence of undernourishment below 2.5%.

1.2 Statement of the problem

Ensuring global food security remains a significant challenge, particularly in sub-Saharan Africa. Despite numerous studies highlighting various factors contributing to food insecurity, one factor that requires further attention is the policy and institutional framework of countries. This study aims to analyze the impact of countries' policy and institutional framework on food insecurity in sub-Saharan Africa, focusing on ten major components including resource allocation, structural policy, social protection, public sector management, environmental sustainability, macroeconomic management, fiscal policy, equity of public resource management, debt policy, and building human resources. By examining the association between these factors and food insecurity, this research seeks to identify the significance of countries' policy and institutional

frameworks in addressing the root causes of food insecurity and promoting sustainable agricultural systems for the achievement of Sustainable Development Goal 2 (Zero Hunger) by 2030.

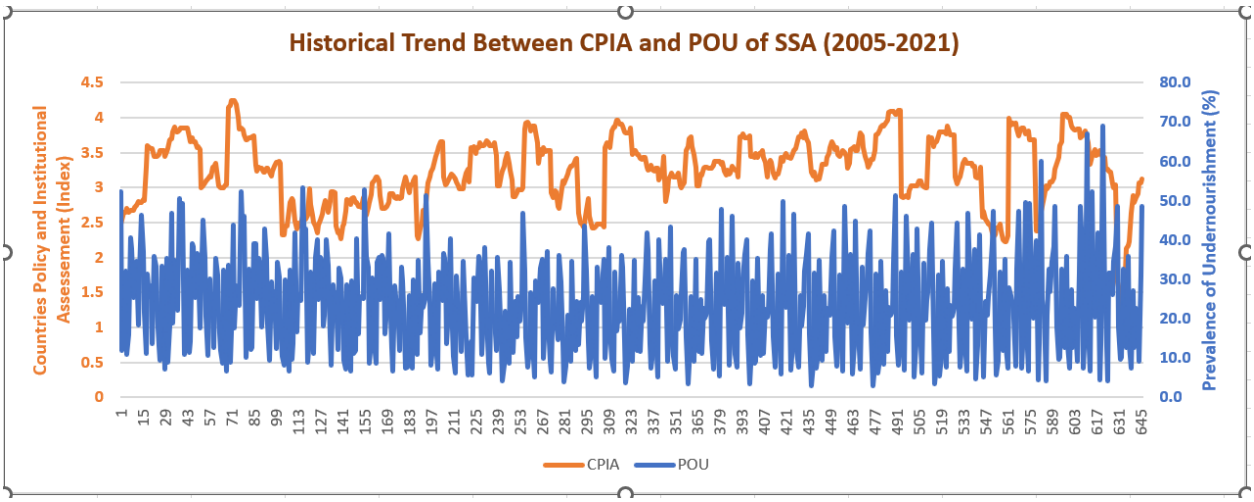

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Fig.1: Countries' policy and institutional assessment and prevalence of undernourishment in 38 sub-Saharan African countries between 2005 and 2021. Where the data sources are FAOSTAT, Statista and the World Bank.

The historical trend reveals a consistent association between the prevalence of undernourishment and countries' policy and institutional framework in sub-Saharan African countries from 2005 to 2021. This suggests that changes in policy and institutional factors corresponds to changes in undernourishment levels, emphasizing the significant role of effective policies and institutions in addressing food insecurity. Additionally, the trend highlights the adverse impact of weak policy and institutional frameworks on agricultural development, resource allocation, governance, and social protection, collectively contributing to food insecurity. However, existing studies have predominantly examined individual components of policy and

[1] In the above figure, figure 1 the assessment of countries' policies and institutional framework was given by index in the form of the CPIA index, and then the average is calculated, and the assessment scale ranged from 1 to 6, with higher values indicating stronger policy and institutional assessment, which reflects better policies and stronger institutions. Similarly, the prevalence of undernourishment, which serve as a proxy for food insecurity, was measured as an average percentage.

institutional frameworks, resulting in a lack of comprehensive understanding of their aggregate impact on food insecurity.

Therefore, this study aims to systematically measure and analyze the impact of countries' policy and institutions on food insecurity in sub-Saharan countries, addressing this research gap. It seeks to explore the collective effect of ten indicators, including building human resources, debt policy, equity in public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policy, and resource allocation. By examining these components collectively, this research intends to provide a more holistic understanding of the multifaceted determinants of food insecurity and identify potential synergies or trade-offs between different policy dimensions.

Furthermore, previous studies on the relationship between population growth, resource allocation, and structural policies on food insecurity have produced conflicting findings, making it challenging to draw definitive conclusions and develop evidence-based interventions. Therefore, this study recognizes the importance of identifying the underlying reasons for these divergent findings and understanding the context-specific nature of the relationship. By conducting a comprehensive analysis and utilizing panel data, this research aims to address these limitations and contribute to the literature by providing valuable insights into the research topic.

In summary, this study fills literature gaps by analyzing the aggregate impact of policy and institutional frameworks on food insecurity. It explores reasons for mixed findings for some variables as well. And finally, this study is expected to inform policymakers in formulating integrated strategies to effectively address the root causes of food insecurity and promote sustainable food systems in diverse contexts.

1.3 Research questions

The main research questions for this study are:

- What are the theoretical constructs underlying the effects of policy and institutional components on food insecurity in sub-Saharan African countries?
- What do previous empirical findings reveal about the impact of variables such as human resource development, debt policy, public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, environmental sustainability, public sector management, social protection, structural policies, and resource allocation on food insecurity?

1.4 Objective of the Study

1.4.1 General Objectives:

- Investigate the impact of countries' policy and institutional frameworks on food insecurity.
- Examine the extent to which a strong policy and institutional framework can reduce food insecurity rates.
- Empirically analyze the effect of major components of countries' policy and institutional frameworks (building human resources, debt policy, public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policies, and resource allocation) on food insecurity in sub-Saharan Africa.

1.4.2 Specific Objectives:

In line with the above general objectives, the following are the specific objectives:

- Revealing whether the relationship between each of the above ten variables and food insecurity is significant or not.
- Examining the overall effects of various dimensions of the above ten variables on food insecurity of Sub-Saharan Africa.
- Forwarding recommendations on how to improve the severe food insecurity of the region under the study based on the final findings.

1.5 Hypothesis of the study

Countries that are considered to be "developed" or "rich" have strong institutions and policy frameworks (Acemoglu, Daron, and Simon Johnson (2005), whereas those which are considered to be "developing" or "poor" countries such as countries in Sub Saharan Africa have yet to form these societal and political foundations. Therefore, I hypothesize that 'having strong institution and policy frameworks lead the countries to improve their severe food insecurity status'. Thus, the study investigates the impact of the independent variables (building human resources, debt policy, public resource management, fiscal policy, macro-economic management, environmental sustainability, public sector management, social protection, structural policies and resource allocation) which are set as a components of countries policy and institutions by the World Bank, on dependent variable (food insecurity proxied by prevalence of undernourishment). And define the complex hypothesis to predict the relationship between those independent variables and dependent variable and test the hypothesis to reject the null hypothesis or fail to reject.

1.6 Significance of the Study

This study is believed to hold significant relevance for sub-Saharan African countries as it examines the impact of countries' policy and institutional framework on food insecurity across 38 countries in the region. It contributes to improving awareness at the societal, government, and non-

governmental organization levels regarding the benefits of enhancing institutions and policy frameworks. Moreover, besides fulfilling the requirements for the researcher's MSc program and further studies, it also serves as a valuable resource for other individuals interested in conducting research in this field. Ultimately, this study enriches the existing literature on food insecurity and the assessment of countries' policy and institutional frameworks, thereby contributing to the ongoing debate on the crucial role of strong policies and institutions in mitigating severe food insecurity in the sub-Sahara region.

1.7 Scope of the study

The scope of this study is delimited to assessing the impact of countries' policy and institutional frameworks by taking its major components on food insecurity, in the case of sub-Saharan Africa. The data used for this specific study is secondary data from the World Bank data catalog. The data taken from this catalog is only for 38 sub-Saharan African Countries within the time range from 2005 to 2021.

Broad, J. (2016, June 6). Global Trade Outlook: Sub-Saharan Africa | Michigan Business. Michigan Economic Development Corporation (MEDC). https://www.michiganbusiness.org/news/2016/06/global-trade-outlook-sub-saharan-africa/

Figure 2. Countries in sub-Saharan Africa

1.8 Organization of the Study:

The rest of this study is organized in the following manner: the next section, section two, covers the theoretical and empirical literature. The third section discus about the methods used including research design, sampling techniques, the source of the data, the variables selected from both independent and dependent variable ends, specification of the model, description of the estimation techniques used, hypothesis tested, and justification of the validity of the model. The fourth section describes the descriptive result, and Econometric result and discussion, and the final section, section five put conclusion, policy implications, and limitations of the study.[2]

[2] Image used without permission, and it is taken from the above source. It is used to show sub–Saharan African Countries under study.

2. Literature Review

2.1 Theoretical Literature

2.1.1 Food security from different theoretical perspectives

Food Insecurity can be defined in different ways depending on the context and purpose of the study. For example, according to the United Nations Committee on World Food Security, food insecurity could be defined as lack of access to sufficient, safe and nutritious food that meets dietary needs for an active and healthy life (International Food Policy Research Institute); while Coleman-Jensen et al (2019) defined food insecurity as a limited or uncertain availability of nutritionally adequate and safe foods, or limited or uncertain ability to acquire acceptable foods in socially acceptable ways; according to FAO, food insecurity is the situation when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active healthy life (FAO, 2023); It can also be defined as the inability of households to secure adequate food due to lack of resources or other constraints (Dinour, L. M et al (2007).

As of its definition, food insecurity can also take different forms such as transitory food insecurity where the shortage of food is short-term and usually seasonal which happens due to natural disasters, economic shocks, or other emergencies (Webb, Coates, and Frongillo, 2006); chronic food insecurity where the problem of having lack of access to sufficient and nutritious food can last for a long and when the problem is ongoing, which resulted from poverty, unemployment or other structural and systematic factors (Tawodzera, G.(2011); and finally, food insecurity can take a form of severe food insecurity where the problem is critical and results in malnutrition, hunger, and other adverse health outcomes, and finally when it leads to starvation and even death in extreme cases (Maxwell, Coates, & Vaitla (2013).

Food security is a complex concept that is discussed in various theoretical perspectives. The following are the key theoretical perspectives on food security:

Entitlement theory, developed by Amartya Sen and according to this theory food security is achieved when individuals have the economic resources and access to food to meet their basic needs. The theory argues that food security is primarily an issue of unequal distribution of resources rather than insufficient production of food (Sen, A.,1981). In this context Maxwell (1996), also provides critical examination of the concept of food security from a post-modern perspective. He challenges traditional approaches to food security that solely focus on production and availability of food, and instead emphasizes the importance of understanding the socio-cultural, political, and economic dimensions of food security. Maxwell argues that food security is not just about having access to sufficient food but also about individuals and communities having the entitlements and capabilities to acquire and utilize food in a dignified and sustainable manner. The article emphasizes the role of power relations, social inequalities, and entitlement failures in shaping food security outcomes. It highlights the need to consider diverse factors such as income distribution, access to resources, social protection, and gender dynamics in analyzing food security. He also discusses the limitations of conventional food security measurement approaches that primarily availability and calorie intake and calls for a more nuanced understanding of food security that incorporates people's perceptions, cultural preferences, and social dynamics surrounding food access and utilization.

Political Economy is another perspective that emphasizes the structural causes of food insecurity, highlighting the influence of political, social, and economic factors on food systems and access to food. It examines how power relations, institutional arrangements, and economic policies shape food production, distribution, and consumption. In addition, the theory also

mentions about the causes of food insecurity such as poverty, inequality, and political instability. The political economy approach argues that addressing these underlying factors is crucial for achieving food security (Alkon, A.H., & Norgaard, K.M. (2009). On the same note, special rapporteur Olivier De Schutter (2011) raised about the social exclusion that marginalized groups such as women, indigenous communities, and ethnic minorities often face, and as the result how these groups remain behind due to limited access to resources, including land, credit, and education. According to the report, the above-mentioned power imbalances contribute to their vulnerability to food insecurity. Land tenure systems and agricultural policies is another important point that have been raised associated with political economy theory. According to Holt-Gimenez & Shattuck, (2011) unequal distribution of land, land grabbing, and land tenure insecurity can limit small-scale farmers' access to productive land, leading to reduced agricultural production and food insecurity.

Resilience theory on the other hand suggests that food security can be achieved by building the resilience of communities and ecosystems to cope with shocks and stresses, such as climate change, conflict, and economic downturns (Folke, C., et al., 2010). In this aspect Gupta et al. (2010) also discuss the application of resilience theory to address food insecurity. The authors argue that resilience theory offers a valuable perspective for understanding and addressing food insecurity because it goes beyond a focus on static vulnerabilities and instead emphasizes the dynamic and complex nature of food systems. They suggest that applying resilience theory to food insecurity involves several key considerations, such as to understand system dynamics i.e., it encourages a deeper understanding of the interconnectedness and feedback loops within food systems, including the social, economic, and ecological dimensions. This understanding helps

identify potential vulnerabilities and points of intervention; resilience theory also enhances adaptive capacity i.e., emphasizing on the importance of building adaptive capacity at different scales, from individual households to regional and global levels. For instance, promoting diverse livelihood strategies, fostering social networks and institutions that facilitate collective action, and supporting learning and innovation; promoting governance and institution for resilience is another important point raised by resilience theory. The theory highlights the significance of governance and institutions in enabling adaptive responses to food insecurity. This includes promoting participatory decision-making process, building collaborative networks, and integrating diverse knowledge systems. Overall, Gupta et al. (2010) argue that resilience theory provides a valuable framework for understanding and addressing food insecurity by focusing on building the capacity of individuals, communities, and systems to navigate and adapt to food-related challenges and disturbances.

Agroecology is another approach that emphasizes the importance of sustainable and locally adapted farming practices for achieving food security. Agroecology seeks to promote ecological sustainability, social justice, and food sovereignty. In this context Altieri, M.A., (2002) emphasizes the importance of understanding and working with the inherent complexity and diversity of agroecosystems. Agroecology seeks to enhance ecosystem functions, biodiversity, and ecological interactions within agricultural landscapes. By adopting agroecological practices, such as polyculture, agroforestry, and biological pest control, farmers can optimize resource utilization, increase productivity, and reduce reliance on external inputs. Promoting farmer participation, local knowledge exchange, and farmer-led experimentation is another area in which agroecology is important. By empowering farmers and valuing their traditional knowledge, agroecology strengthens local capacities for sustainable food production and management. Give attention on

community participation, social equity, and local control over resources are another significant point raised by the paper. Overall Altieri's work underscores the potential of agroecology as a holistic approach to address food security challenges by integrating ecological principles, local knowledge, and social equity. It highlights the importance of sustainable resource management and the empowerment of small-scale farmers in marginalized environments.

In the paper titles "Why the capability approach" by Alkire (2005), the author discusses the capability approach and its relevance to understanding and addressing issues of human development and well-being, including food insecurity. Capability Approach focuses on the human capabilities required for achieving food security, such as access to education, health care, and information. The capability approach argues that individuals should have the freedom to choose the kind of life they want to lead, including the food they eat. Regarding food insecurity, Alkire highlights that the capability approach provides a comprehensive framework to analyze the multidimensional nature of food security beyond mere calorie intake or availability. It emphasizes the importance of individuals having the freedom to access and choose an adequate and nutritious diet, which seems that the idea by Amartya Sen about the importance of individuals' capabilities and freedoms to lead lives they must reason to value.

As far as theoretical literatures on the impacts of policies and institutions on food insecurity are concerned, the following are the key perspectives.

Institutional Economics, which emphasizes the importance of formal and informal rules, norms, and conventions in shaping economic behaviour and outcomes. In the context of food security, institutional economics highlights the importance of property rights, access to credit and markets, and other institutional arrangements that affect agricultural productivity and food

availability. This perspective suggests that policies and institutions that promote secure property rights, market competition, and access to credit and markets can improve food security (North, D.C., 1993).

Political Economy emphasizes the distributional aspects of economic policies and institutions. In the context of food security, political economy highlights the importance of power relations, social norms, and political institutions in shaping access to food and nutrition. This perspective suggests that policies and institutions that promote equity, social justice, and democratic governance can improve food security (Bardhan, P., & Udry, C., 1999).

Sustainable Development emphasizes the need to balance economic, social, and environmental objectives in pursuing development goals. In the context of food security, sustainable development highlights the importance of promoting sustainable agricultural practices, reducing waste and losses, and addressing environmental challenges such as climate change and biodiversity loss. This perspective suggests that policies and institutions that promote sustainable agriculture and resource management can improve food security (Burton, I. (1987).

Human Rights emphasizes the importance of protecting and promoting the right to food as a fundamental human right. In the context of food security, human rights highlight the importance of ensuring access to food and nutrition for all, particularly the most vulnerable and marginalized populations. This perspective suggests that policies and institutions that promote human rights, social protection, and food assistance can improve food security (United Nations General Assembly, 1949).

Overall, the above theoretical literatures on food security offers a range of perspectives on how to achieve food security. While there is no one-size-fits-all solution, these perspectives provide important insights into the complex and multifaceted nature of food security.

Finally, while recognizing the multifaceted nature of food security and the need to consider various influencing factors, it is important to acknowledge that this research focuses on specific variables for empirical analysis. The study primarily incorporates economic theories and theoretical literature related to key variables, including GDP per capita, population growth, arable land, distance from the port (landlocked), and countries' policy and institutional frameworks. The research does not directly incorporate other essential characteristics and specific contexts from economic theories and previous literature mentioned earlier, but rather emphasizes these specific variables in its empirical analysis.

2.1.2 Theoretical Base for the Study

2.1.2.1 GDP per capita and Food Insecurity

In general, economic theories and literatures provide insights into the impact of GDP per capita on food insecurity. While it is important to note that various factors contribute to food insecurity, including agricultural productivity, and income distribution, GDP per capita can be a useful indicator of overall economic development and living standard. In this context, we can raise the concept income-based approach, which is important concept behind the purchasing power. It suggests that higher GDP per capita leads to increased incomes, which in turn reduces food insecurity i.e., as people's purchasing power improves, they can afford an adequate and nutritious diet. Alderman, H., et al. (2001) in this aspect, using cross-country data and found that higher GDP per capita income reduces the prevalence of undernourishment. In addition, economic theories highlight the role of agricultural development in poverty reduction, income generation, and food

security. Having policies that promote agricultural investment, access to credit, and technology transfer can contribute to overall economic development and alleviate food insecurity. For example, if we take many developing countries, a larger proportion of the population relies on agriculture for their livelihoods. In this sense, high GDP per capita can enhance agricultural productivity through improving rural infrastructure, and providing support to smallholder farmers which are crucial for reducing food insecurity. Abdullahi et al. (2020) also incorporate GDP per capita in the form of income for their study 'the impact of political instability on food insecurity', their reasoning in this sense is related with purchasing power i.e., more income leads the family to purchase more and in turn lead them to reduce malnutrition by meeting the family's food preferences, and the family become healthy. Therefore, we can take GDP per capita as our first determinant to our empirical analysis the impact of countries policy and institutional frameworks on food insecurity.

2.1.2.2 Food Insecurity and Population Growth:

Population growth is our second factor that we use in our analysis. In this sense, Malthusian and neo-Malthusian theories are among the key theories that are concerned with population growth and its impact on food security. Malthusian theory was developed by Thomas Malthus in the 18th century. The theory argues that population growth will outstrip food production, leading to food scarcity and famine. According to Malthus, population growth is exponential while food production is linear, which means that population growth will eventually surpass the ability of food production to keep pace. Malthus said, population growth is limited by two main factors; one is positive checks where natural or social factors reduce the population through means such as famine, disease, war, or other forms of suffering. And he argued that positive checks would be necessary to prevent population growth from outstripping the available food supply: the second

check is preventive check where individuals and societies to consciously limit population growth, through late marriage, abstinence, and contraception. He believed that preventive checks were essential to avoid the adverse consequences of over population including food insecurity. And thus, Malthusian theory suggests that population control measures are necessary to prevent food insecurity (Malthus, T.R.,1798). Another literature on population growth and food insecurity is a paper by Brown, L.R. (1995). Brown acknowledges the significant challenge posed by population growth and its impact on food security. He highlights that a growing global population place increasing pressure on agricultural resources, requiring sustainable and efficient approaches to food production.

2.1.2.3 Food Insecurity and Arable Land:

Neo-Malthusian Theory is an updated version of Malthusian theory, which considers factors such as environmental degradation, resource depletion, and climate change. The neo-Malthusian theory argues that population growth exacerbates these problems, making it even more difficult to achieve food security (Follett, C., 2020). The theory suggests that population control measures, as well as environmental conservation and sustainable resource use, are necessary to address food insecurity. As far as our third factor in our analysis of arable land is concerned, Neo-Malthusian argue that the availability of arable land is a crucial factor in determining a nation's capacity to produce enough food to meet the needs of its growing population. Neo-Malthusian emphasize that arable land is a finite resource, and its expansion is limited. They argue that as the global population continues to grow, the pressure on available land for agricultural purposes intensifies (Follett, C., 2020). And this situation can lead to a decline in per capita arable land, making it more challenging to produce enough food to meet the population's needs. In this aspect

Ehrlich (1968), raised the point that rapid growth of population poses a significant strain on the planet's resources, including arable land. He asserts that as population expands, the demand for food increases, putting pressure on agriculture systems to produce more. Ehrlich suggests that this population growth rate surpasses the ability of arable land to keep up with the escalating demand, potentially leading to food shortages and insecurity. He also acknowledges that conversions of forests and other natural habitats into farmland has adverse ecological consequences, leading to biodiversity loss and ecosystem degradation. Furthermore, he argued that the remaining potential agricultural land is often of inferior quality, making it challenging to sustainably increase food production to meet the needs of a growing population.

2.1.2.4 Food Insecurity and Distance from the port (Landlocked Ness)

Distance from the ports or landlocked Ness is the fourth factor in this empirical analysis that should be investigated. In this aspect, on theoretical framework that can help to understand the relation between distance from ports or landlocked ness and food insecurity is the "spatial access theory" (Fujita, M., Kumagai, S., & Nishikimi, K. (Eds.)., (2008), which suggests that the physical distance and connectivity of regions to transportation networks, particularly ports, can influence their ability to access food and other resources. According to the theory regions with better access to ports and transportation infrastructure have an advantage in terms of food availability, affordability, and variety, while landlocked regions or those located far from ports may face challenges in accessing food, resulting in increased food insecurity. The study conducted by Merker, V. (2007) can also be a good illustration of the above concept. In his study, Merker quantified the impact of transport-prohibitive characteristics in the sub-Saharan region on food insecurity. And the result revealed that a distance of 300 kilometers between the port of disembarkation and the major population agglomeration in the importing country corresponds to

a one percentage point increase in the undernourished population. This finding underscores the significance of infrastructure investment and the reduction of trade barriers to mitigate the costs associated with remoteness. By addressing these challenges, it becomes possible to promote the eradication of hunger in the region and enhance food security for its population. Another seminal work that helps to discusses the impact of distance from ports and landlocked Ness on food insecurity is "Geography and Trade" by Paul Krugman (1992). In fact, this paper primarily focusses on trade patterns and economic geography, it explores the concept of "home market effects". These effects suggest that regions with better access to ports and transportation networks have a higher likelihood of attracting trade and investment, which can improve their access to a variety of goods, including food. This work provides theoretical insights into the relationship between transportation connectivity, trade, and regional development, which can be extended to understand the implications for food insecurity.

2.1.2.5 Food Insecurity and Countries Policy and Institutional Framework:

Despite all the economic theory and theoretical literatures mentioned above, it should be noted that, no research has done yet on the aggregate impact of all 10 components of Countries policy and institutional framework on food insecurity. Of course, some studies have done on investigating the effect of few of the components of CPIA on food security. Therefore, this study takes components of countries policy and institutional frameworks, such as building human resources, debt policy, equity on public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policy, and resource allocation, as explanatory variable and investigate their impact on food insecurity of the region using prevalence of undernourishment as a proxy variable.

Food insecurity in Sub-Saharan Africa has been a topic of interest in the academic literature for many years. Of which the following are the key theoretical perspectives on the issue:

The Food System Approach: This approach considers the food system as a complex network of actors and processes that influence food production, distribution, and consumption. In sub-Saharan Africa, food systems are characterized by smallholder agriculture, limited access to markets, and low agricultural productivity. This approach suggests that interventions to improve food security should focus on strengthening food systems by addressing constraints in production, distribution, and consumption (Pinstrup-Andersen, P., 2009).

The Political Economy of Food: this perspective highlights the role of power relations, social norms, and political institutions in shaping access to food and nutrition. In sub-Saharan Africa, political instability, conflict, and unequal distribution of resources have contributed to food insecurity. This approach suggests that policies and institutions that promote equity, social justice, and democratic governance can improve food security (Maxwell, S., & Slater, R., 2003).

The Livelihood Approach: This approach considers food security as a component of broader livelihood strategies that households adopt to cope with economic, social, and environmental challenges. In sub-Saharan Africa, many households rely on a combination of agricultural and non-agricultural activities to meet their food and other needs. This approach suggests that interventions to improve food security should be integrated into broader livelihood strategies that address multiple vulnerabilities (Devereux, S., 2001).

The Gender Approach: This approach considers the differential impact of food insecurity on woman and men, and the role of gender norms and power relations in shaping access to food and nutrition. In sub-Saharan Africa, gender inequalities in access to resources and decision making have contributed to food insecurity among women. This approach suggests that

interventions to improve food security should address gender inequalities in access to resources and decision making (Quisumbing, A.R. et al., 1996).

Overall, the theoretical literature on food insecurity in Sub-Saharan Africa highlights the need for a comprehensive and integrated approach that addresses the multiple dimensions of food security, including availability, access, utilization, and stability. In this sense, the above theoretical literatures, and economic theories I have reviewed provide a strong foundation for my research, highlighting the significance of countries' policy and institutional framework in addressing food insecurity. By building upon these theories and previous findings, this study contributes to the understanding of how specific policy and institutional factors can influence food security outcomes, ultimately informing potential interventions and policy recommendations.

2.2 Empirical Literature

In this empirical literature part, the researcher focuses only on selected empirical studies that highlighted the relationship between GDP per capita, population growth, arable land, landlocked ness, components of policy & institutional frameworks, other most common variables, and food insecurity, among various factors influencing food insecurity.

2.2.1 Studies on the Impact of GDP per capita on Food Insecurity

There are numerous empirical studies that have examined the impact of GDP per capita or income on food insecurity. For example, research by Nord, M., (2002) revealed that higher per capita income levels were associated with increased purchasing power and improved access to diverse and nutritious food, thereby reducing the prevalence of food insecurity among households: Pingali (2007) on its own emphasizes that "economic access to food has been proven by growing their ability to buy home made protein and nutritious food from income i.e., there will be more

food in the house when the house has more income and vice versa". Nord, M., & Prell, M. (2009) also used data from current population survey food security supplement, which is a nationally representative survey in the United States that collects information on food security status and household characteristics, and employ descriptive statistics and regression analysis to examine the relationship between household income and food insecurity among households with children. The study finds that as household income increases, the prevalence and severity of food insecurity decreases. The study highlights the importance of income as a key determinant of food security among households with children and provides insights into the characteristics of food-insecure households. On the same note Hoddinott, J. (2006) studied about economic shocks and its consequence across and within households in rural Zimbabwe. The study uses panel data collected through household surveys in rural Zimbabwe, capturing information on household's characteristics, income, and food security status, and finds that economic shocks have adverse effects on household food security, with varying impacts across households. Which shows that income changes and crop failure can lead to reduced food availability, limited access to food, and compromised food utilization, contributing to food insecurity in rural Zimbabwe.

2.2.2 Studies on the Impact of Population Growth on Food Insecurity

Regarding the empirical studies that have examined the impact of population growth on food insecurity, Headey, D.D., & Fan, S. (2010) used national and global datasets on food production, consumption, prices and population growth rates, and employs descriptive statistics and regression analysis to explore the relationship between population growth and food insecurity. Their finding shows that population growth, combined with other factors such as rising food prices and low agricultural productivity, contributes to food insecurity. It emphasizes the importance of sustainable agricultural development and investment in smallholder farmers to address the

challenges posed by population growth and food security. According to Waithanji, E., & Qaim, M. (2017) about impacts of population growth on agri-food systems, the study uses household survey data from five sub-Saharan African Countries, including information on population dynamics, agricultural production, and food security indicators, and employing the panel data analysis and instrumental variable regression to examine the relationship considering potential endogeneity issues. The finding shows that population growth has mixed effects on food security. While higher population density is associated with increased agricultural intensification and improved food availability, rapid population growth rates can pose challenges for sustainable resource management and exacerbate food insecurity. The findings highlight the importance of context-specific policies to address the impacts of population growth on agri-food systems. In addition, the following studies also highlights the effects of population growth on food insecurity. For instance, according to Brown et al. (1981) "...more food demand increases after an increasing abundance of people and contributes to inadequate food to feed the whole population". Tian, (2016) also claimed that "rapid population growth has significantly affected food availability and has led to food insecurity mostly in central South and northern America, Southeast Asia, and sub-Saharan Africa".

2.2.3 Studies on the Impact of Arable Land on Food Insecurity

Regarding the impact of Arable land on food insecurity, Liu and Schneider, (2010) have been identified that "arable land is important for food security and food production. And without the arable land it is impossible to secure food production". Carr, E.R. (2008) also studied about livelihood and adaptation in Ghana's Central region. The study utilized a combination of qualitative and quantitative data, including household surveys, and it employs a mixed methods approach combining descriptive statistics and spatial analysis to explore the relationship between

arable land availability, livelihoods, and food security. The study finds that access to arable land and agricultural productivity play a crucial role in household livelihood strategies and food security i.e., limited access to arable land, due to factors such as land tenure insecurity and competition, negatively impacts food security outcomes in the study area. Mekonnen, D.A., & Kohlin, G. (2009) also studied and found that limited access to arable land and high reliance on fuelwoods as a primary cooking fuel are associated with increased food insecurity. Household with limited land resources are more likely to rely on fuel wood, which can have adverse effects on food security due to the time-consuming nature of fuelwood collection and potential deforestation.

2.2.4 Studies on the Impact of Landlocked ness on Food Insecurity

Empirical studies that have examined the impact of landlocked ness on food insecurity are many of which Zafari, K., & Ismailov, A. (2016) is one. Based on the study using wide range of literature and case studies to examine the relationship between food insecurity and landlocked Ness, being a landlocked country combined with conflict, can exacerbate food insecurity through multiple channels. Constraints on trade and transportation, limited access to markets, and disruptions in supply chains can contribute to reduced food availability and increased vulnerability to food crises in landlocked countries.

2.2.5 Studies on the impact of other Variables on Food Insecurity

Other factors which previous empirical studies have identified other than the above four main determinants of food insecurity all over the world in general and in sub-Saharan Africa in particular, are the following: Climate change and environmental degradation is one of the factors which have a negative impact on agricultural productivity and food availability, and then lead to food insecurity. In this sense, a study by Lobell et al. (2011) found that climate change has already reduced global maize and wheat yields, and projected future yield reductions could lead to

significant food insecurity: Agricultural policies and practices are other factors that have been given attention by scholars. In this sense, agricultural policies that prioritize large-scale commercial production over smallholder farming can contribute to food insecurity. A study by Demeke et al. (2010) in Ethiopia found that agricultural policies focused on commercialization led to a neglect of smallholder agriculture and a decline in food security: Poor health and nutrition also can contribute to food insecurity, as individuals who are sick or malnourished may have limited access to food or be unable to work. A study by Hadley and Patil (2006) in Tanzania found that health and nutrition were important determinants of food insecurity.

2.2.6 Studies on the Disaggregated Effect of Components of CPIA on Food Insecurity

Regarding the causal effect of countries' policies and institutions on food insecurity, based on the knowledge of the researcher no study has been found that shows the combined effect of all 10 indicators on food insecurity so far, however, a few studies have tried to see the relationship between some of the components of policies and institutions with food insecurity. To mention a few of them, if we want to see how building human resource affect food insecurity Aminaa. A (2021) identified that education can be a crucial factor contributing to improved food security in sub-Saharan Africa. Her research demonstrated that higher levels of education positively influenced agricultural productivity, as educated farmers are more likely to adopt modern farming techniques, applying sustainable practices, and make informed decisions associated with resource allocation, ultimately leading to improved food security: a study regarding the social protection programs, such as cash transfers and food assistance, can improve food security by increasing household income and access to food. In this sense, a study by Kondylis et al. (2012) in Niger found that cash transfers had a significant impact on food security, reducing the prevalence of hunger by 14 percentage points: About the impact of human resources on food insecurity, study

by Van Campenhout and Bizimungu (2018) in Uganda found that education was positively associated with food security, and with every additional year of education there was a 4.8 percentage point reduction in the probability of food insecurity: On the same note, a study by Abuya et al.(2015) in Kenya found that poor health was a significant predicator of food insecurity, with households with a sick member more likely to be food insecure: About the empirical literature that examines the causal effect of public resource management on food insecurity, study by Diao et al. (2019) in Malawi found that increased public investment in agriculture was associated with higher agricultural productivity and reduced food insecurity: Environmental sustainability is another factor that plays an important role in food security, as the degradation of natural resources can affect agricultural productivity and increase food insecurity. In this context, a study by Nelson et al. (2010) found that climate change-induced reductions in crop yields could increase the number of people at risk of hunger in sub-Saharan Africa: Study by Popkin, B.M., Adair, L.S., & Ng, S.W.(2012), argues that structural policies, such as the globalization of food markets and the promotion of processed and high-calorie foods, have contributed to the rise of obesity and other diet related health problems in developing countries. Based on these studies we can see that structural policies have a negative causal effect on food security outcomes, particularly when they prioritise market-oriented approaches over social and environmental goals. However, more research is needed to fully understand the complex interactions between structural policies and food security, as well as to identify potential policy solutions that can support more equitable and sustainable food systems: Last but not least, according to studies that examine the causal effects of resource allocation on food insecurity, a study by Jayne et al. (2014) in Kenya found that reallocating land from large to small farms was associated with increased food production and improved food security. A study by H.Ibrahim (2009) is another study that we can mention

regarding the effect of resource allocation on food security. According to the study "an effective allocation of resources can enhance the food security status of farming households" (H. Ibrahim, 2009).

2.2.7 Studies on Food Insecurity and Sub-Saharan Africa

Finally, in the context of sub-Saharan Africa, the relationship between food insecurity and various factors can be described based on the findings of the following studies: Helal (2016) suggests a positive relationship between food insecurity and corruption. This implies that higher levels of corruption within given country or region are associated with increased food insecurity. The study highlights that corrupt practices can undermine the effectiveness of food security programs and hinder equitable access to food, particularly among vulnerable populations: Muhammad Khalid A. et al. 2021 also studied how innovation and social inclusion, which are a key component of institution, and food insecurity are related. And his study shows that there is a negative relationship between innovation and social inclusion on one hand, and food insecurity on the other hand in sub-Sharan Africa. This implies that lower levels of innovation within the region are associated with reduced social inclusion, which can contribute to increased food insecurity. Therefore, it is expected that limited innovation in agricultural practices, technology, and value chains hampers productivity and resilience in the agricultural sector, affecting the livelihood and food security of marginalized communities: Another interesting point that has been raised is the effect of political institution on food security by Zhou. Zhou, (2017) reveals a negative relationship between political institution quality and food insecurity. This suggest that countries with better political institutions tend to have lower levels of food insecurity. The study emphasizes that strong political institutions, such as good governance, effective policy implementation, and inclusive decision-making processes, can create an enabling environment for agricultural development,

enhance food production, and mitigate food insecurity risks. In summary, within the context of global in general and sub-Sharan Africa in particular, these studies indicate that corruption is positively associated with food insecurity, innovation and social inclusion are negatively related to food insecurity. And we can see that these findings highlight the importance of addressing corruption, promoting innovation and social inclusion, and improving political institutions as a key strategy for reducing food insecurity and promoting sustainable development in the region.

2.3 Conceptual Framework

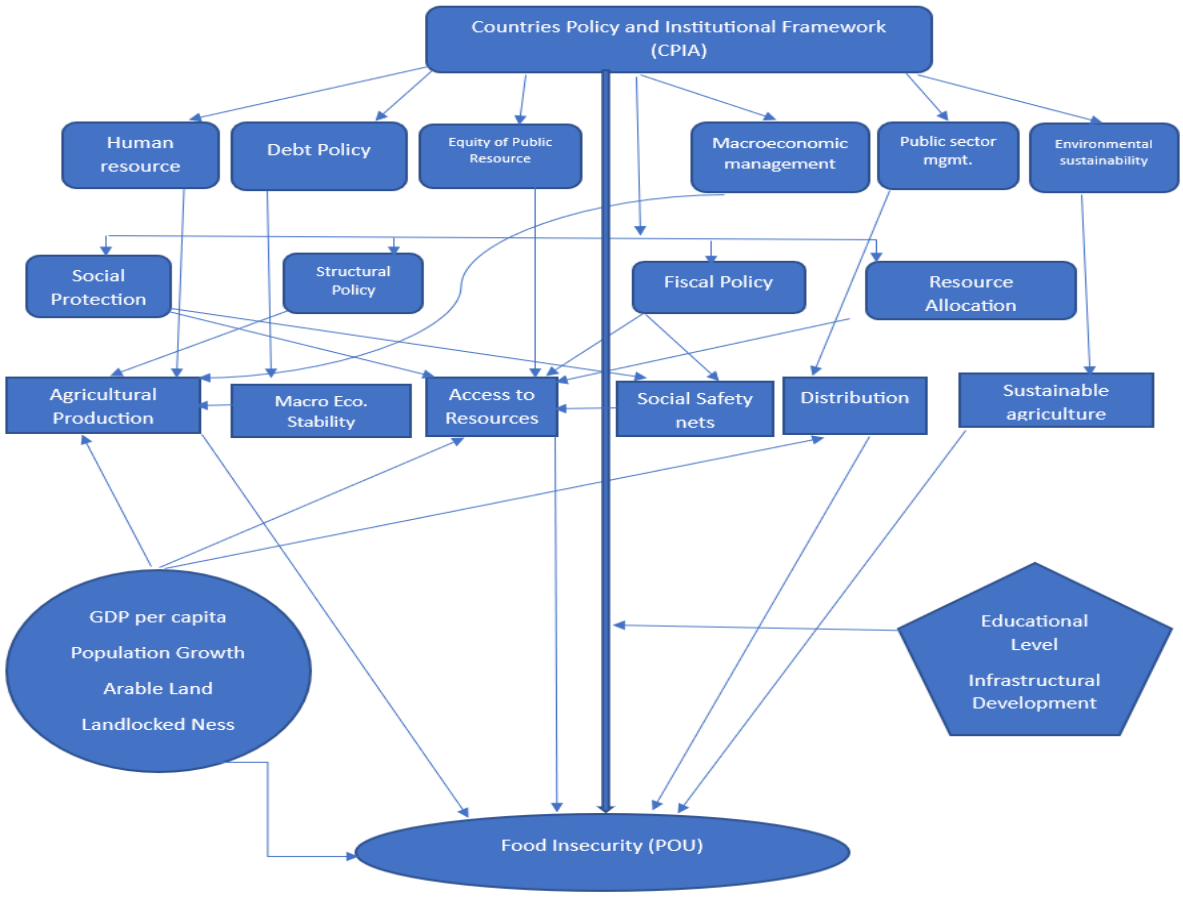

Figure 3. Conceptual Framework of the Study

3. Methodology

This chapter of the study encompasses various components that shed light on proposed topic and research question, research design, data sources, selection techniques, variables, and measures, as well as the estimation techniques employed to address the research question. Let's begin with the proposed topic and research question to have a big picture about the study.

3.1 Proposed Topic and Research Question

How do components of policy and institutional frameworks affect the food insecurity of developing countries taking the case of Sub-Saharan Countries?

3.2 Research Design

This study employs a quantitative research design to examine the relationship between a country's policy and institutional framework and food insecurity. The reason for using a quantitative approach is that because it allows for the exploration of trends, patterns, and statistical relationships within the data, so that it provides a valuable insight into the research question raised above.

3.3 Country Selection Criteria

The study adopted a purposive selection technique to choose countries from Sub Saharan Africa for analysis. The selection included 38 countries out of total 49 countries in the region. The selection criteria consider data availability as a main factor i.e., all countries with available data on both the dependent variable, food insecurity proxied by prevalence of undernourishment, and independent variables, countries policy and institutional framework indicators were included in the analysis.

3.4 Data Sources

The primary data sources for this research study are publicly available datasets, reports, and data bases that contain relevant information on countries policy and institutional frameworks, control variables as well as data on food insecurity indicators. These sources include reputable international organizations. The World Bank database, FAOSTAT, and Statista are used as a primary source of secondary data. Where data related to the prevalence of undernourishment (in % of population) is obtained from FAOSTAT, and Statista and the data cover a period from 2005 to 2021 covering a 17-year period, which provides comprehensive country-level estimates based on food balance sheets and other relevant sources. While indicators representing the components of the policy and institutional framework (building human resources, debt policy, equity on public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policy, and resource allocation), are collected from the World Bank database using data ranges from 2005 to 2021 as well, to align with the period of the dependent variable, including various economic, social and environmental indicators. The data for control variables also collected from the World Bank database.

3.5 Variables and Measures

The key variables in this study are countries' policy and institutional frameworks, which serve as the independent variables, and food insecurity represented by prevalence of undernourishment. The researcher used a panel sample of 38 countries from sub-Saharan Africa using the data that span from 2005 to 2021. Because measuring food insecurity is not an easy task this study uses prevalence of undernourishment as a proxy measurement for food insecurity, where according to FAO prevalence of undernourishment is "the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to

maintain a normal active and healthy life. For example, data showing as 2.5 may signify a prevalence of undernourishment below 2.5%" (The World Bank, 2023).

The countries policy and institutional framework indicators comprises a total of 21 variables of which 10 are selected. One of the reasons for selecting only 10 variables out of the 21 components of countries' policy and institutional framework, as defined by the World Bank, is based on economic theory. Economic theory suggests that certain factors have a more direct and significant impact on food insecurity in developing countries. By carefully examining the economic literature and theoretical frameworks, the 10 selected variables were identified as having relatively a strong theoretical foundation and empirical evidence linking them to food insecurity. For example, economic theory emphasizes the role of factors such as human resource development, fiscal policy, macroeconomic management, environmental sustainability, and resource allocation in shaping the socio-economic conditions that contribute to food insecurity. These variables are considered by many previous literatures as a key driver of economic growth, poverty reduction, and the development of robust and sustainable agricultural systems. Furthermore, selecting a subset of variables allows for a more focused and manageable analysis, enduring that the research remains feasible within the scope of the study i.e., by narrowing down the variables to the most relevant and influential ones, the analysis can provide more meaningful insights into the specific relationship between countries policy and institutional frameworks and food insecurity. But it is also important to note that the selection of variables based on economic theory doesn't imply that the other components of the policy and institutional framework are insignificant or unimportant. Rather, it should be noted that the selection reflects a deliberate decisions of researcher to focus on variables that have a strong theoretical foundation and are more likely to yield actionable insights and policy recommendations regarding food insecurity in sub-

Saharan African countries. All components of countries' policy and institutions are allotted a numerical value within a specified range from 1 to 6, where the lowest value 1 indicates that specific country has weak policy and institutional framework in that specific indicator, while the highest value 6 indicates that the country has strong policy and institutional framework on that specific indicator.

A total of four control variables such as GDP per capita, population growth, arable land and distance to the port have been used to account for potential confounding factors. Where:

GDP per capita represents the economic output per person in a country and serve as a proxy for the level of economic development (The World Bank, 2023). This study used GDP per capita as an important control variable as it helps account for the economic context in which countries' policy and institutional frameworks operate i.e., higher GDP per capita may indicate greater capabilities to address food insecurity.

Annual population growth is another key demographic factor that influences food security. Rapid population growth can put additional pressures on food production, distribution, and access. Including this variable as a control helps to account for the population dynamics and their potential impact on food insecurity in the selected countries.

Arable land as agricultural land under temporary crops as a percentage of the total land reflects the extent of available agricultural land suitable for temporary crops (The World Bank, 2023) i.e., the agricultural resource base for food production and is an important control variable as it accounts for the potential productive capacity of the land. Countries with higher proportions of arable land may have greater agricultural potential, which can influence food security outcomes.

Landlocked ness (distance from the port) is a binary variable indicates whether a country is landlocked or has access to a seaport. Being landlocked can pose challenges to trade, transportation, and access to international markets, which can have implications for food security. Therefore, including this variable as a control helps to account for the geographic context and potential constraints on a country's food system.

Overall, by including these control variables in the analysis, this study aims to isolate the specific impact of countries' policy and institutional frameworks on food insecurity, while accounting for the influence of economic factors (GDP per capita), demographic factors (population growth), agricultural resources (arable land), and geographic factors (landlocked status). The researcher believes that controlling for these variables allows for a more comprehensive understanding of the relationship between policy, institutions, and food insecurity in the sub-Sharan region.

As far as the statistical software used is concerned, in this study two main statistical software programs were used to conduct the analysis. Excel was primarily used for descriptive statistics, such as means, standard deviations, and correlations, to provide a comprehensive overview of the variables used in the study. Examining historical trends and patterns between the dependent variable and independent variable, visualization of the data through charts and graphs have also been done by Excel, while STATA was employed for the main econometric analysis of dynamic panel data i.e., it was employed to conduct the dynamic panel data analysis to examine the causal relationships and long-term effects between variables over time. By employing STATA, this study was able to apply advanced statistical techniques to analyze the impact of countries' policy and institutional frameworks on food insecurity. By employing the combination of these two software programs, the researcher believes that the analysis was conducted with accuracy,

rigor, and efficiency, allowing for a thorough investigation of the research question and providing reliable insights into the relationship between countries' policy, institutions, and food insecurity in the sub-Saharan region.

The detailed explanation and sources of all variables can be found in Table 1, along with the corresponding symbols used for the empirical analysis. [3]

Table 1. Sources of the data and explanation of variables

Symbols	Variables	Explanation	Source
	Dependent		
Foodinsec	Food Insecurity	Food insecurity proxied by prevalence of undernourishment (in terms of % of population)	FAOSTAT, Statista, and the World Bank
	Independent		
Humanres	Building human resource rating	CPIA business regulatory environment rating (1=low to 6=high)	World Bank
Debtpolicy	Debt Policy Rating	CPIA debt policy rating (1=low to 6=high)	World Bank
publicres	Equity of public resource use rating	CPIA equity of public resource use rating (1=low to 6=high)	World Bank
Fiscalpol	Fiscal policy rating	CPIA fiscal policy rating (1=low to 6=high)	World Bank
Macroecomgmt	Macroeconomic management rating	CPIA macroeconomic management rating (1=low to 6=high)	World Bank
Envtsust	Policy and institutions for environmental sustainability rat	CPIA policy and institutions for environmental sustainability rating (1=low to 6=high)	World Bank
Pubsecmgmt	Public sector management and institutions cluster average	CPIA public sector management and institutions cluster average (1=low to 6=high)	World Bank
Socialprotection	Social protection rating	CPIA social protection rating (1=low to 6=high)	World Bank
Structuralpol	Structural policies cluster average	CPIA structural policies cluster average (1=low to 6=high)	World Bank
Resourcealloc	Resource allocation index	IDA resource allocation index (1=low to 6=high)	World Bank
	Control		
Landlocked	Landlocked	Having no coastline or seaport (dummy 1 for yes 0 for no)	tutor2u
Arableland	Arable land	Agricultural land under temporary crops as a percentage of the total land	World Bank
Popgrowth	Population growth	The annual population growth rate in percentage	World Bank
Gdppercapita	GDP per capita	GDP per capita is gross domestic product divided by midyear population(in USD)	World Bank

Table 1. Detail on sources of data and explanations of variables[4]

[3] Table 1 provides comprehensive information on each variable, ensuring transparency and clarity regarding their definitions, sources, and notations for the purpose of this study.

[4] Details of the variables used in the analysis and their full definitions as per the sources of the data are found in the appendices (appendix 2)

The following table provides information about the descriptive statistics (total observation, mean, minimum, maximum, and standard deviation values)

Descriptive statistics, 2005-2021					
Variables	**Obse**	**Mean**	**S.Dev**	**Min**	**Max**
Food Insecurity	646	22.4695	0.482507	3.1	69
Building Human resource	646	3.455108	0.592195	1	4.5
Debt Policy	646	3.218266	0.85156	1	5
Public Resource Management	646	3.306502	0.63772	1	4.5
Fiscal Policy	646	3.270124	0.629524	1	4.5
Macroeconomic management	646	3.569659	0.647434	1	5
Environmental sustainability	646	3.142415	0.553912	1.5	4.5
Public Sector management	646	2.976471	0.472405	1.6	4.1
Social Protection	646	2.993808	0.551917	1	4.5
Structural Policy	646	3.257276	0.427514	1.5	4.16667
Resource Allocation	646	3.204373	0.450363	1.4	4.2
Landlocked	646	0.289474	0.45387	0	1
Arable land	646	16.73937	14.21019	1.086281	48.72219
Population Growth	646	2.702299	0.689454	1.015135	5.6274
GDP percapita	646	1133.544	813.3592	151.1885	5101.984

Table 2. Descriptive statistics, 2005-2021

3.6 Specification of the Model:

3.6.1 Theoretical Framework:

According to Malthusian theory in the late 18th century population growth tends to outpace the growth of food production which will then lead to food scarcity and insecurity. Malthus said population increases exponentially, while food production grows linearly. As a result, he argued that population growth would eventually surpass the capacity of the earth to produce enough food to sustain the population (Malthus, T. R., 1986). He emphasized the role of natural checks on population growth, such as disease, famine, and war, as mechanism to control population size and prevent over consumption of limited resources. Neo-Malthusian theory builds up on Malthus ideas

and incorporates modern factors that contribute to food insecurity. The theory argues that rapid population growth, combined with factors such as environmental degradation, resource depletion, and climate change, exacerbates food insecurity (Olimar E. Maisonet-Guzman, 2011). Neo-Malthusian also stress the importance of sustainable resource management, conservation efforts, and population control measures to mitigate food insecurity and achieve long term sustainability. Regarding arable land, Neo-Malthusian perspective is as population increases, the demand for food also rises. However, the availability of arable land, which is essential for agricultural production, is limited and subject to various constraints such as urbanization, degradation, and loss due to climate change and other factors. Neo-Malthusian, therefore, assert that this limited arable land poses a threat to achieving food security on a global scale (Meadows, D. H., et al., 1972). From these theories we can build a basic food insecurity equation as follows.

$$Foodinsec_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 AL_{it} + \varepsilon_{it}, \ldots\ldots\ldots\ldots (1)$$

Where Foodinsec denotes the food insecurity assessment proxied by prevalence of undernourishment, POP represents population growth, and AL represents the arable land.

The construction of the initial model in this study is guided by both theoretical foundations and empirical evidence from previous literature on food insecurity. Drawing on established theoretical frameworks, such as Malthusian and Neo-Malthusian theories, this study identified key variables that are widely recognized as influential factors in determining food security outcomes such as GDP per capita and being land locked. In this sense, various studies have been shown that being landlocked has its own negative effect on economic growth and food security. For example, Jayne, T.S., Villarreal et al. (2005) examines how limited access to ports and transport infrastructure can affect the cost, availability, and quality of imported and exported food commodities, thus influencing food security outcomes. Grigoriou, C. (2007) also assess the impact

of landlocked Ness on central Asian trade using a panel gravity equation and their result shows countries need to have transit corridor, and even countries should actively seek diversification of their transit corridor. Zafari, K., & Ismailov, A. (2016) also agrees that landlocked countries experience higher levels of food insecurity compared to countries with access to maritime trade routes.

Regarding the relation between GDP per capita and food insecurity, Headey, D., & Fan, S. (2008) examines how changes in economic factors, including GDP per capita, can influence food insecurity outcomes. In fact, their specific focus was on the causes and consequences of surging food prices. However, they discuss how higher GDP per capita levels generally lead to improved food security by enhancing access to food through increase purchasing power and better infrastructure for agricultural production and distribution.

Furthermore, my model is built upon the methodology employed in a notable study by Abdullahi et al. (2020). Their research design and variable selection closely align with my approach, providing a solid basis for constructing my initial model. By adopting a similar framework, this study aims to ensure consistency and comparability with their findings, thereby contributing to the robustness and generalizability of our results. In this context, this study considers variables such as population growth, GDP per capita, arable land, and landlocked Ness as critical variables for building our initial model. These variables have been extensively studied in the literature and have demonstrated significant associations with food security outcomes in various contexts, The inclusion of these variables in this model allows to capture their individual and combined effects on food security, enabling a comprehensive analysis of these factors influencing food security in sub-Saharan Africa. In this sense, the initial small model which was

built by using Malthusian and Neo-Malthusian model in equation one can be expanded and take the following equation:

$$Foodinsec_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 AL_{it} + \beta_3 GDP_{it} + \beta_4 landlocked + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots (2)$$

In addition to above factors economic theory and literatures also support that countries policy and institutional frameworks have a significant impact on food insecurity. For example, we can take institutional economics which states about the role of institutions, including formal rules, and informal norms, in shaping economic outcomes, including food security. Other institutions such as property rights, governance structures, and regulatory frameworks influence agricultural production, market functioning, and access to food resources (North, D.C., 1992). Political economy theory also examines the interaction between politics, economics, and institutions in shaping food security outcomes. It highlights the role of power, distributional conflicts, and policy choices in determining access to food and resources (Bardhan, P. (2004). Literatures on agriculture and its policy also covers extensive area on how policies such as subsidies, trade regulations, and input support influence production levels, food availability, and access to food. Here, the design and implementation of agricultural policies can affect incentives for farmers, investment in agriculture, and overall food security outcomes (Swinnen, J.F., & Vandeplas, A., 2010). As far as governance and institutions is concerned literatures told us that good governance, transparency, and accountability in policy-making and public resource management are crucial for achieving food security (Deininger, K., & Mpuga, P. ,2005). In this sense, we can see that sound institutions and effective governance systems contribute to equitable distribution of resources, investment in agriculture, and social protection measures.

Given that the above theories and literatures provide an insight into the relationship between countries policy and institutional frameworks and food insecurity on one hand, and they highlight the importance of institutions, political economy factors, agricultural policies, and governance in shaping food security outcomes we can finalize the panel data econometrics model to be used for this specific study by incorporating the countries policies and institutional framework variable.

$$Foodinsec_{it} = \beta_0 + \beta_1 POP_{it} + \beta_2 AL_{it} + \beta_3 GDP_{it} + \beta_4 landlocked_{it} + \beta_5 CPIA_{it} + \varepsilon_{it} \quad (3)$$

Where i=1, 2….38, t=1, 2…...17, ε ~ N (0, σ2), CPIA indicates countries policy and institutional framework's 10 indicators used, such as human resource development, debt policy, equity on public resource management, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policy, and resource allocation:

β's is estimated parameters (β_0 is intercept and β_i are slope coefficients for 10 CPIA variables and 4 control variables used.

Finally transforming all the above variables into its logarithmic form gives us the following equation.

$$lnFoodinsec_{it} = \beta_0 + \beta lnX_{it} + \varepsilon_{it} \quad (4)$$

Where lnFoodinsec is the transformed log form of food insecurity, and X represents the set of all explanatory variables including the control variables GDP per capita, population growth, distance from the port, arable land, and countries policy and institutional frameworks (CPIA's); furthermore, i represent sub-Saharan countries under the study, and t represents time period for each country.

As explained earlier given that the nature of the data is panel, we use Dynamic panel data estimation as proposed by Arellano and Blundell (1991) i.e., due to the fact that Arellano-Bond estimation method addresses endogeneity and dynamic panel data issues in empirical research, we

apply dynamic panel data estimation unlike the traditional panel data estimation techniques. The key insight of Arellano and Blundell approach is to use lagged differences of the variables as instrumental variables to account for endogeneity and to obtain consistent estimates, which can be highly appliable in this study as most of the explanatory variables are endogenous. In addition, Arellano and Blundell discuss on their paper about the limitations of traditional panel data estimation technique when dealing with endogeneity and serial correlation problems (Arellano, M., & Bonds, S., 1991). Therefore, we use the generalized method of moments (GMM) estimator that uses lagged differences as instruments to address these issues, and to inspect the impact of countries policy and institutions on food insecurity for sub-Saharan African countries under the study.

3.6.2 Estimation Techniques, Hypothesis and Specification Tests

In this section the estimation techniques applied, the test carried out to detect various specification problems will be covered. In empirical research, the use of statistical tests plays a crucial role in evaluating hypothesis and assessing the validity of the chosen analysis technique. One such technique that is applied in this study is Generalized Method of Moments. GMM is applied due to its ability to handle endogeneity and accommodate dynamic panel data. However, it is important to not only examine the hypothesis being tested but also assess the potential misspecification of the model. Therefore, this introductory section aims to provide an overview of tests of hypothesis and misspecification in the context of the study utilizing GMM as the analysis technique. It also highlights the significance of hypothesis testing in empirical studies and the potential challenges related to model specification. In the case of hypothesis testing, as Baum et al., (2003) mentioned in their paper the use of GMM allows for estimation under weak assumptions and can help address endogeneity concerns, making it powerful tool for hypothesis testing.

Specifying the appropriate moment conditions, GMM provides consistent and efficient parameter estimates, enable me to draw a valid conclusion about the relationships of interest. While GMM offers advantages in dealing with endogeneity and dynamic panel data, it is crucial to assess the potential misspecification of the model so that it is possible to mitigate the problem of getting biased parameter estimates and incorrect inference associated with failure to address misspecification. To assess misspecification in GMM models, various diagnostic tests will be applied. Among the top benefits, misspecification tests help to identify potential issues such as omitted variables, functional form misspecification, or serial correlation. Therefore, conducting these tests ascertain the robustness and validity of the estimated model, ensuring that it appropriately captures the relationships among the variables under investigation (Baum, C.F., Schaffer, M.E., & Stillman, S., 2003).

Given that one of the biggest challenges in estimating techniques are a problem associated with endogeneity, using the GMM estimation techniques can provide several advantages over other analysis methods such as Ordinary Least Square (OLS) and Two-Stage Least Squares (2SLS). For instance in terms of addressing endogeneity by using instrumental variables, the capacity of handling dynamic panel data for better control of unobserved heterogeneity and serial correlation, getting consistent estimate in the presence of measurement errors, and above all robustness to misspecification such as heteroscedasticity and serial correlation in the error terms, and a capacity of providing efficient estimates even when the assumptions of OLS are violated makes GMM a flexible and reliable method (Arellano and Blundell, 2017). But it should also be noted that despite all these advantages it is important to note its effectiveness relies on appropriate instrument selection and model specification. Therefore, this study tries to carefully validate instrument relevance and perform diagnostic tests to assess model specification.

For my further analysis here is the general form of dynamic panel regression model equation:

$$\ln Foodinsec_{it} = \beta_0 + \delta \ln Foodinsec_{it,\,t-1} + \beta \ln X_{it} + \lambda Z_{I} + \varepsilon_{it} \ldots\ldots\ldots\ldots \quad (5)$$

Where: $Foodinsec_{it}$ represents the dependent variable for unit i at time t; $Foodinsec_{it-1}$ represents the lagged dependent variable (lagged food insecurity) in our case. X_{it} represents a vector of time-varying independent variables. Z_i represent a vector of time-invariant individual specific characteristics. The coefficients β_0, β, δ, λ are the coefficients to be estimated; and finally, ε_{it} represents the error term.

Given the above equation, equation 5, we can control for unobservable time-invariant individual specific characteristics as Arellano did by taking the first difference -GMM of equation 5. This method is commonly used in dynamic panel data model to address endogeneity and other issue. Where differencing of the equation looks the following (Arellano and Blundell, 1991).

$$(\ln Foodinsec_{it} - \ln Foodinsec_{it,t-1}) = \delta\,(\ln Foodinsec_{it,\,t-1} - \ln Foodinsec_{it,\,t-2}) + \beta\,(\ln X_{it} - \ln X_{it,\,t-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

By taking the first difference of the variables, we can eliminate the individual-specific effects (fixed effects) which helps us to address endogeneity concerns since the differenced variables are used as instruments to address endogeneity in the model; differencing also helps us to remove serial correlation in the model by differencing out the time-invariant individual-specific effects; furthermore, given that first difference GMM estimation can help us to handle unobserved heterogeneity and control for time-invariant individual-specific characteristics in our model, it can provide us consistent estimates for the potential measurement errors or omitted variables (Arellano and Blundell, 1991). This leads us to rewrite the above first difference equation as:

$$\Delta \ lnFoodinsec_{it} = \delta \Delta lnFoodinsec_{it,\ t-1} + \beta \Delta lnX_{it} + \Delta \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots (7)$$

But the problem is still we have a correlation among the lagged explained variable and the new error term **(Δ lnFoodinsec$_{it-1}$ and $\Delta\varepsilon_{it}$)** which means that there is an endogeneity problem still, although, we removed the serial correlation by differencing out the time-invariant individual-specific effects which could be a source of serial correlation. Therefore, we need to extend the first difference GMM by including the levels of the variables as additional instruments. This helps us to address endogeneity by exploiting the orthogonality (instead of subtracting the previous observation from the contemporaneous one, it subtracts the average of all future available observations of a variable), between the levels and differences of the variables, and we call this system GMM (Blundell, R., & Bond, S., 1998). System GMM corrects endogeneity by introducing more instruments to improve efficiency, and by transforming the instruments to make them uncorrelated with the fixed effects. System GMM builds a system of 2 equations, the original equation and the transformed one. Where one equation is expressed in levels form with FDs as instruments, and the original model looks:

$$lnFoodinsec_{it} = \beta_0 + \delta lnFoodinsec_{it,\ t-1} + \beta lnX_{it} + \lambda Z_{\ l} + \varepsilon_{it} \ldots\ldots\ldots\ldots (8)$$

And second equation is expressed in first difference form with levels as an instrument, where its transformed model looks:

$$\Delta \ lnFoodinsec_{it} = \delta \Delta lnFoodinsec_{it,\ t-1} + \beta \Delta lnX_{it} + \Delta \varepsilon_{it} \ldots\ldots\ldots\ldots\ldots (9)$$

By this, system GMM uses more instruments than difference GMM and gives us an advantage of getting more robust standard error, especially in the presence of heteroscedasticity and serial correlation (Arellano and Blundell, 1991). In summary, System GMM can help us to

address serial correlation by using lagged levels and differences of the variables as instruments to capture the autocorrelation structure in the model. Another interesting issue that we can handle by using system GMM is that system GMM estimation can effectively deal with unobserved individual-specific effects, control for time-invariant heterogeneity, and omitted variable (Arellano, M., & Bond, S. (1991), and (Blundell, R., & Bond, S., 1998), and (Roodman, D., 2009).

Although, it is not always true that system GMM can always be more accurate than first difference GMM, it seems that system GMM gives more sense in our case, as it is believed to have there is strong endogeneity presence, due to the following reasons. The first reason is that system GMM allows for more flexibility in capturing the endogeneity between the levels and differences of the variables which potentially provides us more accurate estimates, it is also better in terms of dealing with unobserved time-invariant individual effects, which can cause a measurement errors, and thus system GMM helps us to control for these biased estimates (Arellano and Blundell, 1991). By incorporating additional moment conditions using lagged level as an instrument, system GMM has also the potential to improve the efficiency of the estimates compared to the first difference GMM.

3.6.3 Justifying the Validity of the GMM

Regarding justifying the validity of the GMM estimator, the system GMM allows us to test overidentifying restrictions to assess the validity of the additional instruments and to check for potential overfitting. In this sense, if the instruments are said to be valid, and the model is well-specified, the overidentifying restrictions test should yield us a p-value that is not statistically significant, indicating that our model fits the data well (Arellano, M., & Bover, O., 1995).

Another test we need to check for is the Sargan-Hansen test which is used to assess the validity of both the instruments in the GMM estimation i.e., it tests the null hypothesis that the

instruments are valid, indicating that they are not correlated with the error term in the model. In system GMM, the Sargan-Hansen test is particularly relevant as it evaluates the validity of both the first-difference instruments and the additional lagged level instruments i.e., if the p-value is not significant in Sargan-Hansen test, it suggests that the instruments are valid and the GMM estimator is reliable (Hansen, L. P., 1982).

Furthermore, concerning the serial correlation, we have AR[1] and AR[2], where AR[1] test is used to examine the presence of first-order autocorrelation in the model's error term i.e., it assesses whether there is residual serial correlation in the model even after using lagged levels and differences of the variables as instruments, while AR[2] test for second-order serial correlation and it is examine whether there is residual serial correlation in the model after using the lagged instruments. A non-significant p-value in the AR (2) test indicates that the second-order serial correlation has been adequately addressed in the estimation (Blundell, R., & Bond, S., 1998).

Finally, according to Arellano and Blundell, good estimate of the lag dependent regressor should fall between its fixed effect and pooled OLS i.e., if the value of lagged dependent variable on the right side is close or below to Fixed effects estimate, it suggests that Difference GMM is downward biased and system GMM should be used which can be one way of deciding which model is appropriate to get efficient estimate in GMM (Abdullahi et al., 2020).

3.6.4 Tests of Hypothesis and Misspecification

In this study of the impact of countries policy and institutional framework on food insecurity using the Generalized Method of Moment (GMM), several hypothesis tests can be useful to evaluate the relationships between variables and assess the significance of my results. The main types of hypothesis tests considered in the first place is Wald test to test the joint significance of a group of parameters i.e., whether the coefficients of a set of independent variables

(components of countries policy and institutional framework and control variables use in my case) are jointly different from zero. Where testing this helps to determine the overall significance of the policy and institutional variables in explaining food insecurity.

The second important test to be considered is Lagrange Multiplier (LM) Test also called Sargan test, which is used to test the validity of the overidentifying restrictions in the GMM model, where it examines whether the moment conditions used in the estimation are well-specified i.e., rejection of the null hypothesis indicates a potential problem with the model specification (Schaffer, M., & Stillman, S., 2016).

The third important test is test for serial correlation using tests such as Arellano-Bond test or the Arellano-Bover/Blundel-Bond test, mainly to check for the presence of serial correlation as GMM estimation assumes that the error term is serially uncorrelated. Therefore, a rejection of the null hypothesis suggests the need to account for serial correlation in the estimation (Schaffer, M., & Stillman, S., 2016).

4. Results and Discussion

4.1 Descriptive Result

Based on the average prevalence of undernourishment data from 2005 to 2021, which is proxy to food insecurity, ranking sub-Saharan African countries from higher to lower looks the following. Zambia, Central African Republic, Zimbabwe, Madagascar, Liberia, Congo democratic Republic, Rwanda, Burundi, Chad, Congo, Sierra Leone, Guinea, Mozambique, Angola, Tanzania, Kenya, Ethiopia, Comoros, Guinea-Bissau, Togo, Lesotho, Uganda, Sudan, Djibouti, Malawi, Cabo-Verde, Gambia, Burkina Faso, Niger, Sao Tome and Principe, Senegal, Cote d'Ivoire, Nigeria, Mauritania, Benin, Cameron, Ghana, and Mali. In 2005, a sub-Saharan African country where prevalence of undernourishment was larger is Angola, with a prevalence of undernourishment 52.2%., while a country where prevalence of undernourishment was lower is Nigeria with only 7.1%.

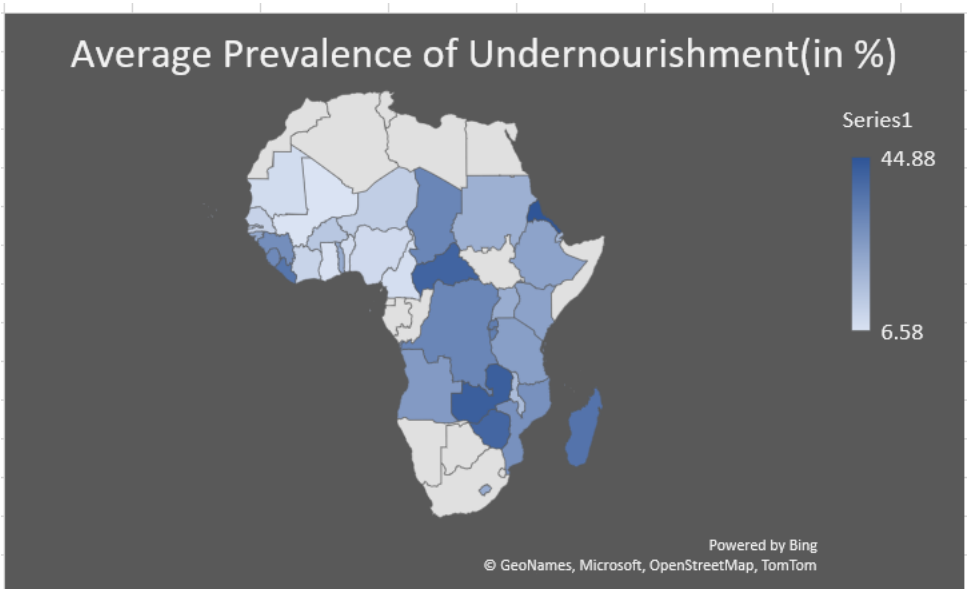

Figure 4 Geographical distribution of Food insecurity in SSA

As far as countries policy and institutions assessment rating in the region is concerned Zimbabwe has the lowest level of 2.28 (where the lowest is 1 and the highest index is 6), while policy and institution assessment rating gets highest in Rwanda with countries policy and institutional assessment rating of 3.93 (1=low to 6=high). This shows that, in Zimbabwe the extent to which the legal, regulatory, and policy environment help in investing, creating jobs, and becoming more productive is low; the debt management strategy to minimize budgetary risks and ensuring long-term debt sustainability is weak; the extent to which the pattern of public expenditures and revenue collection affects the poor is high; the short and medium-term sustainability of fiscal policy and its impact on growth is low; the monetary, exchange rate and aggregate demand policy framework (under macroeconomic management) is weak; policy and institutions for environmental sustainability which assess the extent to which environmental policies foster the protection and sustainable use of natural resources and the management of pollution is weak; the public sector management and institutions which incorporates property rights and rule based governance, quality of budgetary and financial management, efficiency of revenue mobilization, quality of public administration, and transparency & accountability are weak; social protection policies to ensure a minimal level of welfare to all people is low; the structural policy which includes trade, financial sector, and business regulatory environment is weak; and finally resource allocation efficiency is also low. The reverse is true for Rwanda.

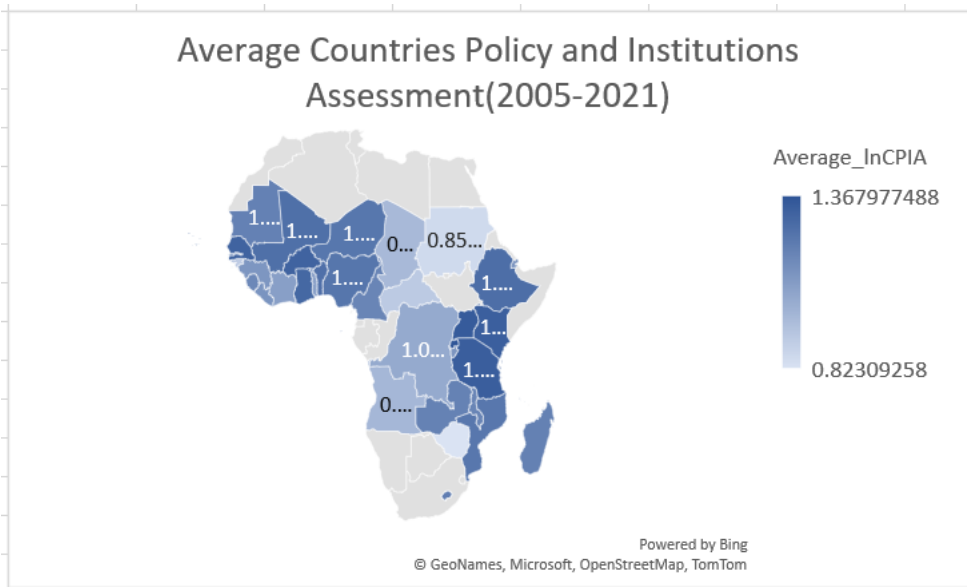

Figure 5. Geographical distribution of Countries policy and Institutions in SSA[5]

4.2 Econometric Result and Discussion

4.2.1 Pairwise Correlation Matrix Discussion

The following correlation matrix provides an insight into the relationship between variables by displaying the pairwise correlations among our dependent variable food insecurity and independent variables indicators of countries policy and institutions and the control variables, where each value in the matrix represents the strength and direction of the linear relationship between the two variables. Having this in mind, our summary table of correlation matrix shows that all components of countries policy and institutional framework have a moderate to strong negative relationship with food insecurity. In addition, given that all correlations between the components of countries policy and institutional framework and food insecurity are significant ($p<0.01$), we can say that the observed associations are unlikely to have occurred by chance. To be mor specific, the strongest negative correlation is observed between our independent variables,

[5] List of countries under the study is found on the appendices (Appendix 1)

resource allocation, public sector management, structural policy, and dependent variable food insecurity, with a correlation coefficient of -0.30, -0.33, and -0.28 respectively ($p<0.01$); while independent variables such as building human resource, equity of public resource use, fiscal policy, macroeconomic management, environmental sustainability, social protection, debt policy shows a moderate negative correlation with our dependent variable food insecurity with a correlation coefficient of -0.17, -0.18, -0.23, -0.24, -0.2, -0.22, -0.24 respectively ($p<0.01$). Here, we can see that the correlations are all significant which suggests that there is a consistent relationship between the independent variables in our case components of countries policy and institutional framework and dependent variable food insecurity, and that changes in one variable are associated with predictable changes in another variable. Of course, we strongly note that correlation doesn't imply causation. Besides that, GDP per capita and arable land are also significantly and negatively correlated with food insecurity, while distance to the port (landlocked) and population growth exhibits a weak positive correlation with food insecurity, with a correlation coefficient of 0.12, 0.01 respectively, where $p<0.01$ for landlocked but insignificant p-value for population growth. From all the descriptive analysis we made above we can say that the correlation matrix results align with what literatures and economic theory says about determining food insecurity, except for population growth where previous literatures as well as my findings suggests a nonsignificant relationship between food insecurity and population growth. For instance, Barrett, C.B. (2010) emphasized that population growth alone doesn't provide a complete explanation for food insecurity i.e., there should be other factors such as economic, social, and political variables that need to be considered together. Another study by Kilic, T., Carletto, C., & Davis, B. (2009) examines the relationship between rural nonfarm income and agricultural productivity in Albania and the researchers came up with the finding that while population growth is considered a factor

influencing rural livelihoods, the impact of population growth on food insecurity is not statistically significant. We can also mention the study by Jayne, T.S., Villarreal et al. (2005) which studied the interactions between the agricultural sector and the HIV/AIDS pandemic in sub-Saharan Africa. According to the study while population growth is one of the factors affecting the agricultural sector, the analysis does not find a statistically significant relationship between population growth and food insecurity, suggesting that other factors play a more significant role.

The correlation matrix was computed to examine the relationship between the components of countries policy and institutional framework, as well as other variables of interest, with the dependent variable, food insecurity. The matrix includes variables such as building human resources, debt policy, equity of public resource, fiscal policy, macroeconomic management, environmental sustainability, public sector management, social protection, structural policy, resource allocation, arable land, distance from the port(landlocked), population growth, and GDP per capita. The results reveals that all components of the countries policy and institutional framework, along with arable land, and GDP per capita, exhibit a negative and statistically significant correlation with food insecurity. This suggests that as the values of these variables increase, the prevalence of undernourishment, used as a proxy for food insecurity, tends to decrease. The negative correlations indicate that countries with stronger human resource development, effective debt policies, efficient public resource management, sound fiscal policies, robust macroeconomic management, sustainable environmental practices, effective public sector management, comprehensive social protection measures, well designed structural policies, optimal resource allocation, higher availability of arable land, and higher GDP per capita tend to experience lower levels of food insecurity. These result from correlation matrix supports the hypothesis that countries with better policies and institutional frameworks are more likely to achieve food security

and reduce the prevalence of undernourishment. The negative and significant correlations underscore the importance of focusing on improving these policy and institutional aspects to address food insecurity effectively. The result from the correlation matrix of the other two control variables such as distance from the port(landlocked) and population growth shows that both variables have a positive correlation with food insecurity, but the correlation coefficient for population growth is not statistically significant. This suggests that there is no significant relationship between population growth and the prevalence of undernourishment, which serve as a proxy for food insecurity. It implies that population growth alone may not be a key driver of food insecurity in the examined context. On the other hand, the fact that being landlocked demonstrates that countries that are geographically landlocked tend to experience higher levels of food insecurity, as indicated by prevalence of undernourishment i.e., geographical factors, such as limited access to international trade routes and potential transportation constraints, may contribute to increased food insecurity in landlocked countries. However, the researcher strongly notes that correlation analysis provides preliminary insights into the relationships between variables but doesn't establish causality. Therefore, to accept this result further analysis using appropriate regression models and controlling for potential confounding factors would be necessary to establish the causality and robustly examine the impacts of these variables on food insecurity.

	lnfoodinsec	lnhumanres	lndebtpolicy	lnpublicres	lnfiscalpol	lnmacroecomgmt	lnenvtsust	lnpubsecmgmt	lnsocialprotection	lnstructuralpol	lnresourcealloc	landlocked	lnarableland	lnpopgrowth	lngdppercapita
lnfoodinsec	1														
lnhumanres	-0.17***	1													
lndebtpolicy	-0.24***	0.55***	1												
lnpublicres	-0.18***	0.72***	0.66***	1											
lnfiscalpol	-0.23***	0.47***	0.67***	0.62***	1										
lnmacroecomgmt	-0.24***	0.46***	0.7***	0.57***	0.74***	1									
lnenvtsust	-0.2***	0.6***	0.57***	0.6***	0.4***	0.42***	1								
lnpubsecmgmt	-0.33***	0.73***	0.67***	0.73***	0.59***	0.63***	0.72***	1							
lnsocialprotection	-0.22***	0.67***	0.56***	0.7***	0.52***	0.52***	0.51***	0.71***	1						
lnstructuralpol	-0.28***	0.67***	0.63***	0.62***	0.51***	0.59***	0.65***	0.8***	0.69***	1					
lnresourcealloc	-0.3***	0.78***	0.82***	0.81***	0.74***	0.77***	0.73***	0.92***	0.78***	0.88***	1				
landlocked	0.12***	-0.12***	0.11***	0.05	-0.03	0.02	0.19***	0.08**	-0.01	-0.01	0.04	1			
lnarableland	-0.09**	0.23***	0.14***	0.24***	0.09**	0.09**	0.31***	0.21***	0.31***	0.26***	0.25***	0.08**	1		
lnpopgrowth	0.01	-0.03	0.13***	0.16***	0.17***	0.1***	-0.04	-0.11***	-0.01	-0.01	0.02	0.01	0.05	1	
lngdppercapita	-0.36***	0.15***	-0.01	-0.07*	-0.03	0.07*	-0.06	0.13***	0.09**	0.1**	0.07*	-0.25***	-0.29***	-0.31***	1

*If the p-value < 0.01, then ***, if p-value<0.05, then **, and if p-value <0.1, then **

Table 3. The Correlation Matrix

4.3 Regression Model selection, Result and Discussion

4.3.1 Rationale behind model selection

In this study, we aim to examine the impact of countries' policy and institutions on food insecurity while accounting to potential endogeneity in the data. To select an appropriate regression model, we concluded model selection tests, including the Hausman-test and Hausman-Taylor test, to compare the suitability of fixed effects and random effects models.

```
Test of H0: Difference in coefficients not systematic

   chi2(12) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  13.20
Prob > chi2 = 0.3544
```

Table 4. Hausman test for appropriate regression model selection

As we can see in the above test, the Hausman test results indicate that the p-value is insignificant, suggesting that the random effects model provides a valid and efficient estimate for the data relative to the fixed effects model. This implies that the time-invariant unobserved factors, which are captured by the random effects, do not significantly influence the relationship between the independent variables, components of countries policy and institutional frameworks, and the dependent variable, food insecurity. However, the Hausman-Taylor test reveals a significant p-value, indicating the presence of endogeneity in our analysis. This suggests that additional measures are required to address endogeneity and obtain unbiased estimates.

4.3.2 Regression Model Selection

Given the results of the Hausman and Hausman-Taylor tests, we conclude that the random effects model is not appropriate for our data due to the presence of endogeneity. To address this concern and obtain unbiased estimates, we adopt the system GMM (Generalized Method of

Moments) of dynamic panel data model. This approach allows us to control for endogeneity and account for the dynamic nature of our panel data.

4.3.3 Result Discussions

Based on the rationale explained above, and analysis using various estimation techniques, such as system GMM, difference GMM, fixed effects, and pooled OLS, this study have obtained results that provide insights into the relationship between countries policy and institutional frameworks and food insecurity in sub-Saharan Africa. According to estimated result of all the regression models which are summarized in the following table, and based on estimation technique using System-GMM and dynamic model equation above (equation 5) for 38 countries from sub-Saharan African using panel balanced data from 2005-2021:

Lagged value of the dependent variable is significant which suggests the presence of a persistent effect of food insecurity over time, indicating that past levels of food insecurity contribute to the current state of food insecurity. This finding aligns with the theoretical framework and existing literature on the dynamics of food insecurity. For instance, according to path dependency, the presence of a significant lagged variable implies intertemporal dependency, indicating that past levels of food insecurity influence the current state of food insecurity i.e., historical conditions and events have a lasting impact on future outcomes (North, 1990). Poverty trap is another factor that can be mentioned associated with the persistence of food insecurity, where households get trapped in a cycle of poverty and inadequate access to food. Studies have shown that chronic food insecurity and poverty often reinforce each other, creating a self-perpetuating cycle (Barrett, 2010; Devereux, 2009)

The negative and significant coefficient for GDP per capita indicates that higher levels of per capita income are associated with lower levels of food insecurity. This suggests that economic

development and improved living standards can have a positive impact on reducing food insecurity. In this context, Barrett, C. B., & Swallow, B.M. (2006) shown on their study that low GDP per capita leads to a lack of income and resources, which in turn increases the vulnerability to food insecurity. Through empirical analysis, they find a significant negative relationship between GDPs per capita and food insecurity, suggesting that higher levels of GDP per capita are associated with lower levels of food insecurity, which aligns with the finding of this study.

The negative and significant coefficient for population growth indicates that a growing population can have a negative impact on food insecurity i.e., an increase in population growth is associated with a decrease in food insecurity. According to previous research, there are divergent views on the relationship between population growth and food security. On one hand, a study by Maisonet-Guzman (2011) suggests that population growth can have a positive impact on food security, particularly in developing countries. The results of Maisonet-Guzman's models did not support the Neo-Malthusian hypothesis, which posits that increasing population growth negatively affects agricultural production and food security. Instead, the study found a positive and significant relationship between agriculture production and population growth, contrary to what was expected by the Neo-Malthusian model. The study highlights the significance of land area dedicated to agriculture in determining agricultural production, emphasizing its importance over population growth rates. This finding aligns with our research, which indicates that in the context of sub-Saharan Africa, population growth can have a positive impact on food security.

The negative and significant coefficient on arable land in the context of this research suggests that an increase in the availability of arable land is associated with a decrease in food insecurity. And the coefficient of Arable land can be interpreted as, for a 1% increase in availability of arable land, we would on average expect an 8.8 % decrease in food insecurity. And thus, this

finding suggests that countries with larger areas of arable land may have a better capacity for agricultural production, which can contribute to food security by ensuring an adequate supply of food. Again, this finding aligns with what the previous literatures by Subramaniam, Y., et al (2020), and even later the study by Abdullahi et al. (2020) confirmed the positive and significant relationship between arable land and food security. In addition to above findings study by Jayne et al (2015), also examined the relationship between arable land and food insecurity in Africa. They argue that access to and ownership of arable land play a crucial role in agricultural investment and productivity, which in turn impacts food security. Through empirical analysis and two step system GMM econometric modeling, they find a significant positive relationship between the availability of arable land and food security, suggesting that countries with larger areas of arable land tend to have lower levels of food insecurity.

The negative and weakly significant coefficient for structural policy implies that the specific policies related to structural reforms may have a significant direct impact on food insecurity in the sub-Saharan African context. In support of this, Glaeser and Schapiro, (2017) based on their study on the impact of structural policy on food insecurity, they found a significant negative relationship between the quality of structural policies and food insecurity, suggesting that countries or regions with better structural policies tend to have lower levels of food insecurity.

The negative and strongly significant coefficient for public sector management indicates that effective public sector management practices, such as transparent governance play a crucial role in reducing food insecurity. This suggests that countries with better public sector management tend to have lower levels of food insecurity. This aligns with the study by Ravallion, M., & Chen, S. (2007). According to the paper, improved public sector management as measured by indicators of governance and administrative efficiency is significantly associated with a reduction in food

insecurity and poverty. They argue that a well functioning public sector can enhance the effectiveness of poverty alleviation efforts, including food security programs.

The negative and significant coefficient for macroeconomic management suggests that sound macroeconomic policies, such as stable inflation rates and prudent fiscal management, contribute to reducing food insecurity in sub-Saharan Africa. This highlights the importance of macroeconomic stability in addressing food security challenges. In this sense, based on the econometric analysis by Babtunde, R.O., & Qaim, M. (2010), macroeconomic management has an effect on food security, particularly through the influence of inflation and exchange rate policies. They argue that stable macroeconomic conditions are crucial for ensuring access to affordable and nutritious food for households.

The negative and significant coefficient for fiscal policy indicates that effective fiscal policies, including government spending and revenue management, have a significant impact on reducing food insecurity. This suggests that proper allocation of resources and targeted fiscal interventions can contribute to improving food security. In support of this we can raise the previous study by Ali, H., & Eswaran, M. (2020). The study examines the relationship between fiscal policy measures and food security outcomes in developing countries. They specifically focus on the role of government expenditures on agriculture, social protection programs, and food subsidies in addressing food insecurity. Through their empirical analysis using panel data from multiple developing countries, the authors find robust evidence of a significant negative relationship between fiscal policies and food insecurity.

The negative and weakly significant coefficients for equity in public resource allocation suggest that ensuring equitable distribution of public resources, including agricultural investments and social support, can help reduce food insecurity in sub-Saharan Africa. This highlights the

importance of addressing inequities in resource allocation for achieving food security goals. Babatunde et al. (2018) investigate the relationship between equity in public resource allocation and food insecurity in Sub-Saharan Africa. Their findings reveal a significant negative association between equity in public resource allocation and food insecurity. Babatunde et al. demonstrates that when public resource is allocated more equitably, with a particular focus on disadvantaged regions and vulnerable populations, it leads to improved food security outcomes.

The negative but insignificant coefficient for debt policy indicates that managed debt levels and debt sustainability may not have direct and significant effect on food insecurity. The negative but insignificant coefficient for human resource development suggests that the specific policies and practices related to building human resources may not have a direct and significant effect on food insecurity in the sub-Saharan African context. My suggestion is this may need further investigation to understand the underlying factors contributing to this result. As far as being a landlocked country, and resource allocation is concerned, the insignificant negative coefficient on being landlocked in the regression analysis contradicts the positive and significant correlation observed in the correlation matrix. This discrepancy may indicate that the relationship between being landlocked and food insecurity is complex and influenced by other factors not captured in this analysis. It is possible that trade policies, infrastructure development, or regional cooperation play a more substantial role in mitigating the potential negative effects of being landlocked on food security; the positive and weakly significant coefficient on resource allocation in the regression analysis contradicts the negative and significant correlation observed in the correlation matrix. This finding suggests that, despite the initial correlation, a higher allocation of resources to certain sectors for instance agriculture is associated with increased food insecurity. This

discrepancy could be due to various factors such as inefficient resource utilization, mismanagement, or unanticipated interaction between variables in the analysis.

Overall, this analysis using various estimation techniques provides evidence of the relationship between countries policy and institutional framework and food insecurity in sub-Saharan Africa. The results highlight the importance of factors such as GDP per capita, arable land, structural policy, public sector management, macroeconomic management, equity on public resource management, and fiscal policy in reducing food insecurity. However, further research and analysis are required to gain a deeper understanding of the drivers and mechanism through which these factors influence food security outcomes in the region.

Regarding the robustness and validity of the findings od this study using System GMM, it is clearly shown that the coefficient estimate of the lagged food insecurity variable in the system GMM model falls within the range of the coefficient estimate obtained from both the pooled OLS and fixed effects models i.e., $0.428 < \mathbf{0.452} < 0.817$. This consistency indicates a robust and valid finding, suggesting that past levels of food insecurity have a persistent and significant impact on current food insecurity levels, irrespective of the model used. In addition, given that in the context of dynamic panel data models, the lagged dependent variable serve as an instrument to address endogeneity, if the coefficient of the lagged dependent variable in the first difference estimation is smaller than the coefficient in the fixed effects model, it suggests that the difference GMM may not adequately address the endogeneity concern, and this discrepancy raises questions about the validity of the instruments used in the difference GMM estimation i.e., it gives an inference that system GMM estimate is more appropriate than difference GMM (Arellano, M., & Bond, S., 1991).

About the appropriate tests under the regression model output, the p-value for the AR (1) coefficient is less than 0.05, which suggests that there is evidence of first-order autocorrelation in this model i.e., the current value of the dependent variable (lnfoodinsec) is dependent on its past values, which implies that using system GMM of Dynamic panel data model is appropriate. On the other hand, having a p-value for the AR (2) coefficient which is greater than 0.05 indicates that there is no evidence that second order autocorrelation exist in our model, and finally having a p-value of the Sargan test of overidentification greater than 0.05 suggests that instruments are valid and that the model is not suffering from endogeneity or omitted variable bias. These strengthens the reliability of the results.

The result of the system GMM analysis revealed some discrepancies between the initial expectations and the actual coefficients obtained for certain variables, Firstly, we expected a positive and significant coefficient on the variable landlocked, assuming that it would have a detrimental effect on food insecurity. However, the regression output from the system GMM analysis shows a negative and insignificant coefficient, indicating that the impact of being landlocked on food insecurity may be more nuanced or dependent on other factors.

Additionally, we hypothesized a negative and significant relationship between resource allocation and food insecurity. However, the analysis yielded a positive and weakly significant coefficient. This challenges the initial hypothesis of a negative association. This unexpected finding prompts us to reconsider our understanding of the complex dynamics between policy and institutional factors and food insecurity. For this unexpected result, there are several potential explanations of which one could be acknowledging the relationship between policy and institutional frameworks and food insecurity is multifaceted, and individual components may interact in complex ways.

Similarly, we anticipate negative and significant coefficients for variables such as social protection, environmental sustainability, debt policy, and human resource development. However, the system GMM results did not support these expectations, revealing either non-significant relationships or unexpected directions of influence. For example, the negative but insignificant coefficient for social protection suggests that the current social protection measures implemented in the region may not have a direct and significant effect on reducing food insecurity. This highlights the need for further analysis and evaluation of social protection programs to identify potential improvements. Again, the positive but insignificant coefficient for environmental sustainability suggests that the specific policies and practices related to environmental sustainability may not have a significant direct impact on food insecurity in the sub-Saharan African context. We would say further exploration of the relationship between environmental factors and food insecurity may be required. From these discrepancies one can see the complexity of the relationship between countries policy and institutional factors and food insecurity associated with the above-mentioned variables in the context of this study. It underscores the importance of further exploration and consideration of additional factors that may influence these dynamics.

On the other hand, majority of the variables show up as expected, for instance the negative and significant coefficient on GDP per capita aligns with the expectation that higher levels of economic development and income are associated with lower levels of food insecurity. This result suggests that countries with higher GDP per capita tend to have better resources and capabilities to address food insecurity issues; the negative and weakly significant coefficient on population growth suggests that contrary to the correlation matrix, higher population growth is associated with lower food insecurity in my regression analysis. This finding may indicate that other factors such as improvements in agricultural productivity or economic growth, are offsetting the potential

negative effects of population growth on food security. It could also suggest that population growth is not a major driver of food insecurity in the context of this study; the negative and significant coefficient on arable land supports the hypothesis that a greater availability of arable land, which is essential for agricultural production, can contribute to reducing food insecurity. This finding suggests that countries with larger amounts of arable land may have a comparative advantage in food production and thus lower levels of food insecurity; the negative and significant coefficient on public sector management suggests that countries with more effective and efficient public sector management practices, including governance, public service delivery, and accountability, are more likely to mitigate food insecurity. This finding underscores the significance of good governance and institutional capacity in addressing food security issues; the negative and significant coefficient on macroeconomic management indicates that countries with sound macroeconomic policies, including inflation control, and monetary management, are associated with lower levels of food insecurity. This result emphasizes the importance of maintaining macroeconomic stability to ensure food security; The negative and significant coefficient on fiscal policy implies that countries with well-designed fiscal policies, including targeted public spending, social protection programs, and investments in agricultural and rural development, can effectively address food insecurity. This finding highlights the role of fiscal policy in promoting food security through resource and social support mechanisms; finally, the negative and significant coefficient on equity on public resource suggests that more equitable distribution of public resources, including investments in rural areas, agricultural development, and social protection programs targeting vulnerable populations, can contribute to reducing food insecurity. This result underscores the importance of addressing inequalities and ensuring inclusive policies for achieving food security.

Regression Models (Static and Dynamic Panel Model), 2005-2021				
Variables	**Pooled OLS**	**Fixed-Effects**	**Difference-GMM**	**System-GMM**
Dependent Variable				
lnfoodinsect-1	0.817***	0.428***	0.202**	0.452***
	35.28	(11.32)	(2.40)	(4.98)
Control Variables				
lngdppercapita	-0.072***	-0.080	-0.192**	-0.229***
	(-3)	(-1.48)	(-2.48)	(-3.77)
lnpopgrowth	-0.101**	-0.078	-0.093	-0.164*
	(-2)	(-0.84)	(-0.73)	(-1.92)
lnarableland	-0.028*			-0.088***
	(-1.93)			(-3.03)
landlocked	0.038			-0.100
	(1.26)			(-0.38)
CPIA variables				
lnresourcealloc	2.507**	3.958***	5.164**	10.309*
	(2.11)	(2.94)	(2.22)	(1.90)
lnstructuralpol	-0.717**	-0.878*	-0.893	-2.713*
	(-1.98)	(-1.87)	(-1.05)	(-1.77)
lnsocialprot	-0.037	0.125	0.468	0.110
	(-0.29)	(0.71)	(1.40)	(0.27)
lnpubsecmgmt	-1.135***	-1.669***	-3.895***	-4.500***
	(-3.31)	(-3.83)	(-4.78)	(-3.12)
lnenvtsust	-0.064*	0.003	0.086	0.258
	(-0.54)	(0.02)	(0.32)	(0.64)
lnmacroecomgmt	-0.373**	-0.627***	-0.626**	-0.886*
	(-2.56)	(-3.88)	(-2.10)	(-1.85)
lnfiscalpol	-0.306**	-0.262	-0.574*	-1.157**
	(-2.11)	(-1.55)	(-1.83)	(-2.04)
lnpubres	-0.048	-0.314**	-0.509*	-0.991*
	(-0.37)	(-1.99)	(-1.71)	(-1.80)
lndebtpol	-0.134	-0.456***	-0.375	-0.784
	(-1.15)	(-3.42)	(-1.41)	(-1.58)
lnhumanres	0.073	-0.19	-0.545*	-0.299
	0.49	(-1.13)	(-1.84)	(-0.53)
Constant	1.407	2.636***		4.174***
	(5.50)	(5.80)		(5.30)
AR(1) p-value			**0.000**	**0.000**
AR(2) p-value			**0.231**	**0.058**
Sargan test			**0.964**	**0.966**
Note: if (p<0.01) ***, if (p<0.05) **, if (p<0.1) *. The values of t-statistic, and z-stat are in bracket.				

Table 5. Regression Model outputs

5. Conclusion, Policy Implications, and Limitations of the Study

Based on the analysis of dynamic panel data for 38 sub-Saharan African countries from 2005 to 2021 using the system GMM model, the findings provide valuable insights into the impact of countries policy and institutional factors on food insecurity, with a particular focus on structural policies, public sector management, macroeconomic management, fiscal policy, and equity on public resource use. The following conclusion and policy implications can be drawn from the study:

5.1 Conclusion

The empirical findings demonstrate that strong policy and institutional factors in sub-Saharan African countries have a significant negative impact on food insecurity. Specifically, the study finds by implementing structural policies in the areas of trade, financial sector, and business regulatory environment, countries under the study can enhance agricultural productivity, promote value chain development, stimulate investment and entrepreneurship, and create an enabling environment for agricultural growth. These measures, in turn, contribute to reducing food insecurity by increasing food production, availability, and access to nutritious and affordable food for populations. Additionally, effective public sector management, specifically securing property rights, promoting rule-based governance, improving budgetary and financial management, having an efficient revenue mobilization, and enhancing public administration quality, transparency, and accountability by combating corruption in the public sector can lead to more effective resource allocation and utilization and ultimately benefiting food security efforts. Furthermore, enhancing macroeconomic management, specifically focusing on the monetary, exchange rate, and aggregate demand policies can contribute to reducing food insecurity. Moreover, prudent fiscal policies, ensure the short-and medium-term sustainability of fiscal policy including considering the impact

of monetary and exchange rate policies as well as maintaining sustainable fiscal frameworks to create a sustainable economic environment that promotes growth and in turn enhances food security. Lastly, equitable allocation of public resource use, particularly in terms of public expenditures and revenue collection, and by ensuring that the allocation of public resources is targeted towards poverty reduction and the needs of the poor, countries can address the underlying socio-economic factors that contribute to food insecurity. Therefore, we can conclude that indeed having a strong policy and institutional framework, at least, in the areas mentioned above ensures the measures toward mitigating the severe food insecurity in the region under study.

5.2 Policy Implications

The study's findings have important policy implications for addressing food insecurity in sub-Saharan Africa. Policy makers should consider the following strategies:

1. Strengthening structural policies: governments should prioritize policy reforms aimed at improving market efficiency, reducing trade barriers, and enhancing agricultural productivity. These reforms can encourage agricultural growth, enhance value chains, and promote food availability and access.

2. Enhancing public sector management: governments need to focus on strengthening governance, transparency, and accountability in public resource allocation. This includes promoting participatory decision-making process, reducing corruption, and ensuring that public resources are efficiently and effectively utilized for food security programs and investments.

3. Improving macroeconomic management: Policymakers should maintain macroeconomic stability through prudent fiscal and monetary policies. This involves

controlling inflation, ensuring exchange rate stability, and creating an enabling macroeconomic environment for sustainable agricultural and rural development.

4. Promoting pro-poor fiscal policies: Governments should prioritize public investments in agriculture, rural development, and social safety nets, targeting vulnerable populations and regions. This can include investments in agricultural infrastructure, irrigation systems, rural credit programs, and social protection initiatives to enhance food access and reduce food insecurity.

5. Ensuring equity in public resource allocation: policy makers should aim for equitable distribution of public resources, focusing on bridging regional disparities and addressing the needs of marginalized and vulnerable populations. This can be achieved by adopting inclusive policies that target regions with high levels of food insecurity and by prioritizing investments in infrastructure, education, and healthcare in underserved areas.

By implementing these policy recommendations, government and stakeholders can work towards reducing food insecurity and promoting sustainable food systems in sub-Saharan Africa.

5.3 Limitations of the Study

- The study was based on a sample of 38 out of the total 49 countries in sub-Sharan Africa. The limited sample size may restrict the generalizability of the findings to the entire region. The omitted countries could have unique characteristics and policy contexts that may influence the relationship between countries policy and institutional frameworks and food insecurity.
- The study utilized a one-step system GMM as the final estimation technique. While this approach has its advantages, such as efficient estimation and

addressing endogeneity concerns, it is important to acknowledge that alternative estimation methods such as two-step GMM may yield different results. Therefore, the choice of estimation technique may impact the magnitude and significance of the estimated coefficients.

- The absence of previous literature specifically focusing on the impact of countries policy and institutional frameworks on food insecurity in the context of sub-Sharan Africa limits the ability to compare and contextualize the study's findings. The novelty of the research topic underscores the need for further studies to corroborate and build upon the current findings.

- The study relied on panel data from 2005 to 2021, sourced from FAOSTAT and the World Bank. While these datasets are widely used and provide valuable information, they may have limitations in terms of data quality, coverage, and measurement. It is important to acknowledge the potential limitations and ensure that the findings are interpreted within the context of the available data.

- Finally, the study focused on sub-Saharan Africa, which is a diverse region with varying socio-economic, political, and cultural contexts. The findings may not be directly applicable to other regions or countries outside the sub-Saharan African context. Therefore, caution should be exercised when generalizing the results beyond the study's specific scope.

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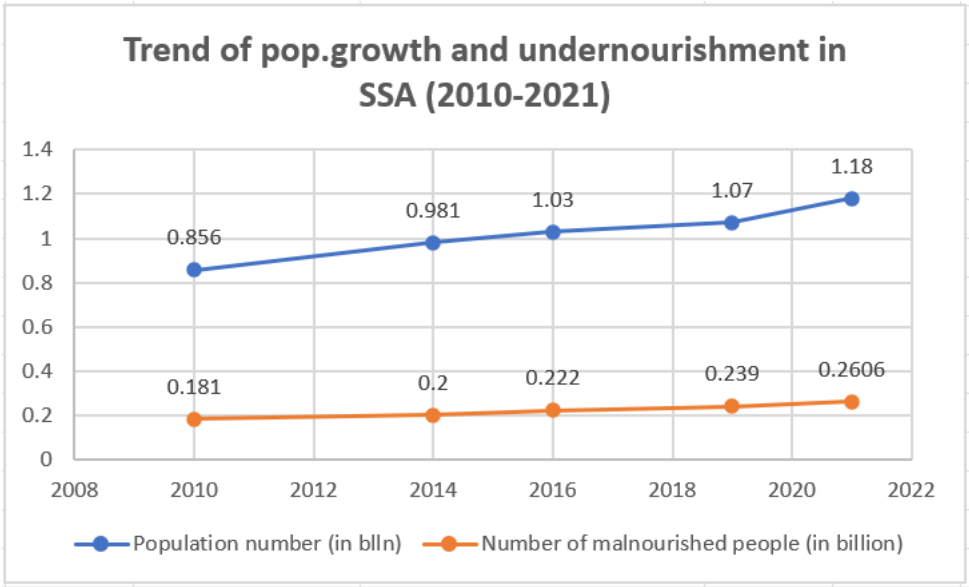
Appendices

Appendix one: Countries included in the study Sample.

Sub-Saharan Countries Included in the Study				
Angola	Comoros	Guinea	Mauritania	Sudan
Benin	Congo (Brazzaville)	Guinea-Bissau	Mozambique	Tanzania
Burkina Faso	Congo(Democratic Republic)	Kenya	Niger	Togo
Burundi	Cote d'Ivoire	Lesotho	Nigeria	Uganda
Cape Verde	Djibouti	Liberia	Rwanda	Zambia
Cameroon	Ethiopia	Madagascar	Sao Tome and Principe	Zimbabwe
Central African Republic	Gambia	Malawi	Senegal	
Chad	Ghana	Mali	Sierra Leone	

Appendix two: Detailed explanation about the variables as per the sources of data

Source	Variables Name	Detailed Explanation
The World Bank (CPIA) Variables	Humanres	Building human resources assesses the national policies and public and private sector service delivery that affect the access to and quality of health and education services, including prevention and treatment of HIV/AIDS, tuberculosis, and malaria.
	Debtpolicy	Debt policy assesses whether the debt management strategy is conducive to minimizing budgetary risks and ensuring long-term debt sustainability.
	publicres	Equity of public resource use assesses the extent to which the pattern of public expenditures and revenue collection affects the poor and is consistent with national poverty reduction priorities.
	Fiscalpol	Fiscal policy assesses the short- and medium-term sustainability of fiscal policy (taking into account monetary and exchange rate policy and the sustainability of the public debt) and its impact on growth.
	Macroecomgmt	Macroeconomic management assesses the monetary, exchange rate, and aggregate demand policy framework.
	Envtsust	Policy and institutions for environmental sustainability assess the extent to which environmental policies foster the protection and
	Pubsecmgmt	The public sector management and institutions cluster includes property rights and rule-based governance, quality of budgetary and financial management, efficiency of revenue mobilization, quality of public administration, and transparency, accountability, and
	Socialprotection	Social protection and labor assess government policies in social protection and labor market regulations that reduce the risk of becoming poor, assist those who are poor to better manage further risks, and ensure a minimal level of welfare to all people.
	Structuralpol	The structural policies cluster includes trade, financial sector, and business regulatory environment.
	Resourcealloc	IDA Resource Allocation Index is obtained by calculating the average score for each cluster and then by averaging those scores. For each of 16 criteria countries are rated on a scale of 1 (low) to 6 (high).
	GDPpercapita	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current U.S. dollars.
	Popgrowth	Annual population growth rate for year t is the exponential rate of growth of midyear population from year t-1 to t, expressed as a percentage . Population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship.
	Arableland	Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded.
UNCTAD	Landlocked	A landlocked country is a country that does not have territory connected to an ocean or whose coastlines lie on endorheic basins. There are currently 44 landlocked countries and four landlocked de facto states. Wikipedia
FAOSTAT Food insecurity Variable	Prevalence of Undernourishment (foodinsec)	Prevalence of undernourishments is the percentage of the population whose habitual food consumption is insufficient to provide the dietary energy levels that are required to maintain a normal active and healthy life. Data showing as 2.5 may signify a prevalence of undernourishment below 2.5%.



Sources: Statista, the WB, FAO and Owolade, A.J.J., et al (2022)

Declaration

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in any other university and that all sources of materials used for this thesis have been duly acknowledged.

The examiner's comments have been duly incorporated.

Declared by:

Name Tilahun Bizuneh Habtemariam

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Date

Confirmed by:

Name

Signature

Date

Place and date of submission, Addis Ababa, June 15th, 2023