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Reducing Food Insecurity in Sub-Saharan Africa: The Role of Institutions and Financial Stability

MOHAMMED MUNTAKA ABDUL RAHMAN [1,*], ASAD UL ISLAM KHAN [1], HASAN VERGIL [1]

[1] *Department of Economics, Ibn Haldun University, Istanbul, Turkey*

**Correspondence details: muntakaabdulrahman@ihu.edu.tr*

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Abstract: Achieving food security (SGD 2) is a central theme in promoting overall well-being, economic growth, and maintaining peace and security. In the efforts to achieve sustainable development goals, Sub-Saharan African countries are still burdened with widespread food insecurity, poverty, and inequality. These bottlenecks are further worsened by institutional inefficiencies and unstable financial systems. This study investigates not only the role institutions and stable financial systems play in the reduction of food insecurity and its four components but also how poverty and well-being in SSA affect food security. The study employed data from 28 SSA countries from 2011 to 2021 which was analyzed using a two-step system GMM estimator. The results show that although financial stability is insignificant relative to food security and utilization of food, it increases the affordability and sustainability of food. Quality institution on the other hand significantly increases food security. Furthermore, well-being increases food security, affordability, utilization, and sustainability, while poverty reduces food security, accessibility, utilization, and sustainability. The study suggests that strengthening financial systems to provide financial access and security will reduce poverty and support the achievement of SDG 2. Additionally, policies to improve people's well-being and further the existing institutions will provide a stronger foundation for SSA countries to achieve SDG 2.

Keywords: institutional quality, financial stability, Food Security, Sub-Saharan Africa, GMM

Introduction

Sub-Saharan Africa (SSA) is at an important point in its development path but is currently experiencing different levels of poverty, hunger, and institutional inefficiencies. The Sustainable Development Goal (SDG) 1 is concerned with the eradication of all forms of poverty, whereas, SDG 2 is directed at alleviating hunger, improving food security and nutrition, as well as sustainable agricultural practices by the year 2030 (Barbier and Burgess, 2021). These two goals may be somewhat independent, yet they are interlinked, and understanding the impact of institutional quality and stable financial systems in their interlinkages in SSA will be a requisite for their achievement by 2030 (Kablan, 2009). The attainment of SDGs by 2030 will hinge primarily on SDGs 1 & 2 which address the eradication of poverty and hunger in all its forms everywhere through food and nutrition security and sustainable agriculture development (Barbier and Burgess, 2021). These targets are even more pertinent in the case of Sub-Saharan Africa (SSA) where poverty and food insecurity are consistently moving upwards (Bjornlund et al., 2022). According to Gerlach (2015), the notion of "food security" was first introduced in

1974 during a discussion about the famine that had struck the Sahel and Dafur regions of Africa, which implies the ability to produce or obtain sufficient food to feed the residents. Considering the issue of global food security, which is a threat, especially with the increase in the world population, encourages food and agricultural stakeholders to prioritize quality nutrition consumption, mechanized agriculture, food innovation, and circular economy within the present unfavorable climatic conditions (Boon, and Anuga, 2020; Brenya et. al, 2024; De Froidmount-Goertz et al., 2020). Poverty and food insecurity are pervasive issues in SSA as yet there has not been enough political commitment to address them. It has been estimated that the region's poverty rate decreased by only 1.6 percentage points between 2015 and 2018, in 2022, at least 123 million people (12 percent of SSA's population) were projected to be acutely food insecure (Barbier and Burgess, 2021). This indicates that food insecurity is a significant concern and needs more attention relative to the increase in climate change across the region. From the perspective of Development as a Freedom by Sen (1999), Mechlem (2004) posited that the right to food and nutrition are fundamental rights and form part of the development process. Globally, it has been estimated that demand for food and nutrition will increase by 50% in 2030 and will range between 80% and 100% by 2050 (Gouvea et al. 2022; Brenya et. al 2024) if prudent measures are not taken to ensure sustainable consumption amid a growing population. The financial system in SSA has evolved from pre-colonial indigenous barter trade-like structures to a more complex system involving various financial institutions. However, the financial infrastructure in most countries remains light, and the contribution of the sector to growth and poverty reduction is still minimal (Gakunu, 2007). The financial sector's role in achieving SDGs 1 and 2 cannot be overstated, as it is crucial for mobilizing resources and directing them towards sectors that can help reduce poverty and improve food security (Kablan,2009). Understanding the relationship between SDG 2 through the lens of institutional quality and financial stability mechanisms in SSA is critical. Institutional quality refers to the effectiveness of social structures, including law, individual rights, and government regulation and services (Barbier and Burgess, 2021). A large empirical literature in economics has established a persuasive link between institutions and long-run economic development. Good governance and institutional effectiveness are associated with long-run development and sustainability success.

Food Security in Sub-Saharan Africa

The COVID-19 pandemic resulted in a sharp rise in food insecurity issues. Global hunger has remained relatively unchanged from 2021 to 2022. Considering the midrange (about 735 million), 122 million more people faced hunger in 2022 than in 2019, before the global pandemic, when the prevalence of undernourishment (PoU) was 7.9 percent. However, undernourishment in Africa continued to rise in 2022, reaching 19.7 percent, well above the global average, and equivalent to more than 280 million people (see Figure 1 below). Among the subregions of Africa, hunger in 2022 was the lowest in Northern Africa, where the PoU was 7.5 percent (below the global average), followed by Southern Africa, where an estimated 11.1 percent of the population was undernourished. The PoU was highest in Central and Eastern Africa (about 29 percent in both cases), twice the prevalence in Western Africa (14.6 percent) (FAO, IFAD, UNICEF, WFP, and WHO, 2024). Sub-Saharan Africa is home to a significant proportion of the world's population experiencing food insecurity and poverty. According to recent estimates, the region accounts for the highest prevalence of undernourishment globally, with over 22% of its population undernourished (FAO, 2020). Factors contributing to food insecurity include inadequate agricultural productivity, climate change impacts, conflicts, and limited access to markets and technology (FAO, 2020; World Bank, 2018).

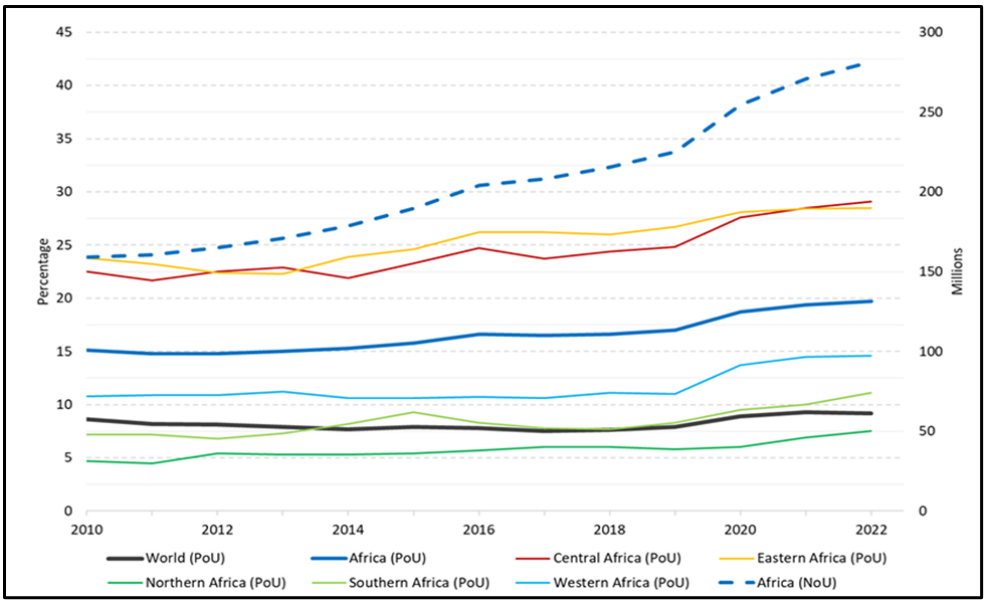

Figure 1: Prevalence of undernourishment in the world, Africa, and subregions, and the number of undernourished in Africa. Source: FAO, IFAD, UNICEF, WFP, and WHO (2024).

The 2024 Global Report on Food Crisis (GRFC) underscores that conflict, extreme weather conditions, economic shocks, and forced displacement continuously escalate the rate of food insecurity and malnutrition throughout the region, with the outlook for 2024 equally grim. Gustafson (2024) posits that the outlook for the region for 2024 is not clear relative to food security. She adds that some countries in the region are expected to experience a reduction in the number of people facing acute food insecurity owing to better food supply systems and declining inflation. In general, levels of acute food insecurity are anticipated to remain high across the region, and conflict and population displacement are expected to persist in several countries (Gustafson, 2024).

The GRFC shows that about 49.6 million people (forming 21%) in 13 countries in Central and Southern Africa are experiencing acute food insecurity in 2023. Out of these, 3.9 million are acutely malnourished children in five food crisis countries[1] with 1.2 million suffering the most severe form of wasting. One of the key drivers of this acute food crisis is the continuous conflict in the Democratic Republic of Congo (D.R. Congo), Central African Republic, and Mozambique. Gustafson (2024) explains that the conflict situation led to the displacement of households, a fall in agricultural production, high unemployment, and a distortion of free trade market access. Further, climate change and extreme weather conditions also played a significant role in pushing hunger and malnutrition levels in the sub-region.

The situation in East even Africa is far worse. The GRFC shows that 64.2 million people (24% of the population) are exposed to high levels of food insecurity in 8 countries in 2023. This is due to the lingering impact of the extraordinary drought that persisted between 2020–2023, the El Niño-driven floods, unending heightened conflicts (in Sudan, Somalia, and Ethiopia), and the cyclical macroeconomic instability exacerbated already high levels of acute food insecurity in eight countries across East Africa (FSIN and Global Network Against Food Crises, 2024). This has caused a decline in agricultural output and restricted financial access to food, which culminated in limited access to food by households. The overwhelming influx of refugees from the Sudanese conflict increased the burden on a few resources in the countries along its borders. Countries such as Burundi, Djibouti, Somalia, and areas of Kenya experienced

[1] These countries are the Central African Republic, D.R. Congo, Zimbabwe, Mozambique, and Zambia

significant deterioration in their food security situations in 2023, and particularly in South Sudan, 63 percent of the population witnessed high levels of acute food insecurity. Uganda, however, was an outlier in the region as it saw a slight reduction in the proportion of people who are in urgent need of food assistance (Gustafson, 2024).

The GRFC also indicated that West Africa and the Sahelian sub-region also have their fair share of food insecurity, restricted access to basic services, and poor nutritional practices that affect child and maternal nutrition. Further, the GRFC revealed that 44.3 million people (that is 11% of the total population of 14 countries) were food insecure in 2023, 14 million children are acutely malnourished with a staggering 3.9 million of them experiencing severe wasting. Gustafson (2024) specifically points out that Nigeria, Burkina Faso, Niger, Cameroon, Chad, Senegal, Mali, Sierra Leone, and Côte d'Ivoire are the 14 countries with major food crises in the sub-region. Moreover, the deteriorating insecurity and weather conditions exacerbated Chad and Nigeria's increased acute food crisis issues.

Financial Systems in SSA

Sub-Saharan Africa (SSA) has made significant strides in financial inclusion over the past decade, driven largely by mobile money adoption (Demirgüç-Kunt and Klapperö 2021). Although a great deal of the countries in SSA are characterized by relatively stagnant financial sectors with little or no active participation in banking, lending, and the stock exchange, the financial systems in SSA, particularly financial inclusion efforts like the mobile money system, have been a game changer as far as the economic activities of the region and the fight against poverty and hunger are concerned. This was made possible due to the upsurge in the demand for reforms such as technological change and "the fintech burst" that has expanded the scope of financial inclusion (Demirgüç-Kunt and Klapperö 2021). Nevertheless, such systems are also often plagued by many factors including but not limited to lack of penetration of financial services (access to credit, mutual funds, and bank loans), weak capital market structures and regulations, and ineffectual capital management policies. Additionally, the region is still beset with several factors that limit the optimum functioning of its financial systems (Pattillo et al., 2006).

There has not been a one-size-fits-all approach to financial inclusion in SSA. Between 2017 and 2022, most countries saw a big increase in people having bank accounts, mainly due to mobile money (Demirgüç-Kunt and Klapper, 2021). For instance, while Senegal and South Africa saw a huge jump of around 15% in the number of mobile money accounts, Kenya had a decrease in account ownership (see Figure 2 below). This could be due to institutional frameworks like political stability, and financial regulations, as well as market structures such as competition between banks, and the overall economic situation.

The banking sector in SSA is dominated by a small number of large banks that control a significant portion of financial assets. Many of these banks are foreign-owned, particularly in countries like Kenya, Nigeria, Ghana, and South Africa. The banking sector is often highly concentrated, with the top five banks in most countries controlling more than 70% of banking assets. This concentration limits competition, which can stifle innovation and reduce the quality of services offered to consumers (Beck et al., 2014). One of the major challenges in the banking sector is the low level of credit provision to the private sector for agricultural investment. The International Monetary Fund (IMF, 2024) posited that the average credit-to-GDP ratio in SSA is around 20%, which is significantly lower than in other developing regions. Many banks prefer to invest in government securities, which are seen as less risky than lending to businesses and individuals, especially in an environment with weak credit information systems and poor contract enforcement mechanisms. These weak systems jeopardize the stability of the financial sector especially when foreign banks decide to fold up or the government defaults on their debt. For instance, Ghana's financial sector clean-up exercise coupled with government debt default in 2022 has caused an unstable financial environment which resulted in a "haircut" of investors'

dividends[2].

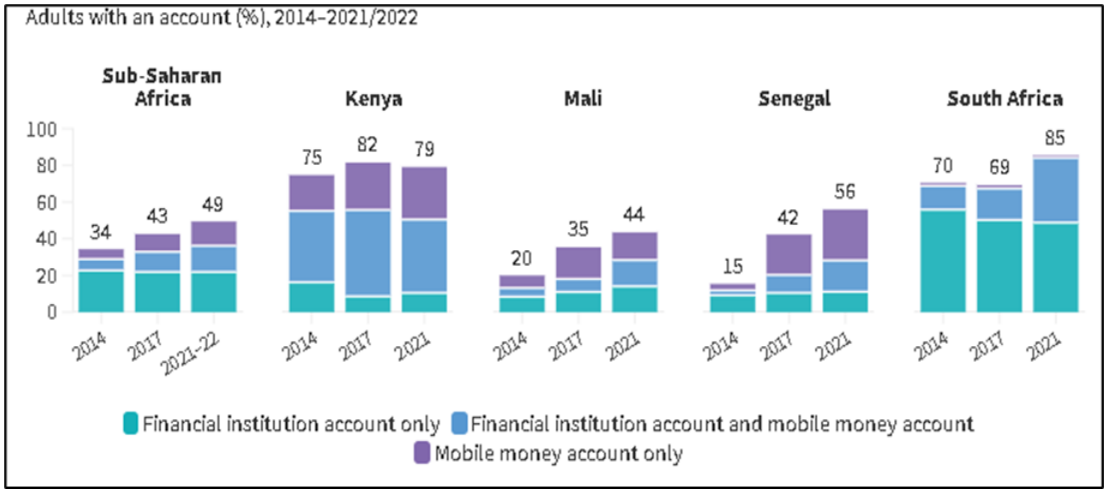

Figure 2: Growth of bank accounts in SSA. Source: Global Findex 2021 (Demirgüç-Kunt et al. 2022)

Moreover, the financial systems in SSA are characterized by vulnerabilities, including inadequate risk management practices, weak supervision and regulation, and susceptibility to external shocks. Financial instability can exacerbate poverty and food insecurity by disrupting economic activities, reducing investment flows, and undermining social safety nets (IMF, 2024). Additionally, weak regulatory frameworks are another major obstacle to the development of financial systems in SSA. IMF's (2024) economic output report of SSA indicates that SSA countries have outdated financial regulations that do not adequately address modern financial risks such as cybercrime and money laundering. Furthermore, regulatory bodies often lack the capacity and resources to effectively supervise financial institutions. This can lead to systemic risks, as was evident during the banking crises in Nigeria and Ghana in the late 2010s. Cross-border banking also presents challenges for regulators. Many of the largest banks in SSA operate across multiple countries, which requires coordination between national regulators. However, differences in regulatory standards and supervision across countries can create loopholes that financial institutions may exploit, leading to instability (Beck et al., 2014).

Further, financial system development in SSA is constrained by inadequate infrastructure. The 2024 Global Systems for Mobile Communications Association (GSMA) report on the state of the mobile banking and finance industry report indicates that physical banking infrastructure such as branches and ATMs in Africa is sparse, especially in rural areas. The report further indicated that there is a lack of digital infrastructure as many countries experience low internet penetration rates and poor mobile network coverage. These deficiencies and bottlenecks limit the reach of digital financial services and mobile banking, which could otherwise play a key role in expanding financial inclusion (GSMA, 2024).

The introduction of the African Continental Free Trade Area (AfCFTA) in 2021 creates a conducive climate for both financial integration and the aligning of different regulatory standards across the continent. If the provisions of AfCFTA were to be enforced without any barriers to cross-border financial flows and investments, there would be development of financial markets in the region. Beck et al (2014) argue that governments in the SSA should not only focus on efforts to improve the best practices of the existing financial systems but also alter

[2] https://www.reuters.com/article/markets/commodities/ghana-asks-bondholders-for-30-40-haircut-idUSL1N3BM1RY/

the existing systems and build new ones including investment in digital infrastructure. Moreover, all the stakeholders including the regulatory bodies have to enhance their supervisory and enforcement functions to safeguard the consumers and risks associated with the sector.

This study investigates how institutional quality and financial stability play a key role in reducing food insecurity in SSA and accounting for the intricate relationship between poverty, hunger, and wellbeing. The relationship between SDG 1 (eradicating poverty) SDG 2 (ending hunger and achieving food security), and SDG 3 (ensuring good health and wellbeing) is complex and multifaceted. Poverty, food insecurity, and well-being are closely intertwined, with poverty often serving as a root cause of hunger and malnutrition, which later affects well-being. In SSA, addressing the interlinkages between poverty, food insecurity, and well-being requires comprehensive strategies encompassing improvements in institutional quality, stable financial systems, agricultural productivity, income generation, social protection mechanisms, and access to basic services. The rest of the study is structured so that the next section contains the methodology (theoretical and empirical), followed by the results and discussion, and the conclusion and recommendations.

Materials and Methods

Data and PCA results

This study used an unbalanced data set of 28 Sub-Saharan African Countries (see Table 1 for the full list of countries), with an annual dataset from 2011 to 2021.

Table 1. List of Countries

LIST OF COUNTRIES	
Angola	Mali
Benin	Mozambique
Botswana	Niger
Burkina Faso	Nigeria
Burundi	Rwanda
Cameroun	Senegal
Chad	Sierra Leone
Congo Democratic Republic	South Africa
Ethiopia	Sudan
Ghana	Tanzania
Guinea	Togo
Kenya	Uganda
Madagascar	Zambia
Malawi	Cote d'Ivoire

Due to a lack of data availability, all 38 Sub-Saharan African countries were not used for the study. In constructing the index for institutional quality and financial stability, a principal component analysis was employed. The data on the food security index and its four dimensions (accessibility, availability, utilization, and sustainability) were taken from the Global Food Security Index (GFSI). Five of the six World Governance Indicators (rule of law, control of corruption, political stability, regulatory quality, governance effectiveness) were used to create an index for institutional quality, whereas banking Z-score and liability to credit ratio data were used to create an index for financial stability. The data for the two indices were taken from the World Bank's World Governance Indicators (WDI) and Global Financial Development (GFD), respectively. Additionally, the study sought to understand how the well-being and poverty levels

of the country's understudy affect the food security issues. Therefore, the study incorporated domestic health expenditure (at international PPP) as a proxy for well-being following the work of Ozili and Iorember, (2023) and the poverty gap as a proxy for poverty. The poverty gap index as a measure of poverty was taken from the World Bank (2024) Poverty and Inequality Platform, and it satisfies the monotonicity and transfer assumptions in measuring poverty. De Janvry and Sadoulet (2015) posit that the poverty gap index is more robust in measuring poverty than the headcount index. For policy control purposes, the study employed population growth, inflation, and agricultural land (% of land area) from the World Development Index dataset (WDI). The variable description is in Table 2.

Table 2. Variable Description

VARIABLE	ID	DESCRIPTION	SOURCE
Food Security	FS	Food security is the state of having reliable access to sufficient, safe, and nutritious food to meet dietary needs and preferences for an active and healthy life	GFSI
Food Affordability	AFF	Food affordability refers to the ability of individuals and households to acquire sufficient quantities of affordable and nutritious food to meet their dietary needs and preferences.	GFSI
Food Availability	AVA	Food availability refers to the physical presence of food in sufficient quantities, variety, and quality to meet the needs of a population.	GFSI
Food Quality & Safety	QAS	Food quality and safety refer to the characteristics of food that make it acceptable for human consumption, including its nutritional value, microbiological safety, chemical safety, and physical safety.	GFSI
Food Sustainability and Adaptation	SUS	Food sustainability ensures the ability of food systems to meet present needs without compromising future generations, while food adaptation allows these systems to adjust to changing environmental conditions for continued food security and sustainability.	GFSI
Financial Stability	FSI	The index was calculated using the banking z-score (BAZS) and bank liquidity coverage ratio (LCRS).	GFD
Institutional quality	ISQ	Computed using 5 of the six world governance indicators (Control of corruption (COC), regulatory quality (REQ), political stability (POS), governance effectiveness (GOE), and rule of law (RUL))	WGI
Wellbeing	DHE	Domestic private health expenditure per capita, PPP (current international $)	WDI
Poverty gap	PGP	The mean shortfall in income or consumption from the poverty line at $2.15 a day (2017 PPP).	PIP
Inflation	CPI	The consumer price index	WDI
Population growth	POP	Annual population growth rate.	WDI
Agricultural Land	AGRL	Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures (%of land area).	WDI

Additionally, the principal component analysis (PCA) is a dimension-reduction technique that decreases the dimension of huge data sets. This technique transforms large data sets of variables into a smaller one, retaining the significant information of the larger one. The results of the PCA for institutional quality and financial stability are in Tables 3 and 4, respectively.

Table 3. PCA results for Institutional Quality

COMPONENTS	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
Comp 1	3.992	3.500	0.798	0.798
Comp 2	0.493	0.249	0.099	0.897
Comp 3	0.244	0.076	0.049	0.946
Comp 4	0.168	0.063	0.034	0.979
Comp 5	0.105		0.021	1.000

EIGEN VECTORS						
VARIABLE	COMP 1	COMP 2	COMP 3	COMP 4	COMP 5	UNEXPLAINED
COC	0.4514	-0.1611	0.7677	0.4247	0.0227	0
GOE	0.4691	-0.2722	0.0039	-0.1668	0.7801	0
POS	0.3823	0.9182	0.0039	-0.0693	0.0770	0
REQ	0.4610	-0.1160	-0.5771	0.5306	-0.3993	0
RUL	0.4664	-0.2084	0.0894	-0.7110	-0.4749	0

Table 4. PCA results for Financial Stability

COMPONENTS	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
Comp 1	1.301	0.601	0.650	0.650
Comp 2	0.699	……	0.350	1.000

EIGEN VECTORS			
VARIABLE	COMP 1	COMP 2	UNEXPLAINED
LCR	0.707	0.707	0
BAZS	0.707	-0.707	0

Theoretical Model of Food Security

In this study, the Becker (1965) model of utility is modified to ascertain the impact of food security. Becker (1965) was the pioneer in constructing a household production function and allocating time within the household. The utility is a function of a vector of attributes. In the utility function, (U_t), Currie (2000) and Arshad (2022) included food in the function:

$$U_t = U(F_t C_t) \qquad (1)$$

Where F_t is food security and C_t is consumption. The output of the activities is created by different inputs (Pollak & Watcher, 1975), and the products are linked with consumption in different phases of time or production of diverse activities (Becker, 1965; Michael & Becker, 1973).

$$F_t = F(N_t, T_F, X_t) \qquad (2)$$
$$C_t = C(O_t, T_O, K_t) \qquad (3)$$

The material inputs in equation 2 is N_t, T_F is the time used for food and X_t is the set of other determinants that affect food. O_t is the inputs that impact the consumption of other goods, T_O is the time spent on the consumption of other goods and K_t is a set of other variables that affect consumption. It is also important to state that equation 2 can be interpreted as a production function for food that explains the transformation of inputs into food.

$$I_t = E_t + w_t T_w \qquad (4)$$

Where I_t is total income, $E_t$is unearned income, w_t is wage rate and T_W is the time spent working. Additionally, the total time is given as:

$$T_F + T_O + T_w = T \quad (5)$$

Where T is the total time, T_F denotes time spent on food, T_O denotes time spent on the consumption of other goods, and T_W is the time spent on earning a wage.

Further, the household faces time and budget constraints (Heckman, 1988). The demand for different activities shifts based on changes in the cost of goods and time. These shifts are influenced by how much time and resources are needed to produce each commodity (Arshad, 2022). Becker expanded on this idea by analyzing how the cost of time can vary between different activities. The household faces a maximization problem to achieve overall satisfaction with the available budget constraint. Therefore, the households aim to get the most out of their resources, taking into account both their budget and available time. The budget limitation, as shown in Equation (4), can be expressed as follows:

$$I_t = E_t + w_t T_w = P_{Nt} N_t + P_{ct} C_t \quad (6)$$

Where P_{Nt} is the price of material inputs and P_{Ct} is the price of consumption of other goods, the budget constraint is equivalent to the non-wage (E_t) and earnings $(w_t T_w)$ to food expenditure $(P_{Nt} N_t)$ and other commodity consumption $(P_{ct} C_t)$. Equation (5) provides the constraints of time which indicates that the total available time (T) to a household is shared on food (T_F), consumption of other goods (T_o), and gaining wages (T_w). By putting equations (2) and (3) into equation (1), the utility function is transformed as:

$$U_t = U(F(N_t, T_F, X_t), C(O_t, T_O, K_t)) \quad (7)$$

Additionally, a combined time and budget constraint is formed by combining equations (5) and (6) as:

$$E_t + w_t(T - T_F - T_O) = P_{Nt} N_t + P_{ct} C_t \quad (8)$$

Alternatively, the budget could be written as:

$$E_t + w_t T = (P_{Nt} N_t + w_t T_F) + (P_{ct} C_t + w_t T_O) \quad (9)$$

The representative individual seeks to maximize their utility, as shown in Equation (7), while staying within the budget constraints outlined in Equation (8). Based on the Marshallian function framework, the utility maximization problem can be resolved by solving the first-order conditions following the demand functions. The utility maximization problem can be stated as follows:

$$Maximize:$$
$$U_t = U(F(N_t, T_F, X_t), C(O_t, T_O, K_t))$$

$$Subject\ to:$$
$$E_t + w_t T = (P_{Nt} N_t + w_t T_F) + (P_{ct} C_t + w_t T_O)$$

Employing the Lagrangian, the maximization problems can be expressed as:

$$\mathcal{L} = U\big(F(N_t, T_F, X_t), C(O_t, T_O, K_t)\big) + \lambda(E_t + w_t T = (P_{Nt} N_t + w_t T_F) + (P_{ct} C_t + w_t T_O)) \quad (10)$$

The first-order condition of the equation follows:

$$\frac{\partial \mathcal{L}}{\partial N_t} = U_F\left(\frac{\partial F}{\partial N_t}\right) - \lambda P_{Nt} = 0 \quad (11)$$

$$\frac{\partial \mathcal{L}}{\partial T_F} = U_F\left(\frac{\partial F}{\partial T_F}\right) - \lambda w_t = 0 \quad (12)$$

$$\frac{\partial \mathcal{L}}{\partial O_t} = U_C\left(\frac{\partial C}{\partial O_t}\right) - \lambda P_{Ct}\left(\frac{\partial C}{\partial O_t}\right) = 0 \quad (13)$$

$$\frac{\partial \mathcal{L}}{\partial T_O} = U_c\left(\frac{\partial C}{\partial T_O}\right) - \lambda w_t = 0 \quad (14)$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = E_t + w_t T - (P_{Nt}N_t + w_t T_F) - (P_{ct}C_t + w_t T_O) = 0 \quad (15)$$

Simplifying all the equations:

$$U_F\left(\frac{\partial F}{\partial N_t}\right) = \lambda P_{Nt} \quad (16)$$

$$U_F\left(\frac{\partial F}{\partial T_F}\right) = \lambda w_t \quad (17)$$

$$U_c\left(\frac{\partial C}{\partial O_t}\right) = \lambda P_{Ct}\left(\frac{\partial C}{\partial O_t}\right) \quad (18)$$

$$U_C\left(\frac{\partial C}{\partial T_O}\right) = \lambda w_t \quad (19)$$

$$E_t + w_t T - (P_{Nt}N_t + w_t T_F) - (P_{ct}C_t + w_t T_O) = 0 \quad (20)$$

To get the demand function for material inputs N_t, equations 16 to 20 are solved to get the function:

$$N_t^* = N^*(P_{Nt}, P_{ct}, w_t, E_t, X_t, K_t) \quad (21)$$

Substituting equation 21 into the food equation, the following model was generated:

$$F_t = F(N_t^*, T_F, X_t) \quad (22)$$

Alternatively, the model could be rewritten as:

$$F_t = F(N^*(P_{Nt}, P_{ct}, w_t, E_t, X_t, K_t)) \quad (23)$$

Equation 23 posits that food is affected by material input (P_{Nt}), price of other commodities (P_{ct}), wage rate (w_t), and non-wage income (E_t). However, other factors that affect food security include stable financial systems to support agricultural investment to boost productivity, strong institutions and systems, population growth, agricultural arable land size which affects yields and productivity relative to efficiency of use; poverty levels and well-being of the population, and inflation which affects prices of agricultural inputs and purchasing of power of consumers.

Empirical Model

This paper seeks to understand how institutional quality and financial stability could play an active role in reducing food security in Sub-Saharan Africa. Previous studies focused on institutional quality (such as Brenya et al.,2024; Soko et al., 2023) financial inclusion (Baborska et al. 2020), financial insecurity (Folayan et al., 2021), and food security. This study looks at the role of institutional quality and financial stability in reducing food insecurity and how poverty and well-being impact the effort to ensure food security. The module of this study follows the work of Ashrad (2022). Thus, the study evaluates the impacts as:

$$FS_t = F(FIS, ISQ, DHE, PGP, INF, POP, AGRL) \quad (24)$$

Equation (24) can be expressed econometrically as:

$$FS_{it} = \alpha_0 + \alpha_1 FS_{it-1} + \alpha_2 FIS_{it} + \alpha_3 ISQ_{it} + \alpha_4 DHE_{it} + \alpha_5 PGP_{it} + \alpha_6 INF_{it} + \alpha_7 POP_{it} + \alpha_8 AGRL_{it} + \mu_{it} \quad (25)$$

Where FS is food security, FIS is financial stability, ISQ is institutional quality, DHE is the domestic health expenditure (a proxy for wellbeing), PGP is poverty gap (a proxy for poverty), INF is inflation, POP is population, $AGRL$ is agricultural land area, i is the country and t is the time.

Food security, according to the Food and Agricultural Organization (FAO), has four components namely, Availability, Accessibility, Utilization, and Stability. The World Bank's Global Food Security Index (GFSI) rather categorized the components as Affordability (AFF), Availability (AVA), Quality and Safety (QAS), and Sustainability and Adaptation (SUS). Understanding the impact of the regressors on these components is key to the analysis of this study. Therefore, the main model was decomposed to account for impacts on the four components as follows using the GFSI categorization:

$$AFF_{it} = \alpha_0 + \alpha_1 AFF_{it-1} + \alpha_2 FIS_{it} + \alpha_3 ISQ_{it} + \alpha_4 DHE_{it} + \alpha_5 PGP_{it} + \alpha_6 INF_{it} + \alpha_7 POP_{it} + \alpha_8 AGRL_{it} + \mu_{it} \quad (26)$$

$$AVA_{it} = \alpha_0 + \alpha_1 AVA_{it-1} + \alpha_2 FIS_{it} + \alpha_3 IS\ Q_{it} + \alpha_4 DHE_{it} + \alpha_5 PGP_{it} + \alpha_6 INF_{it} + \alpha_7 POP_{it} + \alpha_8 AGRL_{it} + \mu_{it} \quad (27)$$

$$QAS_{it} = \alpha_0 + \alpha_1 QAS_{it-1} + \alpha_2 FIS_{it} + \alpha_3 ISQ_{it} + \alpha_4 DHE_{it} + \alpha_5 PGP_{it} + \alpha_6 INF_{it} + \alpha_7 POP_{it} + \alpha_8 AGRL_{it} + \mu_{it} \quad (28)$$

$$SUS_{it} = \alpha_0 + \alpha_1 SUS_{it-1} + \alpha_2 FIS_{it} + \alpha_3 ISQ_{it} + \alpha_4 DHE_{it} + \alpha_5 PGP_{it} + \alpha_6 INF_{it} + \alpha_7 POP_{it} + \alpha_8 AGRL_{it} + \mu_{it} \quad (29)$$

Where $AFF, AVA, QAS, and\ SUS$ represents food affordability, availability, quality and safety, and sustainability and adaptation respectively.

This study employs the two-step system generalized methods of moments (GMM) estimator developed by Arellano and Bond (1991) and Arellano and Bover (1995) for dynamic panel data. This method is preferable especially when the cross sections are larger than the time series (N>T). The problem of serial correlation and endogeneity is resolved by the use of international instruments (the lags of the explanatory variables) (Arellano and Bond, 1991). According to Blundell and Bond (1998), the lagged levels of explanatory variables are weak instruments of regression when these variables are persistent over time. They are likely to adversely affect small samples and the asymptotic properties of the difference estimator. To resolve this weak instrument problem, Arellano and Bover (1995) recommend the first difference GMM regression combined with an estimator in levels to produce a system. Additionally, Blundell and Bond (1998) proposed two different post-estimation tests (Hansen or Sargan tests, and serial correlation) to check the validity of the instruments used in these regressions. The Hansen / Sargan tests check for overidentifying restriction, which tests the overall validity of the instruments. The second is the serial correlation test (AR1 and AR2) which examines the hypothesis that the residuals from the estimated regressions are first-order correlated but not second-order correlated (Subramaniam et al., 2019).

Financial stability affects food security through household income, access to credit, and economic growth. A stable financial system provides households access to financial resources that could be used for food production, distribution, and consumption (Gundersen and Ziliak, 2014). This helps in reducing food insecurity. Institutional quality such as effective governance, transparency, and the rule of law can improve food security by strengthening property rights (securing land rights), fair distribution of food, good land tenure systems, and an increase in agricultural productivity. Burchi et al. (2011) posit that strong institutions reduce corruption and inefficiencies that hitherto stifle food supply and agricultural production. Soko et al. (2023) add that quality institutions positively impact food security through effective management of public agricultural spending, leading to improved cereal production.

Poverty also limits households' purchasing power, affecting their access to adequate amounts of required nutritious food. Additionally, poorer households spend larger proportions of their income on food and are more vulnerable to price shocks, exposing them to food insecurity issues (WHO, 2020). Wellbeing represented by domestic health expenditure generally reflects better healthcare access, indirectly improving food security. Thus, better wellbeing reduces the burden of health-related costs on households to channel resources on food rather than medical and health costs. Inflation, especially in food prices, erodes the purchasing power of households relative to adequate food consumption and access, and this exposes households to food insecurity issues. Further, food inflation contributes more to the overall consumer price index in Sub-Saharan Africa[3]. Headey and Ruel (2020) stressed that inflation during crises, such as COVID-19, exacerbates food insecurity, particularly among vulnerable groups and low-income earners.

Population growth without a proportional increase in food availability and access increases food insecurity through scarcity and rising food prices (Shang et al., 2024). The size and productivity of agricultural land determine the ability of a country to meet its food demand. Countries with arable agricultural land size can be self-sufficient and achieve food security. Herrero et al. (2017) argue that larger agricultural land size leads to higher agricultural productivity, which helps reduce food insecurity and increases food availability. However, sustainable land management practices are essential to maintain long-term productivity.

Results and Discussion

Descriptive Statistics

The descriptive statistics of the data used are shown in Table 5 below. Inflation (INF) has the highest standard deviation, meaning that inflation data are spread far away from the mean as compared to other variables. Food security (FS) has clustered data closer to the means, as demonstrated by its standard deviation compared to other variables. Inflation has the highest mean, whereas institutional quality (ISQ) has the lowest mean.

Table 5. Descriptive statistics

VARIABLES	OBS	MEAN	STD DEV	MIN	MAX
FS	308	1.660	0.051	1.516	1.822
AFF	308	1.653	0.11	1.34	1.893
ACC	308	1.638	0.079	1.423	1.831
QAS	308	1.649	0.06	1.446	1.870
SUS	308	1.639	0.07	1.442	1.765
FIS	308	5.76e-09	1	-1.679	1.682
SIQ	308	-1.23e-09	1	-3.058	1.764
DHE	308	2.101	0.325	1.327	3.083
PGP	308	-0.963	0.08	-1.102	-0.847
INF	308	9.199	4.156	5.803	20.875
POP	308	2.753	0.543	0.387	3.867
AGRL	308	1.682	0.176	1.116	1.913

Pairwise Correlation

The pairwise correlation matrix results (Table 6) indicate that financial stability (FIS), poverty (PGP), and population growth rate (POP) have a negative correlation with food security (FS). The rest of the variables have a positive correlation with FS. All the variables except

[3] Choi (2021) https://www.imf.org/en/Blogs/Articles/2021/12/06/food-inflation-in-sub-saharan-africa

population have a negative correlation with food affordability (AFF). Similarly, except for financial stability, poverty, and population growth, all other variables have a positive correlation with food accessibility (ACC). All the variables have a negative correlation with food quality (QAS) except institutional quality and domestic health expenditure (DHE). Regarding food sustainability (SUS), institutional quality and inflation have a positive correlation with SUS, whereas all other variables have a negative correlation.

Table 6. Pairwise correlations

Var	FS	AFF	ACC	UTI	SUS	FIS	ISQ	DHE	PGP	INF	POP	AGRL
FS	1.000											
AFF	-0.045	1.000										
ACC	0.691**	-0.155**	1.000									
QAS	0.644**	-0.090	0.306**	1.000								
SUS	0.264**	-0.233**	0.220**	0.131**	1.000							
FIS	-0.183**	-0.061	-0.166**	-0.135**	-0.164**	1.000						
ISQ	0.613**	-0.017	0.451**	0.234**	0.138**	0.058	1.000					
DHE	0.599**	-0.146**	0.370**	0.512**	-0.010	-0.076	0.450**	1.000				
PGP	-0.271**	-0.064	-0.264**	-0.150**	-0.299**	0.388**	0.085	-0.112**	1.000			
INF	0.026	-0.102	0.112**	-0.001	0.146**	-0.058	-0.032	0.057	-0.579**	1.000		
POP	-0.474**	0.263**	-0.346**	-0.348**	-0.093	0.032	-0.392**	-0.664**	0.106	-0.098	1.000	
AGRL	0.151**	-0.401**	0.235**	-0.0001	0.233**	-0.019	0.333**	0.345**	-0.030	0.013	-0.478**	1.0

**** p<0.01, ** p<0.05, * p<0.1*

Unit Root and Cross-Sectional Dependency

Two cross-sectional dependency tests were conducted to ensure the validity of statistical inferences. Thus, in order not to have inconsistent estimates, incorrect standard errors, inefficient estimates, and misleading inferences, it is prudent to check for cross-sectional dependency. Therefore, Pesaran (2015, 2021) and Fan et al. (2015) conducted cross-sectional dependency tests. The results of the tests, as shown in Table 7 below, show that there is cross-sectional dependency among the variables.

Table 7. Cross-Sectional Dependency Test.

VAR	MODEL 1		MODEL 2		MODEL 3		MODEL 4		MODEL 5	
	CD	CDw+	CD	CDw+	CD	CDw+	CD	CDw+	CD	CDw+
fs	24.35***	498.4***	---	---	---	----	----	----	----	-----
fisi	64.48***	1251.6***	64.48***	1259.8***	64.48***	1254.4***	64.48***	1252.7***	64.48***	1256.8***
isq	12.19***	495.4***	12.19***	492.9***	12.19***	493.9***	12.19***	491.4***	12.19***	494.3***
che	20.62***	592.2***	20.62***	592.7***	20.62***	592.5***	20.62***	591.6***	20.62***	549.3***
pgp	64.48***	1251.6***	64.48***	1259.8***	64.48***	1254.4***	64.48***	1252.7***	64.48***	1256.8***
cpis	64.48***	1251.6***	64.48***	1259.8***	64.48***	1254.4***	64.48***	1252.7***	64.48***	1256.8***
pop	18.40***	596.9***	18.40***	597.5***	18.40***	598.5***	18.40***	596.4***	18.40***	599.2***
agrl	23.78***	713.64***	23.78***	714.7***	23.78***	712.48	23.78***	712.04***	23.78***	719.8***
aff	-----	-----	13.14***	329.3***	------	-----	-----	------	------	----
acc	-----	-----	------	------	8.39***	399.0***	-------	--------	------	-----
uti	-----	------	------	------	--------	---------	6.95***	417.6***	--------	-----
sus	-----	------	-------	------	------	-------	-----	------	28.45***	708.3***

*Note: *** p<0.01, ** p<0.05, * p<0.1,* CD: Pesaran (2015, 2021), CDw+: CDw with power enhancement from Fan et al. (2015)

The PESCADF, a second-generation unit root test, was conducted due to a strong cross-sectional dependency among the series. The results of the unit root test in Table 8 indicate that all the variables are significant at the first difference at 1% except for the financial stability index, poverty, inflation, and population growth rate, which are significant at 10%.

Table 8. PESCADF Unit Root Test.

VARIABLES	LEVEL		1ST DIFFERENCE	
	CONSTANT	*TRENDS*	*CONSTANT*	*TRENDS*
FS	-2.150**	-2.173	-3.026***	-3.402***
AFF	-2.627***	-2.938***	-3.821***	-3.757***
ACC	-1.959	-1.957	-2.505***	-2.513
QAS	-1.778	-2.259	-2.741***	-2.559
SUS	-2.039*	-2.383	-2.862***	-2.639*
FIS	2.610	1.700	-2.673*	-2.669
ISQ	-2.297**	-2.542*	-3.077***	-3.004**
DHE	-1.810	-2.852**	-3.367***	-3.547***
PGP	2.572	2.613	-2.701*	-2.644
INF	-1.635	-1.634	-2.733*	-2.667
POP	1.559	1.548	-2.818*	-2.570
AGRL	-2.223**	-2.294	-2.709***	-2.958**

*** *p<0.01, ** p<0.05, * p<0.1*

Two-step System GMM

Institutional quality and financial stability are key in shaping how the effort to achieve food security becomes efficient. The results of the five estimations are presented in Table 9 below. While the Sargan test rejects the null hypothesis of a weak model, the Hansen J test shows that the models are strong and not weakened by instruments. The AR1 and AR2 tests of heteroscedasticity suggest that the model has no heteroscedasticity problems.

The lags of dependent variables were significant in all the models. This indicates that previous years' efforts in achieving food security, food affordability, food accessibility, food quality and safety, and food sustainability and adaptation influence current or future efforts by 68.5%, 80.1%, 68.7%, 51.4%, and 80.7% respectively, *ceteris paribus*.

Table 9. Two-step System GMM results

VARIABLES	Model 1 Dep.var (fs)	Model 2 Dep.var (aff)	Model 3 Dep.var (acc)	Model 4 Dep.var (qas)	Model 5 Dep.var (sus)
FIS	-0.001	0.017***	-0.006**	0.001	0.006**
	(0.001)	(0.002)	(0.002)	(0.001)	(0.003)
ISQ	0.009***	0.005**	0.008***	0.003*	0.003***
	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)
DHE	0.008*	0.002	-0.003	0.051***	0.005
	(0.005)	(0.016)	(0.007)	(0.017)	(0.005)
PGP	-0.026**	0.044*	-0.091***	-0.001	-0.063*
	(0.13)	(0.026)	(0.017)	(0.021)	(0.0101)
INF	-0.111***	-0.092**	-0.023**	-0.001***	-0.003*
	(0.00121)	(0.00019)	(0.00022)	(0.00051)	(0.0014)
POP	-0.006***	0.009	-0.007*	-0.006*	-0.001***
	(0.002)	(0.007)	(0.004)	(0.003)	(0.001)
AGRL	-0.023***	-0.036*	-0.016	-0.062***	0.019
	(0.006)	(0.019)	(0.014)	(0.14)	(0.008)
Lag	0.685***	0.801***	0.687***	0.514***	0.807***
	(0.047)	(0.035)	(0.035)	(0.084)	(0.051)
constant	0.554***	0.428***	0.485	0.846***	0.207**
	(0.075)	(0.127)	(0.084)	(0.129)	(0.84)
AR 1	-2.82**	-3.25***	-3.45***	-2.29**	-3.39***
AR 2	-1.54	-1.04	-0.12	-1.42	-0.25
Sargan Test	258.37***	2.19.57***	257.60***	267.7***	262.44***
Hansen Test	23.69	19.98	24.49	22.39	17.80
Mean dep. Var	1.633	1.661	1.645	1.697	1.646
No. obs	252	252	252	252	252

*** *p<0.01, ** p<0.05, * p<0.1*

Financial stability is a strong foundation for economic growth. A stable financial system demonstrates the resilience of a financial system to withstand economic shocks and disruptions. It connotes a condition where financial markets function smoothly, and credit flows are available to support economic activities and food security initiatives. Financial stability also indicates how inclusive and structured financial systems are.

The results in the first model indicate that financial stability has a negative impact on food security, although it is statistically insignificant. This indicates that the financial systems in Sub-Saharan Africa (SSA) are not structured to support agricultural production. This could be due to the volatile financial systems and lack of investment in agriculture in most of the SSA countries. Mapanje et al. (2023) stressed that financial services such as credit, savings, insurance, and remittances are still underdeveloped. Additionally, smallholder farmers produce about 80% of food in SSA (Jellason et al., 2021), yet they are considered unbankable by financial institutions (Mapanje et al., 2023). SSA countries are experiencing some form of financial instability post-COVID-19 pandemic, worsening the food insecurity situation. For instance, Ghana is facing the worst form of financial crisis despite the financial sector clean-up in 2020, which saw the collapse of 9 indigenous banks. Ghana has defaulted on its debt, which has seen investors having a "haircut" of their investments (Appiah and Otoo, 2019), which has dumped the spirit of saving and investment in Ghana. Furthermore, it was evident that these challenges have resulted in the prevalence of Insufficient Food Consumption (IFC). The Food Security Monitor July 2024 edition[4] indicates the prevalence of IFC in July across 17 countries from Eastern, Southern, and Western Africa, and have become food insecurity hotspots[5] include Burkina Faso (56.6%), Mali (69.1%), Niger (82.6%), and Nigeria (51.5%). The number of people with IFC remained unchanged in most countries except Ghana, Nigeria, and Uganda, where it rose by 5.77%, 3.98%, and 7.5% respectively, and in Zimbabwe where it decreased by 5.45%. Compared to a year ago, however, most countries have experienced surges in the number of people with IFC except in Mozambique, Rwanda, South Sudan, Uganda, and Zambia where the current is lower. These challenges make sustainable financing of agriculture productivity difficult and thwart the effort towards food security. Considering the relationship between financial stability and the components of food security, the results indicate that financial stability increases food affordability, sustainability, and adaptation in models 2 and 3 respectively. However, it reduces food accessibility and is statistically insignificant relative to the quality and safety of food. This provides mixed evidence of the relationship between stable financial systems and food security.

Institutional quality connotes norms, values, customs, regulations, and societal structures (formal or informal) to promote social uniformity, growth, and sustainable development. Oyelami et al. (2023) posit that institutional quality leads to the efficacy of a food security system. The results show that institutional quality increases food security, food affordability, food accessibility, food quality and safety, and food sustainability and adaptation by 9%, 5%, 8%, 3%, and 3% respectively. This implies that when effective institutions for food security exist, food production (increasing food supply) and distribution will be efficient. The increase in food supply will translate to a drop in food prices, which will expand food access. The effective institutions will include effective mechanisms to check the quality of food and its safety for utilization. Additionally, the increase in the quality of institutions will influence policy geared toward sustainable agriculture and adaptation to engender population dynamics and globalization. For example, Subramaniam et al. (2023) explain that the regulatory system can

[4] AGRA (2024): https://agra.org/wp-content/uploads/2024/08/Food-Security-Monitor_July-Issue-Editon-49.pdf

[5] Food Security Hotspot is defined as countries where over 50% of the total population has IFC (AGRA, 2024).

support food security objectives by preparing policies to maintain the flow of goods and services to the agricultural ecosystem. Policies on sustainable land use, land tenure systems, sustainable agriculture, agricultural input subsidies, and resource management will support forest restoration, food production, and agroforestry to enhance water storage, soil retention, and soil fertility, which are among the needed policies for productive agriculture. Soko et al. (2023) had similar results and concluded that institutional quality plays a significant mediating role in the impact of public agricultural spending on food security. Ashraf and Javed (2023) posit that institutional quality decreases the negative environmental implications of food security.

The results also indicate that well-being proxied by domestic health expenditure increases food security, food affordability, food quality and safety, and food sustainability and adaptation by 0.8%, 0.2%, 5.1%, and 0.5% respectively, although it is statistically insignificant in the case of food affordability, and food sustainability and adaption. However, well-being reduces food accessibility by 3%. This indicates that increased health spending can improve nutritional outcomes and food utilization by reducing disease burdens, enhancing productivity, and increasing life expectancy. This, in turn, supports food security by improving the population's ability to access, utilize, and maintain a stable food supply. Affoh et al. (2022), and Gassara and Chen (2021) posit that health expenditures have a direct positive impact on critical health outcomes, such as reduced child mortality and improved life expectancy, which are essential for food security at the household level. Moreover, Nketiah-Amponsah (2019) stressed that improved health infrastructure and increased domestic health expenditure mitigate the impacts of poor nutrition. Therefore, it is prudent for SSA countries to invest in domestic health expenditure to improve health outcomes that influence food production, dietary diversity, and the ability to withstand economic and environmental shocks.

The results further show that an increase in poverty reduces food security by 2.6%, food affordability by 4.4%, food accessibility by 9.1%, quality and safety by 0.1% (although insignificant), and sustainability and adaptation by 6.3%. This suggests that poverty experiences in SSA make households prone to higher food insecurity due to limited economic access to sufficient and nutritious food. Affoh et al. (2022) express that poverty exacerbates the inability to purchase or produce food, leading to inadequate dietary diversity and nutritional deficiencies. Thomas and Zuberi (2012) indicate that reducing the poverty gap improves food access and utilization, positively affecting overall food security in SSA. Singh (2023) and Gomina et al., (2024) stressed that poverty limits access to a variety of nutritious diets and essential agricultural resources. This will exacerbate food insecurity and perpetuate a cycle of chronic hunger and malnutrition among affected households. Additionally, the results of the study indicate that poverty in SSA affects food security as it restricts access to resources, reduces purchasing power, and increases vulnerability to food shortages. This will affect most of the rural populations in SSA who rely heavily on agriculture for income (Post et. al., 2021). A sustainable agricultural investment policy is central to ensuring food security and poverty alleviation in SSA and providing well-structured social safety nets and welfare systems to aid vulnerable people to move them out of poverty (Gomina et al., 2024).

Inflation significantly impacts food security, particularly among vulnerable populations. Rising food prices, driven by various factors including agricultural price inflation and global crises, exacerbate food insecurity and alter consumer behavior. The following sections explore these dynamics in detail. The results show that an increase in inflation (proxied by the consumer price index) negatively affects food security, affordability, accessibility, quality and safety, and sustainability and adaptation by 11.1%, 9.2%, 2.3%, 0.1%, and 0.3% respectively. This indicates that high inflation (particularly food inflation) leads to changes in consumer purchasing patterns, especially among food-insecure individuals in SSA. Haydaroğlu and Bilgiç (2024) indicate that most vulnerable households with moderate to severe food insecurity prioritize price over health in their food choices, reflecting a shift in consumption behavior due to inflationary pressures (Haydaroğlu and Bilgiç, 2024). Furthermore, inflation bedevils food accessibility efforts particularly in poorer countries in SSA, hence, regulating food prices and ensuring income

growth matches the inflation rate are key to maintaining food affordability and accessibility (Parshukov, 2024). Though inflation is one of the key threats to food security in SSA, target policy interventions and social safety nets that will cushion poorer households and vulnerable people from its adverse effects will ensure households' capability to access and afford quality safe foods (OECD, 2023).

The results also indicate that an increase in population growth rate leads to a 0.6% decrease in food security, reduces food access by 0.7%, food quality and safety by 0.6%, and food sustainability and adaptation by 0.1%. Although insignificant, it increases affordability by 0.9%. This implies that as populations in SSA increase, the demand for food escalates, often outpacing agricultural output, leading to heightened food insecurity. Subramaniam (2023) indicated that the interaction between population growth and biofuel production negatively affects food security across availability, accessibility, utilization, and stability. For instance, Nigeria has a significant gap between (2.6%) and agricultural output growth (3.5%) contributing to food insecurity (Aiyedogbon et al., 2022). Policies targeting family planning and agricultural investment are imperative to redress the negative effects of population growth on food security (Ahmed and Elasraag, 2023).

Agricultural land size negatively impacts food security, food affordability, food accessibility (although insignificant), and food quality and safety by 2.3%, 3.6%, 1.6%, and 6.2% respectively. This could be due to the inefficient use of agricultural land and land degradation. The double impacts of agricultural activities and climate change have accelerated the degradation of agricultural land grown both for arable land (Jacquemot, 2020) and pastures (Prăvălie, 2016). Despite the large agricultural land availability, a significant proportion is subject to serious ecological vulnerabilities such as losses by erosion, salinization of soils, leaching of nutrients, accelerated mineralization, export of plant biomass, risk of invasion by predators, heavy metal leaching from mining, and recurring plant diseases (Chaoran and Restuccia, 2018) as well as low organic matter rates. The watered regions in SSA, which account for approximately 58% of the area cultivated in Africa, do not fare much better, even if the issue of soil degradation is not quite the same (Jacquemot, 2020), significant rainfall in these areas causes floods, especially when the soil has a low plant cover. The resulting water erosion mainly concerns central Africa where the index of annual Tillage erosivity is very high (Panagos et al., 2017). There is a need for proper policy and planning to combat these conundrums to ensure sustainable agriculture and food security.

Robustness Check and Pathways Impact

The study through a robustness check explores the institutional mechanism that really influence food security and the various components. We seek to identify the pathways through which institutional quality and financial stability affects food security. In the analysis, we focused on control of corruption, and quality regulations as the key institutional variables that has direct impact on overall development and improvement in food security situation. The assumption is that once corruption is controlled to the barest minimum and regulatory frameworks are of top quality, the other institutional indicators – governance effectiveness, political stability, rule of law and voice and accountability will all fall in place.

Similarly, for institutional quality we used the banking Z-Score (which signal how far banks are from liquidation) and bank liquidity coverage ratio (which show the strength of banks to finance credit in the short term with liquid assets) as proxies for financial stability. The assumption is that the farther banks are from liquidity the stronger the financial system is, and the more liquid assets a bank has to finance short – term credit the more farmers can get short term loan and credit to finance their agricultural activities. These proxies have been used in several studies to represent institutional quality (Lantz, 2021, Olabiyi, 2022) and financial stability (Bawuah, 2024; Bekoe etal.,2025).

The robustness in table 10 indicates that control of corruption (coc) has a positive effect on food security, affordability, accessibility, and sustainability by 1.4%, 1.3%, 5.1%, and 1.3% respectively. However, tit has a negative (1.6%) relationship with quality and safety of food. This suggests that reducing corruption primarily benefits access, affordability, and sustainability aspects of food security, potentially by lowering transaction costs and market distortions. This indicates that corruption if not controlled properly leads to a diversion of public funds and international aid which are intended for agricultural development, infrastructure (such as irrigation and storage), social safety nets, and food assistance programs (UNDP, 2022) The Transparency International in 2022 posits that investigations in countries like Somalia, Nigeria and Ethiopia have revealed that food aids were misappropriated by officials for personal profits (Transparency International, 2020; Lantz, 2021). Furthermore, Olabiyi (2022) indicated in his work that bureaucratic corruption, especially between public institutions, negatively impacts household food security status. Similarly, issues of land grabbing, which are mainly fueled by corruption, displace smallholder farmers who play a vital role in local food production but are food insecure themselves (Lewis and Lenton, 2008).

Table 10. Robustness Check: Dynamic Panel GMM Results.

	(1) FOOD SECURITY	(2) AFFORDABILITY	(3) ACCESSIBILITY	(4) QUALITY AND SAFETY	(5) SUSTAINABILITY
Lags of Dep. Var	0.654***	0.792***	0.671***	0.830***	0.993***
	(0.082)	(0.046)	(0.045)	(0.055)	(0.015)
BAZS	0.132**	0.776***	-0.032**	0.000	0.087*
	(0.053)	(0.110)	(0.009)	(0.058)	(0.052)
LCRS	0.055	0.214**	-0.036***	0.054	0.015***
	(0.041)	(0.087)	(0.007)	(0.098)	(0.003)
COC	0.014***	0.013**	0.051***	0.016***	0.013***
	(0.004)	(0.009)	(0.013)	(0.005)	(0.003)
REQ	0.029***	0.023**	0.040**	0.015*	0.017**
	(0.008)	(0.005)	(0.016)	(0.008)	(0.007)
CPI	-0.001***	-0.001*	0.000	-0.000	-0.000
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
DHE	0.012**	-0.030*	0.034***	0.011	0.034***
	(0.005)	(0.018)	(0.005)	(0.007)	(0.005)
PGP	-0.027	0.087***	-0.019	0.048	-0.019
	(0.023)	(0.028)	(0.038)	(0.038)	(0.017)
POP	-0.004	-0.018	0.027***	-0.009	0.033***
	(0.003)	(0.014)	(0.008)	(0.007)	(0.004)
AGRL	-0.024**	-0.050*	0.041***	-0.020	0.029***
	(0.010)	(0.028)	(0.012)	(0.012)	(0.009)
Constant	0.332**	-0.486***	0.380***	0.312	-0.280***
	(0.168)	(0.172)	(0.129)	(0.190)	(0.074)
Observations	252	252	266	240	240
AR(1)	-2.94***	-3.31***	-3.57**	-3.01***	-3.30***
AR(2)	0.240	-1.13	-0.15	-1.42	-0.71
Hansen J	24.52	20.36	24.75	22.26	-1.36
Sergan Test	242.80***	206.62***	271.58***	232.60***	195.94***

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The robustness result in Table 10 further indicates a consistent positive effect of quality regulations (req) on food security, affordability, accessibility, quality, safety, and utilization, and sustainability by 2.9%, 2.3%, 4.0%, 1.5%, and 1.7% respectively. This indicates that better regulatory frameworks improve all aspects of food security and thus create a more effective food governance system. This means that improved regulatory systems ensure good enforcement of regulations against food fraud, such as mislabeling, counterfeiting, and food contamination (Chukwugozie et al., 2024). This prevents health risks and improves nutritional values derived from consumed food (Mphage et al., 2024). Moreover, poor regulations on agricultural inputs such as seeds, fertilizer application, and pesticides can lead to substandard

food circulation, a fall in crop yield, and farmer income. Abdi et al. (2024) add that weak environmental regulations and the enforcement of good farming practices can cause land degradation, water and soil pollution, which are critical for agricultural production. This has the potential to affect food production and food quality. Safety and utilization in the long run.

Controlling corruption and ensuring that an effective and efficient regulatory framework is central to ensuring a strong food security environment, as indicated by the results in Table 10. However, these two indicators are in their worst state in most SSA countries. Nigeria, for instance, is faced with significant corruption challenges and structural institutional weakness. These two factors, in concomitance with security unrest in northern Nigeria, have exacerbated the food security situation in northern Nigeria, resulting in a 180% increase in undernourished people over a decade (Hoffmann, 2025; Cassimon et al., 2022).

Furthermore, the robustness result in Table 10 shows that while banking Z-score had a positive and significant effect on food security, affordability, and sustainability by 13.2%, 77.6%, and 8.7% respectively. However, it had a negative effect of 3.2% on accessibility and had no significant effect on quality, safety, and utilization. Additionally, the results reveal that the bank liquidity coverage ratio has a positive effect on affordability and sustainability by 21.4% and 1.5% respectively, but it has a negative effect on accessibility by 3.6% and no significant impact on food security, food quality, safety, and utilization.

The results suggest that there is a potential trade-off between financial stability proxies and food security. Banking Z-Score, which measures the distance of a bank from insolvency, and the liquidity coverage ratio of banks. which explains the ability of banks to meet their short-term obligation with short-term liquid assets, has a general positive impact on food security, affordability, and sustainability (Bekoe et al., 2025; Bawuah, 2024). However, they both create some challenges for accessibility. This could be due to stricter lending regimes, higher rates of interest, and the underdevelopment of financial systems in most SSA countries. Zimbabwe, for instance, had a prolonged economic crisis, hyperinflation, and currency instability, which shook the financial sector and contributed to chronic food security. The Global Report on Food Crises (2024) pointed to the food security situation in Zimbabwe as a weak currency and a financial system. Similarly, Sudan's prolong civil war has crippled the financial sector, hence, worsening the already fragile food security situation (FFSIN and GNAFC, 2024). Similarly, Democratic Republic of Congo, Central African Republic and Sudan are all experiencing protracted inefficient financial system and poor institutional quality leading to crippling banking crisis and extreme food security situations (FFSIN and GNAFC, 2024).

Additionally, the results suggest that the differential effect across food security dimensions (especially strong impact on food affordability and less on quality, safety, and utilization) demands financial sector policies that primarily impact the economic aspects of food security (Tsongo et al., 2024). To address the issues of food quality, safety, and nutritional utilization, there is the need for a more nuanced combination of policies that encompasses both food safety regulation, nutrition education, and social transfer policies that grants people easy access to safe quality nutritious food (Nigo & Gibogwe, 2024; Burchi et. al, 2018).

Conclusion and Recommendation

Food insecurity in Sub-Saharan Africa (SSA) requires an integrated approach considering all its dimensions. Institutional quality and financial stability are crucial in addressing food insecurity in Sub-Saharan Africa (SSA). However, high poverty rates, poor institutions (in terms of weak policies, bad governance, and political instability), inflation, and underdeveloped financial systems have thwarted the effort to sustain the food security situation in SSA. Using a panel dataset covering 28 SSA countries from 2011 to 2021, the study examines how variables such as institutional quality, financial stability, poverty, inflation, population growth,

agricultural land use, and healthcare expenditures interact to influence food security across its four dimensions – availability, affordability, quality, and sustainability.

The study found that institutional quality is essential for fostering transparent governance, ensuring equitable resource distribution, and implementing cogent agricultural policies to achieve food security. However, the region's financial systems remain underdeveloped and often fail to meet the credit needs of the agricultural sector, limiting their potential to support food production and availability. High poverty rates exacerbate food insecurity in SSA by reducing the purchasing power of poor people, particularly in rural areas and the urban poor. Additionally, inflation impacts affordability by pushing food prices beyond the reach of many low-income households. Additionally, rapid population growth strains the food supply, and despite SSA's considerable arable land, poor land management reduces productivity and limits food availability. Further, health expenditure (a proxy for well-being) indirectly affects food security by improving overall population health and productivity. However, it is an underutilized factor in SSA's food security landscape.

The study suggests that institutional frameworks should be strengthened to enhance transparency, accountability, and anti-corruption efforts within the agricultural sector, which would support more equitable food distribution and resource access. Additionally, governments should improve financial infrastructure (structures, regulations, law) in their countries to ensure financial stability. This could improve financial inclusion and expand agricultural credit to smallholder farmers with the necessary resources to increase production, manage risks, and resilience against market fluctuations. Further, adopting sustainable land management practices, such as agroforestry and soil conservation, would mitigate the effects of environmental degradation and improve long-term agricultural productivity. For future research, a multifaceted approach to investigating and driving measurable improvements in food security, poverty alleviation, and economic stability at the micro level in SSA countries will be a huge contribution to the literature.

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