Globalization and food security in Sub-Saharan Africa

Yuxiao Shang[1]*, Yeming Lv[2], Zhenghui Chen[2], Rowland Bassey[3]*, Timothy A. Aderemi[3,4]* and Oluwafemi Enilolobo[3]

[1]Business School, Luoyang Normal University, Luoyang, China, [2]Business School, Henan University of Science and Technology, Luoyang, China, [3]Department of Economics, Accounting and Finance, Bells University of Technology, Ota, Nigeria, [4]Department of Economics, University of Religions and Denominations (URD), Qom, Iran

The research aimed to assess the impact of globalization and innovation on food security in Sub-Saharan Africa (SSA) between 2001 and 2021. The study utilized secondary data from the World Development Indicators to analyze the relationship. Food security was measured in terms of accessibility and availability, represented by the "Food Production Index (2014−2016 = 100)" and "Gross Domestic Product *per Capita*, PPP, Dissemination (constant 2017 international $)" respectively. The research employed a two-step System Generalized Method of Moments (GMM) to evaluate the data. The results indicated that globalization showed a direct and statistically insignificant influence on food security availability, but it had a negative and significant effect on food security accessibility. On the other hand, innovation had a direct but statistically insignificant effect on food security availability, while it had a positive and significant impact on food security accessibility. The interaction between globalization and innovation had an indirect but significant effect on food security availability and a direct and significant effect on food security accessibility. Additionally, the study found that arable land and population growth significantly influenced the availability aspect of food security, while arable land indirectly affected the accessibility aspect. Population had a direct but statistically insignificant effect on the accessibility measure of food security. Based on these findings, the study recommends that the governments of SSA countries and other stakeholders should adopt and operate integrated policy approaches that captures the diverse effects that globalization has on food security.

KEYWORDS

globalization, food security, Sub-Saharan Africa, sustainable development, agricultural productivity

1 Introduction

The physical and economic access that people have to cater nutritional needs and preference of food for everyday active and healthy living is what is referred to as food security (Wisdom et al., 2022). Food security has been a major global pursuit toward global improvement since the increase in world food prices in 2007. This is seen in the increasing interest in the topic and the dedication of the second Sustainable Development Goal (SDG 2) to the matter of food security alone. In 2019, it was shown that about 690 million people (that is 8.9 percent of the world population) were undernourished globally. As at 2022, the figure for the undernourished people in the world rests slightly above 820 million (UNICEF, 2022; Wudil et al., 2022).

Africa hosts at least one-third of the global undernourished population with a 30-year declining agriculture *per capita* income. With an expected leap in population of Africa from 1.2 billion in 2020 to 1.8 billion by 2050, the agricultural sector absorbs in employment about 60% of the working population. Despite this, the sector accounts for only 10% of export revenue and contributes about 22% of the GDP (Wudil et al., 2022). This poor performance, according Willy et al. (2020), could be attributed to over-dependence of African nations on food imports and the significant untapped agricultural potential.

Recent global observation showed that the number of people suffering from acute hunger in the world rose from 135 million in 2019 to 345 million in 2022 as a direct result of COVID-19 and the recent Ukraine conflict (UNICEF, 2022). In early 2020, in countries all over the world, the COVID-19 pandemic and the measures adopted to control the spread of the virus, especially the restriction of movement, had severe implications on economies and food security. For many African countries, staple foods like rice and maize are mostly planted between March and mid-April, a period which was met by the COVID-19 movement restrictions which inhibited farmers from planting. This in effect reduced the already low staple food production thereby causing an increase in importation of such food as rice to meet the high consumption demand from the region (Arumugam et al., 2021).

Historically, the exchange of agricultural products and produce between nations of the world has been a major propagator of globalization. Centuries before now, nations have traded agricultural produce such as salt, spices, sugar, etc. which has fostered globalization (Von Braun and Diaz-Bonilla, 2008). Globalization is the networking of various socio-economic, political and technological activities of all the nations of the world (Collier and Dollar, 2002; Umo, 2007). Economic globalization manifests in increasing free movement of goods, services, information, capital resources, and humans which concerns many fields like management, social, political, and cultural life, as well as natural and climatic effects of human activity. It is important when considering the concept of globalization in the light of agriculture to look at the whole sector of the agricultural business and rural areas. Through the trading of food, raw materials, capital and labor, nations who are engaged in it could improve the level of food security. Mellor (2003) inferred that the chances of low-income nations which is hosted majorly by Sub-Saharan Africa (SSA) to improve agricultural production is greatly increased in the presence of globalization thereby bringing about food security in SSA and the world.

The difficulty of attaining food security has been growing all over the world since 2015 and does not leave out the economically developed countries as estimates show that in 2020, between 720 million and 811 million people suffered from hunger in the world (Sun and Zhang, 2021). Succinctly put, food security has been a major concern for scholars around the world and many research works published testify to this, few of them being Khan et al. (2014) and Ayanlade and Radeny (2020). There have been very few recent empirical studies that have focused on the nexus between globalization and food security (Mary, 2019; Fusco et al., 2020; Montolalu et al., 2022). Consequently, the gap in food security literature is the unavailability of adequate empirical literature which focuses on uncovering the effect of globalization on food security in Sub-Saharan Africa. This study closes the literature gap by providing a well-researched empirical study that addresses the inadequacy of empirical literature focused on globalization and food security. Furthermore, the objective of this study is to determine the impact that globalization has on food security in Sub-Saharan Africa. Hence, the study answers the question "does globalization have a significant impact on food security in Sub-Saharan Africa?".

This study offers significant value to governmental authorities, international organizations (such as the United Nations and the Food and Agriculture Organization), and non-governmental organizations by providing comprehensive reviews and findings on the impact of globalization and innovation on food security in the Sub-Saharan African region. The findings aim to guide the formulation of appropriate policies to achieve sustainable development goals related to food security not only in the sub-region but also across Africa and globally. Additionally, the study contributes to the knowledge of researchers and scholars, offering insights into how globalization and innovation influence food security in Sub-Saharan Africa. Moreover, it serves as a foundational resource for future research in this field and related areas of study.

2 Literature review

2.1 Theoretical underpinning

This study is hinged on the Hescher-Ohlin international trade theory formulated in the 20th century by Heckscher and Ohlin (1991). The Heckscher-Ohlin (HO) theory states that countries tend to export goods that use their abundant factors of production intensively and import goods that use their scarce factors. In other words, a country will specialize in producing and exporting goods that it is relatively more efficient at producing compared to other countries. In the context of food security, the HO theory encourages that a country should identify her comparative advantage in agriculture and focus her resources and guide trade policies that promote food self-sufficiency and reduce dependence on imports. For example, if a country has abundant land and labor resources, it may have a comparative advantage in producing staple crops such as rice or maize, and thus, should focus on expanding its agricultural sector. On the other hand, if the country is resource-poor, it may import these goods from other countries where production is more efficient. Therefore, the encouragement of foreign trade in agriculture and related products is an essential factor to promote food security in Africa.

In the past three decades, numerous countries, both developed and underdeveloped, have implemented substantial policy reforms, including trade policy changes aimed at reducing both tariff and non-tariff barriers. These reforms, intended to foster economic growth and alleviate poverty, have contributed to a global increase in international trade (Josling et al., 2010). The rationale behind trade policy reforms lies in the anticipated improvements in efficiency, resource allocation, and output growth. However, findings from 15 country case studies on the impact of trade reforms on food security gathered by FAO in 2006 present a mixed picture (Dithmer and Abdulai, 2017). These studies indicate either no significant effects on aggregate food security indicators or positive effects, primarily driven by increased employment, income, and a rapid surge in food supplies following domestic production shortfalls.

For instance, Nigeria, a member of the Sub-Saharan Africa region, embraced open trade policies through the adoption of the structural adjustment program. Despite compliance with these policies, the agricultural sector in Nigeria faced constraints stemming from both trade and non-trade factors. The period from 1986 to 2003 witnessed trade policy reforms that did not substantially impact the development of the agricultural sector. Major policy efforts during this time failed to address the fundamental issue of food production (Abdullateef and Ijaiya, 2010). In the context of this study, therefore, the Heckscher-Ohlin (HO) international trade theory is relevant. Each country under examination possesses distinct agricultural resources, and these resources can be strategically harnessed and exported to improve food security. The theory suggests that countries should identify and capitalize on their comparative advantage in agriculture, aligning trade policies with their abundant resources to enhance food self-sufficiency and reduce dependence on imports.

The study by Affoh et al. (2022) examines the impact of climatic factors on food security in Sub-Saharan Africa from 1985 to 2018. The findings reveal that rainfall positively influences food security in the long term, while temperature negatively affects food accessibility and availability, with no impact on consumption. Carbon dioxide emissions improve food accessibility and availability but do not affect consumption. The study, utilizing advanced models, identifies short-run causal links between food availability and CO2 emissions, food accessibility and temperature, and food consumption and temperature. The report emphasizes policy considerations for decision-makers, emphasizing the importance of integrating climate change into food security planning. This knowledge complements the study of globalization's impact, offering a holistic perspective that incorporates both climatic and economic factors.

Determinants of food security in Nigeria were investigated by Enilolobo et al. (2022). The study outlined a multiple regression model that accounted for the effects of labor input (as measured by agricultural employment), domestic capital investment (as shown by gross fixed capital), bank inclusion (as measured by bank lending to agriculture), environmental quality (as measured by the ratio of carbon dioxide emissions to GDP), and oil revenue. For this model analysis, the study utilized the autoregressive distributed lag (ARDL) technique, and for the robustness, the study turned to pairwise granger causality. The study found that only domestic capital had a positive impact on food security in Nigeria, whereas bank loans had a positive impact only in the short run. The study's results prompted suggestions for enhancing the Central Bank of Nigeria's (CBN) bank lending policies in favor of the agricultural sector, for the Federal Ministry of Agriculture, the Ministry of Finance, and the private sector to formulate short- and long-term strategies for the growth of Nigeria's agricultural sector. This resonates with the broader study on the impact of globalization on food security in Sub-Saharan Africa, emphasizing the interconnectedness of economic factors and agricultural outcomes.

Montolalu et al. (2022) analysis of trade liberalization and dietary consumption in diverse Indonesian districts reveals a negative relationship between import tariff exposure and nutritional intake, varying across economic sectors and geographic regions within Indonesia. The study underscores the importance of considering regional specifics, economic conditions, and employment factors when implementing trade policies. This review is pertinent to the broader study on the impact of globalization on food security in

Sub-Saharan Africa, emphasizing the need for nuanced, region-specific approaches to address food security challenges arising from trade policies.

Liu et al. (2022), conducted a study titled "Globalization and Economic Growth: A Sustainability Analysis for South Asian Countries," exploring the impact of globalization on the economies of eight South Asian countries from 1996 to 2019. The study, using a pooled autoregressive-distributed lag approach, found that globalization positively affects economic development, with potential moderating factors like rising interest and inflation rates. The research highlights the intricate relationship between economic globalization, development, and factors like investment and corruption control. The research demonstrated that while globalization has a favorable effect on economic development, rising interest and inflation rates might counteract that effect. These insights offer valuable perspectives for understanding the potential implications of globalization on sustainable development in the context of Sub-Saharan Africa.

Nugroho et al. (2021), conducted a study on the impact of economic globalization on agricultural value added (AVA) in low-income nations. Analyzing factors such as currency exchange rates, FDI inflows, agricultural exports, import taxes, and fertilizer imports between 2006 and 2018 across 17 developing nations, the research revealed a positive correlation between AVA and agricultural exports. The findings suggest that economic globalization has a favorable impact on AVA in underdeveloped nations. The report concludes with recommendations for emerging nations to invest in human capital and technology, encourage collaboration between international investors and domestic businesses, promote exports, and foster a conducive economic climate. This highlights potential benefits for Sub-Saharan Africa to enhance agricultural development through globalization, international collaboration, and technological advancements.

Jerzak and Śmiglak-Krajewska's (2020) study on vegetable protein feed in Poland and the EU addresses food security and globalization's impact on sustainable development. Utilizing data from various sources between 2010 and 2018, the research reveals the EU's reliance on imported protein due to insufficient production, jeopardizing food security. Globalization's effect on the Polish market marginalizes domestic plant protein sources, affecting economic and environmental aspects. The study underscores the need to reevaluate production processes, explore sustainable methods, and reduce dependence on imports for long-term food security. This offers crucial insights for tackling food security challenges in Sub-Saharan Africa.

The reviewed studies provide insights into various aspects of the impact of globalization on food security. Affoh et al. (2022) examine climatic factors' influence on food security, but a direct link to globalization effects is not explicitly explored. Enilolobo et al. (2022) identify determinants of food security in Nigeria without directly assessing the role of globalization in shaping these factors. Montolalu et al. (2022) focus on trade liberalization and dietary consumption in Indonesian districts, leaving a gap in understanding broader implications for the country's food security. Liu et al. (2022) explore globalization's impact on economic growth in South Asia but do not delve into specific implications for food security. Nugroho et al. (2021) analyze economic globalization's effect on agricultural value added, with a gap in connecting these findings to broader food security outcomes. Jerzak and Śmiglak-Krajewska (2020) highlight challenges

in the EU's reliance on imported protein but do not explicitly explore how global trade dynamics contribute to these challenges.

3 Methodology

3.1 Sample and data

The sample period of this study covered from 2001 to 2021, a total of 21 years of 38 Sub-Saharan countries making the data a panel data. The data used were sourced from World Development Indicators (WDI) published by the World Bank (2023). The data sourced from the WDI included food availability (FA) measured by food production, food accessibility (AC), measured by Gross domestic product *per capita*, PPP, Dissemination, population growth rate (PGR) measured as the percentage of annual population increase or decrease, arable land (AL) measured as a percentage of land area, globalization (GL) foreign direct investment, net inflow (% of GDP) and innovation (IN) measured by this will be proxied by fixed telephone subscription (per 100 people). The choice of the years and countries was due to the availability of data for all the variables for this study.

3.2 Estimation procedure

This study examined the effect that globalization has on food security proxied by food availability and food accessibility. The study analyzed the nature of the datasets using the descriptive statistics analysis. Then the stationarity properties of the datasets were tested. Finally, to achieve the objective of the study, and answer the question, the model was estimated.

3.3 Estimation technique

In estimating the model of this study, the General Method of Moments estimation method was used. This estimation method was established by Arellano and Bond (1991). This method of estimation is suited for a dataset in which the cross-sectional observations is big represented by "N" and a small time series observations represented as "t" (Blundell and Bond, 1998).

3.4 Model selection

To analyze the objective of this study, the model specification is developed from theoretical framework and related empirical studies. Therefore, based on the theoretical framework and the objectives of the study, the model can be written as:

$$FSi = f\left(IN, GL, GL * IN, X\right) \quad (1)$$

Where;

FSi = food security dimensions to be used in this study.

The study estimates the model by measuring food security using food availability and accessibility because the consumption of food is a key component in reducing food insecurity and this is determined by food availability and accessibility (Montolalu et al., 2022). Hence, Food security in this study is represented as:

1 = (Availability (AV)) proxied by "Food production Index (2006 = 100)."

2 = (Accessibility (AC)) proxied by "Gross domestic product *per capita*, PPP, Dissemination (constant 2011 international $)."

IN = Innovation proxied by access to mobile internet subscription (% of total population).

GL = Globalization proxied by foreign direct investment.

GL*IN = Interaction between globalization and innovation (derived by multiplying the proxy for both variables).

X = Control variables that may affect food security.

Hence, from Equation 1;

$$AV = \beta 0it + \beta 1INit + \beta 2GLit + \beta 3GL * INit + \beta 4Xit + \mu it \quad (2)$$

$$AC = \alpha 0it + \alpha 1INit + \alpha 2GLit + \alpha 3GL * INit + \alpha 4Xit + \mu it \quad (3)$$

The control variables (X) that may influence food security selected in this study are first, population growth. This choice is due to the negative influence population growth is assumed to have on food security and various empirical studies show that population is an important factor in the discussion of food security. Few of these studies are Prosekov and Ivanova (2016), Oguntegbe et al. (2018), Fusco et al., (2020), and Pickson and Boateng (2022). The second control variable selected is arable land. The choice of arable land is because food security cannot be discussed without food production and food cannot be produced without arable land. Some studies such as Metu et al. (2016), Oguntegbe et al. (2018), Prosekov and Ivanova (2016), and Molotoks et al. (2021); have also shown arable land to be an important influence on food security.

Therefore, Equations 2, 3 can be expanded further as Equations 4, 5 below:

$$AV = \beta 0it + \beta 1INit + \beta 2\ GLit + \beta 3GL * INit \\ + \left(\beta 4PGit + \beta 5AL\right) + \mu it \quad (4)$$

$$AC = \alpha 0it + \alpha 1INit + \alpha 2GLit + \alpha 3GL * INit \\ + \left(\alpha 4PGit + \alpha 5AL\right) + \mu it \quad (5)$$

where:

PG = Population growth.

AL = Arable Land.

β_0 and α_0 are the intercept of the models.

β_1 and α_1 to β_5 and α_5 = Parameter Estimates.

μ = Stochastic Disturbance Error Term.

i = country (38).

t = time.

Therefore, Equations (6) and (7) will be specified to form the GMM models as follows;

$$lnAV = \beta 0it + \Omega lnAVit{-}1 + \beta 1lnGL * INit \\ + \beta 2lnPGit + \beta 3lnAL + \mu it \quad (6)$$

$$lnAC = \alpha_{0it} + \partial InACit - 1 + \alpha_1 lnGL * INit$$
$$+ \alpha_2 lnPGit + \alpha_3 lnAL + \mu it \qquad (7)$$

Ω, and ∂ are the coefficient of the first-lag of the dependent variables in Equations 5, 6 respectively.

4 Result and discussion

4.1 Descriptive analysis

The given descriptive statistics report in Table 1 provides information on six variables: AC, AL, AV, GL, IN, and PG. The variable AC has a high mean and maximum value of 4217.614 and 23681.58, respectively, indicating some large values in the data set. The standard deviation for AC is 4522.466, indicating a wide range of values. AL has a relatively low mean of 14.82244 and standard deviation of 13.14372. AV has a negative skewness value of −0.322 and a kurtosis value of 3.406, suggesting a slightly peaked and heavier-tailed distribution. GL has a high kurtosis value of 62.748, indicating a heavily tailed and positively skewed distribution. IN has a high kurtosis value of 13.04508, indicating a peaked and heavier-tailed distribution. The PG distribution is slightly skewed to the left with a negative skewness value and a kurtosis value of 3.602. The descriptive statistics show that variable AC has a high mean and maximum value, indicating the presence of some large values in the data set. AC also has a high standard deviation and positive skewness and kurtosis values, suggesting that the distribution is heavily tailed and skewed to the right. Variable AL has a low mean and relatively low standard deviation, with positive skewness and slightly leptokurtic distribution. Variable AV has a relatively high mean and maximum value, with negative skewness and slightly peaked and heavy-tailed distribution. Variable GL has a low mean but a very high maximum value, with a positive skewness and extremely leptokurtic distribution. Variable IN has a low mean, high standard deviation, positive skewness, and highly peaked and heavy-tailed distribution. Variable PG has a low mean, negative skewness, and slightly peaked and heavy-tailed distribution. All variables fail the Jarque-Bera test for normality. The probability values listed under the in the table are associated with the Jarque-Bera statistic for each variable. If the probability value is less than the significance level, it suggests that there is enough evidence to

reject the null hypothesis that the data follows a normal distribution. In this case, all the probability values are listed as 0.000 which means the data for each variable does not follow a normal distribution. This suggests presence of more extreme values in the dataset that are not clustered around the mean. As a result of this, a regression technique that does not rely on the assumption of a normally distributed dataset is required to estimate the data.

4.2 Unit root test

The Table 2 is the ADF test results which show that AV, AC, and IN are I(1) variables, which means they are non-stationary in their levels and require differencing to achieve stationarity. AL, GL, PG, and GL*IN, on the other hand, are I(0) variables, which means they are stationary in their levels and do not require differencing to achieve stationarity.

Overall, this unit root test result indicates that some of the variables in the analysis are non-stationary and require differencing to achieve stationarity, while others are stationary. This is important information to consider when selecting an appropriate econometric model for the data.

4.3 Model estimation

The provided Table 3 presents the outcomes of a regression analysis involving two dependent variables labeled as "Dependent AV" and "Dependent AC." The analysis includes several independent variables denoted as y(−1) through y(−4), AL, GL, GLIN, IN, and PG. The results reveal that all independent variables, with the exception of GL and IN, exhibit a statistically significant relationship with the "Dependent AV" variable. Notably, y(−1), AL, IN, and GL are positively associated with "Dependent AV," while GLIN and PG have a negative association with it. Regarding the "Dependent AC" variable, all independent variables demonstrate a statistically significant relationship with the dependent variable. Specifically, y(−4), AL, and GL display a negative relationship with "Dependent AC," while y(−1), y(−2), y(−3), GL*IN, PG, and IN exhibit a positive relationship. The significance of the independent variables is assessed using the Wald chi-square test, where a value of p of 0.05 or lower indicates statistical

TABLE 1 Descriptive statistics result.

	AC	AL	AV	GL	IN	PG
Mean	4217.614	14.822	91.012	4.403	3.344	2.396
Median	2252.675	10.669	95.985	2.668	0.893	2.614
Maximum	23681.58	48.722	181.510	103.337	36.884	5.785
Minimum	687.194	0.321	30.860	−10.954	0.000	−0.401
Std. dev.	4522.466	13.143	20.859	8.034	6.850	0.946
Skewness	2.170	1.173	−0.322	6.490	3.239	−0.701
Kurtosis	7.255	3.243	3.406	62.748	13.045	3.602
Jarque-Bera	1228.520	185.099	19.298	124300.4	4744.571	77.319
Probability	0.000	0.000	0.000	0.000	0.000	0.000
Observations	798	798	798	798	797	798

Source: Author's Computation (2023).

TABLE 2 Unit root test result.

Variable	ADF		Order of integration
	Level	1st difference	
AV	NA	620.213* (0.0000)	I(1)
AC	NA	325.979* (0.0000)	I(1)
AL	413.889* (0.0000)	NA	I(0)
GL	196.867* (0.0000)	NA	I(0)
IN	NA	228.752* (0.0000)	I(1)
PG	117.580* (0.0016)	NA	I(0)
GL*IN	203.214* (0.0000)	NA	I(0)

Source: Author's Computation (2023).

TABLE 3 GMM result (Dependent variables: food availability and food accessibility).

	Dependent AV	Dependent AC
Variables	Equation 5	Equation 6
$y(-1)$	0.8406* (0.000)	0.858* (0.000)
$y(-2)$	NA	0.066* (0.000)
$y(-3)$	NA	0.080* (0.000)
$y(-4)$	NA	−0.146* (0.000)
AL	1.972* (0.000)	−5.667* (0.000)
GL	0.071 (0.947)	−1.467* (0.000)
GL*IN	−0.076* (0.000)	0.809* (0.000)
IN	0.301 (0.445)	10.722* (0.009)
PG	−3.035* (0.000)	1.941 (0.644)
No. of observation	720	606
No. of groups	38	38
Wald chi^2	14207.87* (0.000)	3,275,305* (0.000)
AR(1)	−3.768* (0.000)	NA
AR(2)	−1.401 (0.161)	−0.003 (0.997)
J-statistics	36.841 (0.255)	33.747 (0.336)

$y(-1)$, $y(-2)$, $y(-3)$, and $y(-4)$ shows the lag of AV and AC. Source: Author's computation (2023) * represent significance at 5% levels of significance. Values in parenthesis are p-values.

significance. The J-statistics indicate that the validity of the instruments cannot be rejected. In conclusion, the findings suggest a statistically significant relationship between the independent variables and the dependent variables, with varying directions of association depending on the specific independent and dependent variables. The findings of the estimated models reveal that globalization has a positive impact on food security as measured by food availability in Sub-Saharan Africa. However, this impact is not statistically significant, which aligns with the findings of the study conducted by Fusco et al. (2020). Conversely, when examining the relationship with food accessibility, globalization is found to have a negative and insignificant effect. Specifically, the proxy for globalization, foreign direct investment (FDI), demonstrates a negative and insignificant impact on food security in terms of accessibility in Sub-Saharan Africa. On the other hand, the results indicate that innovation has a positive but insignificant effect on food security proxy for availability in Sub-Saharan Africa. However, it has a significant and direct effect on food security proxy for accessibility, which is consistent with the findings of the study conducted by Khalid Anser et al. (2021). This

implies that an increase in innovation in Sub-Saharan Africa will lead to a significant improvement in food accessibility. Furthermore, the interaction between globalization and innovation is found to have a significant impact on both food availability and accessibility. However, its impact on food security proxy for availability is negative. In other words, an increase in the interaction between innovation and globalization will result in a decrease in food security proxy for availability. Conversely, food security proxy for accessibility will increase due to the direct effect of the interaction between globalization and innovation.

Directly addressing the objective of this study, the result informs that globalization has a positive impact on food security proxy for availability in sub-Sahara Africa. This impact is however not significant in sub-Sahara Africa which is in agreement with the study carried out by Fusco et al. (2020). The opposite is observed when regressed against accessibility. It is seen to have a negative and significant effect on accessibility. Globalization proxied by FDI is seen to have a negative significant impact on food security proxy for accessibility in sub-Sahara Africa.

5 Conclusion

This study examined the influence of globalization on food security in Sub-Saharan Africa during the period from 2001 to 2021. The sample consisted of 38 countries in Sub-Saharan Africa, selected using convenient sampling based on data availability.

Based on the result of the model analysis, the study concludes that globalization has a direct and insignificant relationship with food security when measured in terms of availability but has an indirect and significant relationship when measured in terms of accessibility. This means that the proxy for globalization has no significant impact on food availability in Sub-Saharan Africa but has a significant impact on food accessibility in Sub-Saharan Africa.

Addressing the research question, "Does globalization impact food security in Sub-Saharan Africa?" our study provides a nuanced answer. It indicates that the impact of globalization on food security is not uniform across all dimensions; rather, its influence is notably pronounced in shaping the accessibility of food in the region. These findings contribute to the ongoing discourse on the interplay between globalization and food security. They underscore the need for policymakers, governmental authorities, and international organizations, such as the United Nations and the Food and Agriculture Organization, to consider the multifaceted nature of globalization's impact on food security when formulating strategies and interventions.

This study brings novelty to the existing literature by examining the impact of globalization on food security in Sub-Saharan Africa (SSA) using the Generalized Method of Moments (GMM) regression technique. Addressing gaps in prior research, our study establishes a direct link between food security and globalization, filling a void in the SSA context. By adopting the GMM method, we enhance methodological rigor, providing fresh insights that contribute to the broader understanding of globalization's effects on food security, especially in the unique context of SSA. This research serves as a recent, region-specific contribution, guiding future studies and enriching scholarly discussions.

5.1 Recommendations

From the findings of this study which showed that globalization has no significant impact on food availability in SSA and a negative significant impact on food accessibility in SSA, the study recommends the adoption of integrated policy approaches in SSA countries especially in the aspect of trade policies and recommendation. Policymakers are urged to recognize the diverse effects on availability and accessibility, therefore tailoring policies accordingly. The study also recommends that capacity building and infrastructure development by the governments of SSA countries and stakeholders can strengthen the region's adaptive capacity to globalization, coupled with strategic investments in infrastructure, can enhance the accessibility of food.

5.2 Limitations and future directions

This study has its limitations and can serve as direction for future research. This study focused on only on Sub-Saharan Africa. Studies therefore could be carried out in other sub-regions in the world. In addition, future studies can make use of all the pillars of food security in the model estimation. Finally, a different estimation method could be applied in future studies. These are areas neglected in this study that can be adopted for future research.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: https://databank.worldbank.org/source/world-development-indicators, World Bank's World Development Indicators.

Author contributions

YS: Literature review, Data collection and curation, and introduction and data analysis. YL: Literature review, Data collection and curation, and introduction and data analysis. ZC: Literature review, Data collection and curation, and introduction and data analysis. RB: Writing – original draft. TA: Methodology, Writing – review & editing. OE: Writing – review & editing.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Abdullateef, U., and Ijaiya, A. T. (2010). Agricultural trade liberalization and food security in Nigeria. *J. Econ. Int. Finance* 2:299.

Affoh, R., Zheng, H., Dangui, K., and Dissani, B. M. (2022). The impact of climate variability and change on food security in Sub-Saharan Africa: perspective from panel data analysis. *Sustainability* 14:759. doi: 10.3390/su14020759

Arellano, M., and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Rev. Econ. Stud.* 58, 277–297. doi: 10.2307/2297968

Arumugam, S., Özkan, B., Jayaraman, A., and Mockaisamy, P. (2021). Impacts of COVID-19 pandemic on global agriculture, livelihoods and food systems. *J. Agric. Sci.* 27, 239–246. doi: 10.15832/ankutbd.941162

Ayanlade, A., and Radeny, M. (2020). COVID-19 and food security in Sub-Saharan Africa: implications of lockdown during agricultural planting seasons. *NPJ Sci. Food* 4, 1–6. doi: 10.1038/s41538-020-00073-0

Blundell, R., and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *J. Econ.* 87, 115–143. doi: 10.1016/S0304-4076(98)00009-8

Collier, P., and Dollar, D. *Globalization, growth, and poverty: Building an inclusive world economy*. Washington, DC: World Bank Publications. (2002).

Dithmer, J., and Abdulai, A. (2017). Does trade openness contribute to food security? A dynamic panel analysis. *Food Policy* 69, 218–230. doi: 10.1016/j.foodpol.2017.04.008

Enilolobo, O. S., Nnoli, T. I., Olowo, S. O., Aderemi, T. A., Adewole, A. O., Olapade, V. O., et al. (2022). Determinants of food security in Nigeria. *Acta Universitatis Danubius* 18, 193–209.

Fusco, G., Coluccia, B., and De Leo, F. (2020). Effect of trade openness on food security in the EU: a dynamic panel analysis. *Int. J. Environ. Res. Public Health* 17:4311. doi: 10.3390/ijerph17124311

Heckscher, E. F., and Ohlin, B. *Heckscher-Ohlin trade theory, translated, edited, and introduced by Harry flam and M. June Flanders*. Cambridge, MA: MIT Press. (1991).

Jerzak, M. A., and Śmiglak-Krajewska, M. (2020). Globalization of the market for vegetable protein feed and its impact on sustainable agricultural development and food security in EU countries illustrated by the example of Poland. *Sustainability* 12:888. doi: 10.3390/su12030888

Josling, T., Anderson, K., Schmitz, A., and Tangermann, S. (2010). Understanding international trade in agricultural products: one hundred years of contributions by agricultural economists. *Am. J. Agric. Econ.* 92, 424–446. doi: 10.1093/ajae/aaq011

Khalid Anser, M., Iqbal Godil, D., Aderounmu, B., Onabote, A., Osabohien, R., Ashraf, J., et al. (2021). Social inclusion, innovation and food security in West Africa. *Sustainability* 13:2619. doi: 10.3390/su13052619

Khan, Z. R., Midega, C. A., Pittchar, J. O., Murage, A. W., Birkett, M. A., Bruce, T. J., et al. (2014). Achieving food security for one million Sub-Saharan African poor through push–pull innovation by 2020. *Philos. Trans. R. Soc. Lond. B* 369:20120284. doi: 10.1098/rstb.2012.0284

Liu, Y., Adejumo, A. V., Adejumo, O. O., and Aderemi, T. A. (2022). Globalization and economic growth: a sustainability analysis for South Asia countries. *Global Pol.* 13, 507–522. doi: 10.1111/1758-5899.13073

Mary, S. (2019). Hungry for free trade? Food trade and extreme hunger in developing countries. *Food Security* 11, 461–477. doi: 10.1007/s12571-019-00908-z

Mellor, J. (2003). "Globalisation and the traditional role of agriculture" in *Trade reforms and food security. Conceptualization the linkages* (Rome: FAO)

Metu, A. G., Okeyika, K. O., and Maduka, O. D. Achieving sustainable food security in Nigeria: challenges and way forward. Proceedings of the 3rd International Conference on African Development Issues (2016). 182–186.

Molotoks, A., Smith, P., and Dawson, T. P. (2021). Impacts of land use, population, and climate change on global food security. *Food Energy Secur.* 10:e261. doi: 10.1002/fes3.261

Montolalu, M. H., Ekananda, M., Dartanto, T., Widyawati, D., and Panennungi, M. (2022). The analysis of trade liberalization and nutrition intake for improving food security across districts in Indonesia. *Sustainability* 14:3291. doi: 10.3390/su14063291

Nugroho, A. D., Bhagat, P. R., Magda, R., and Lakner, Z. (2021). The impacts of economic globalization on agricultural value added in developing countries. *PLoS One* 16:e0260043. doi: 10.1371/journal.pone.0260043

Oguntegbe, K., Okoruwa, V., Obi-Egbedi, O., and Olagunju, K. (2018). Population growth problems and food security in Nigeria. Available at: https://ssrn.com/abstract=3330999. (Accessed 23 October 2023)

Pickson, R. B., and Boateng, E. (2022). Climate change: a friend or foe to food security in Africa? *Environ. Dev. Sustain.* 24, 4387–4412. doi: 10.1007/s10668-021-01621-8

Prosekov, A. Y., and Ivanova, S. A. (2016). Providing food security in the existing tendencies of population growth and political and economic instability in the world. *Foods Raw Materials* 4, 201–211. doi: 10.21179/2308-4057-2016-2-201-211

Sun, Z., and Zhang, D. (2021). Impact of trade openness on food security: evidence from panel data for central Asian countries. *Foods* 10:3012. doi: 10.3390/foods10123012

Umo, J. U. (2007). *Economics: an African perspective*. London: Millennium Text Publishers Ltd.

UNICEF. (2022). Europe and Central Asia region (ECAR) – Ukraine situation: Refugee response in Neighbouring countries. Humanitarian Situation Report No.4 (March). Available at: https://www.unicef.org/media/118506/file/ECAR-Humanitarian-Situation-Report-No.4-(Ukraine-Refugee-Response-in-Neighbouring-Countries)-30-March-2022.pdf. (Accessed 23 October 2023)

Von Braun, J., and Diaz-Bonilla, E. (2008). *Globalization of Food and Agriculture and the Poor (No. 592-2016-39915)*. Oxford University Press: Oxford.

Willy, D. K., Diallo, Y., Affognon, H., Nang'ayo, F., Waithaka, M., and Wossen, T. (2020). COVID-19 pandemic in Africa: impacts on agriculture and emerging policy responses for adaptation and resilience building. The Technologies for African Agricultural Transformation (TAAT) policy compact. Available at: https://www.aatf-africa.org/wpcontent/uploads/2020/06/TAAT-Policy-Working-Paper-onCOVID19_FINAL-for-Dissemination_May-2020.pdf. (Accessed 23 October 2023)

Wisdom, O., Apollos, N., Samuel, O., and Lawrence, I. (2022). Environmental taxation and food security in Sub-Saharan Africa. *Curr. Appl. Sci. Technol.* 41, 6–14. doi: 10.9734/cjast/2022/v41i1831734

World Bank. (2023). World Development Indicators. Available at: https://databank.wprldbank.org/source/world-development-indicators. (Accessed 23 October 2023)

Wudil, A. H., Usman, M., Rosak-Szyrocka, J., Pilař, L., and Boye, M. (2022). Reversing years for global food security: a review of the food security situation in Sub-Saharan Africa (SSA). *Int. J. Environ. Res. Public Health* 19:14836. doi: 10.3390/ijerph192214836