Original Research Article

Implication of cereal production and intra-food trade to agricultural growth in Sub-Saharan Africa

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Abstract

The supply-demand balance of cereals in Sub-Saharan African (SSA) countries left a gap that needs to be bridged by growth-inclusive agricultural production. Agricultural growth failed to keep pace with the population growth resulting from low technology adoption, mechanization, reduced yield, food loss/waste, trade barrier and distortion, low investment, and tenure security. This study investigates the impact of cereal production and intra-food trade on agricultural growth in Sub-Saharan Africa, utilising a cross-sectional panel dataset of 48 countries from 1986–2021. Employing the Im-Pesaran-Shin unit root tests, pairwise correlation analysis, and random effects regression modeling, the study reveals that cereal production significantly contributes to agricultural growth by 0.8%. In comparison, intra-food trade positively and significantly influences agricultural growth by 2.5%. The result shows that cereal production positively affects agriculture growth, while intra-food trade and population growth negate the hypothesis of trade-led agricultural growth. Conclusively, the study recommended lifting trade barriers, developing trade-driven policies, encouraging agriculture exports, and expanding free trade agreements within the region.

Keywords: agricultural land; cereals, supply; technology; trend; production; population growth

INTRODUCTION

Africa is the center of origin and main producer of numerous grains such as sorghum, pearl millet, millet, teff, and African rice. The other major grain, maize, has replaced these traditional grains, while wheat is widely grown in North Africa, Sudan, and Ethiopia. Agriculture is the "engine of growth" in Africa. Most countries in the continent are naturally blessed with adequate resources that allow the timely and good growth of crops and/or livestock. Yet, the region spends a huge amount on the importation of food to meet local demand. According to Statista (2024), it will cost Africa about US$100 billion to import food in 2021, with cereals and preparation taking the highest percentage of the import at around US $40 billion. Cereal grains, including wheat, maize, and paddy, are considered primary crops as they are staple foods for most of the population across the globe Wang et al. (2018).

Sustainable food production that will meet the demands of a growing human population is one of the major problems most countries face in the 21st century. The challenge is mostly accelerated by increasing urbanization, climate change, environmental degradation, soil nutrient depletion, and sometimes the availability of human resources. The resultant effect poses a great threat to feeding the world's growing human population, projected to exceed nine billion by 2050 (Lobell et al., 2019; Godfray et al., 2010).

Another major constraint on self-sufficiency in food is the regional imbalance in agricultural production. This widens the demand-supply gap and increases the deprivation of the vulnerable and food-insecure. Agriculture occupies a pivotal role in the improvement of Sub-Saharan countries' economies and their citizens' social security. This is the case, as the sector provides the primary means of employment and accounts for 14% of the Gross Domestic Product (GDP) in Sub-Saharan Africa (SSA) (Oxford Business Group, 2021). Agricultural produce has been traditionally a major and important trade product in SSA. It has been of major economic importance in the region due to the number of citizens involved in agriculture. However, agricultural productivity in SSA failed to be commensurate with the demands due to the increasing population in the region (Bjornlund, 2020). The slow rate of agricultural productivity could be attributed to climate change factors, low technological adoption and practice, a lack of productive inputs, and weak institutions (Food and Agriculture Organization [FAO], 2019). SSA had unpretentious growth in agricultural production per capita between the 1960s and the 1970s (FAO, 2009). However, the trend declined, and consequently, a food security problem surfaced, with more than 30% of SSA's population facing hunger (Pfister 2011; FAO 2021).

Smallholder farmers are the most vulnerable in SSA, despite being primarily food producers (Mera, 2018; Derbile et al., 2022). Climate change will have a greater effect on the existing precarious situation. Changes in growing seasons and rainfall patterns, together with extreme weather events such as floods and droughts, have increasingly undermined food production and disrupted lives. Leveraging the potential of SSA countries has been a giant step taken by its leaders. They believed that the prosperity of Africa lay in integration. With integration issues allayed, the challenges of doing business in the region will be reduced. The Malabo 2014 declaration commits African leaders to increase agricultural commodity trade to fast-track the establishment of a continental free trade area (African Union (2014). But despite all these efforts, intra-African food trade has remained low and disappointing when compared with what is obtainable in other regions of the world. According to Odjo et al. (2023), in 2019–2021, the share of intra-African agricultural exports in Africa's total agricultural exports was 19.8%, very similar to its value nearly two decades earlier of 20.4% in 2003–2005, further to that is a reported decline in the share of Africa's agricultural imports sourced within the continent, from 18.7% in 2003–2005 to 14.2% in 2019–2021, showing increasing growth in import from the rest of the world than intra-Africa sources. On this account, it is imperative for the study to provide answers to these questions: does intra-food trade in sub-Sahara Africa contribute to agricultural growth? And what was the impact of cereals production on growth in the region? Therefore, this study examines the implication of cereal production and intra-food trade on agricultural growth in SSA.

Trade and food balance

Over the last three decades, Africa has been a net importer of agricultural products and has the highest risk of malnutrition. Between 2016 and 2018, Africa imported approximately 85% of its food, worth US$35 billion, from outside the continent, while 73 million people suffered from severe food insecurity (Organization for Economic Cooperation and Development [OECD], 2020). It is worrying that new phenomena such as climate change are disproportionately affecting Africa, despite its vast agricultural potential. The real value of Africa's external agricultural imports grew by 7.4% annually from 1999–2019, surpassing the annual growth rate of its external agricultural exports and intra-agricultural trade (United States Department of Agriculture [USDA], 2022). Agricultural imports in Africa rose to US$100 billion in 2021, with cereals and preparation being the major contributor to the continent's food imports (36%), followed by fats and oils excluding butter (15.9%), sugar and honey (8.1%), fruits and vegetables (7.7%), dairy products and eggs (6%), fish (5.3%), meat and meat preparation (5.1%), beverages (3.2%), and other food (12.7%) (Statista, 2024).

Endogenous growth

Differences in output and productivity growth rates within and between countries have attracted renewed interest since the region has been revitalised by the development of endogenous growth models that allow them to play a central role in policy. The cornerstone of the new growth theory is that while all actors may face diminishing returns, the positive externalities associated with factors such as technology, education, healthcare, and infrastructure have the characteristics of a common good, but lead to increasing returns at the aggregate level. The new approach bridges the gap between development and growth and aims to identify exogenous policy variables that causally precede per capita output (Total Factor Productivity) growth (Romer, 1989). If the policy explains a significant portion of the variation in growth and the per capita income, the consequences for human well-being are striking (Lucas, 1988). The empirical growth models (particularly in the context of the World Bank's International Center for Economic Growth Bill Easterly) now provide important support for growth strategies based on research and development along with technological production (but also education, infrastructure, and healthcare).

MATERIALS AND METHODS

The survey examines cereal production and intra-food trade in Sub-Saharan African countries. The study adopts a multi-country secondary analysis using a cross-sectional panel dataset for 1986–2021. The data were sourced from the World Bank Development Indicators (WDI) and Food and Agriculture Organization (FAO) database. In the study, agricultural GDP (i.e. % of agriculture's contribution to GDP) was used as a proxy for agricultural growth, area of land under cereal production (hectares), Population growth (annual %), Inflation and Labour force participation rate (%). Food trade was obtained by dividing the sum of both net food exports and food imports by growth. The study tested for stationarity of the data using the Im-Pesaran-Shin (IPS) unit-root test and Fisher-type unit root; this will prevent spurious regression. Like the renowned Dicky-Fuller (DF) unit root test, the IPS test entails testing for unit roots in panel data (Im et al., 2003). The test of the IPS unit root relies on accepting the alternative hypothesis of stationarity of the panels as against the null hypothesis of the unit (non-stationary) root of the panels. The IPS test for unit roots was performed.

Analytical techniques

$$Y_{it} = \alpha_i + x'_{it}\beta + \mathcal{E}_{it} \qquad \text{(i)}$$

where Y is agricultural growth, α_i is usually random unrelated to x_{it}; x_{it} are the regressors and all the estimators are consistent for β. $\mathcal{E}_{it}$is idiosyncratic error.

There are two basic models for α_i; these are fixed and random effect models. In the fixed effect model (FE), allowing the α_i to be correlated with the regressors x_{it} will permit a limited form of endogeneity. The error is $\mu_i = \alpha_i + \mathcal{E}_{it,}$ so allowing the regressors to correlate with the time-variant component of the error and we continue to assume that the regressors in uncorrelated with the idiosyncratic error. It is possible to estimate β, for time-varying regressors by appropriate differencing transformations applied that could be annual and influence α. The model implied that $E(y_{it}|\alpha_i, x_{it}) = \alpha_i + x'_{it}\beta$, assuming $E(\mathcal{E}_{it}|\alpha_i + x'_{it}) = 0$,

RESULTS AND DISCUSSION

Table 1 presents the summary statistics of the variables used for the study. This includes agricultural growth, food trade, cereal output, the cultivated area under cereal production, labour force participation rate (%), population growth, inflation, consumer price index, and tax on international trade. The table revealed the average agricultural growth as 1.347. Food trade was 6.209; the average cereal output was put to 2504738 metric tons; meanwhile, the area under cereal cultivation was 4.024 hectares on average, the average labour force (%) stood at 44.88, and the population growth was 2.464. The inflation rate was about 46% and the tax on international trade (% of revenue) was 28.160

Unit root test was conducted on the variables of choice with or without trend. Fisher-type (Fisher) unit root test and Im-Pesaran-Shin (IPS) unit-root test entails testing for the existence of unit roots in panel data (Im et al., 2003). The test of the IPS unit root relies on accepting the alternative hypothesis of stationarity of the panels as against the null hypothesis of the unit (non-stationary) root of the panels. In this survey, an

Table 1. Summary statistics

Variables	Observation	Mean	Std. deviation
Agric GDP growth	1,536	1.347	0.694
Food Trade	1,536	6.209	0.282
Cereal_output	1,536	2504738	4744.234
Cultivated_area	1,536	4.024	0.252
Labour_force	1,536	44.886	7.082
Population growth	1,536	2.464	6.124
Consumer price index	1,536	2.464	1.097
Inflation	1,536	45.773	6.917
Tax on international trade	1,536	28.160	0.901

Source: Author computation, 2023

Table 2. Im-Pesaran-Shin Unit root test

Variables	*t*–statistics	*p*-value	lag	Stage	Decision
AgricGDP_growth	–12.9569	0.0000	1	Level	Stationary
Food Trade	–8.7195	0.0000	1	Level	Stationary
Cereal_output	–2.9708	0.0015	1	1st difference	Stationary
Cultivated_area	–4.0378	0.0000	1	1st difference	Stationary
Labour_force	–1.9850	0.0236	1	Level	Stationary
Population growth	–28.5274	0.0000	1	Level	Stationary
Consumer price index	–7.0268	0.0000	1	Level	Stationary
Inflation	–13.2433	0.0000	1	Level	Stationary
Tax on international trade	–6.7973	0.0000	1	Level	Stationary

Source: Author computation, 2023

IPS test for unit roots was performed. A lag difference of 1 was used. As presented in Table 2, the *t*-statistics of all the series except cereal output and the cultivated area under cereal production have *p*-values < 0.05; indicating that the series were statistically significant and did not contain unit roots at their level form. The two variables (cereal output and cultivation area) were significant at different levels. The result implied that similar stochastic processes generated all the series and also exhibited the possibility of moving together in the long run. Since the variable failed the stationarity test at the level, it is therefore imperative to establish the relationship between the variables (Seok and Moon 2021).

In Table 3, the pairwise correlation result was presented. The test was carried out to test the collinearity of the explanatory variables, that is, if the variables were collinear. From the result, it was observed that the coefficient of the estimates is less than unity. This implies the absence of perfect collinearity among the variables of interest, however, the condition satisfies the establishment of the relationship between the dependent and the explanatory variables. A multicollinearity test was also performed. The variance inflation factor (VIF) mean value was 1.73; with this value, it was deduced that there is no multicollinearity since the mean VIF was less than 10 (rule of thumb). Also, the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity was carried out to confirm if the model maintained constant variance of the error term, however, the result was below the significance level of 5%, thereby indicating the absence of heteroskedasticity.

In panel data estimation, the choice of the most appropriate model might be of concern. So, a test to guide the choice of the model was performed. To ascertain the model performance, firstly, the Ordinary Least Square regression (OLS) model was run to establish the relationship between the dependent and the explanatory variables; and the variables were also regressed against the residual of the OLS. Secondly, the Hausman test to decide on the best and most appropriate model between the fixed effect model and the random effect model was carried out. The result of the test pinpoints failure to accept the null hypothesis, since the *p*-value was higher than 5% and hence, the random effect model was appropriate for the study.

Table 3. Pairwise correlations of the explanatory variables indicated

Variables	AgricGDP_ growth	Food Trade	Cereal_ output	Cultivated_ area	Labour_ force	Population growth	Inflation	Tax on int. trade
AgricGDP_growth	1.0000							
Food Trade	–0.0153	1.0000						
Cereal_output	–0.0573	0.0050	1.0000					
Cultivated_area	0.0741	0.0103	0.0141	1.0000				
Labour force	0.0426	0.0805	0.0030	0.8789	1.0000			
Pop_growth	–0.0203	0.0169	0.0444	0.0715	0.0520	1.0000		
Inflation	0.0069	0.1102	0.0632	0.0513	0.0159	0.0905	1.0000	
Tax on int. trade	0.0406	0.0573	0.0434	0.0199	0.0646	0.0417	0.4830	1.0000

Source: Author computation, 2023

Table 4. Regression results from cereal production and Food Trade to Agricultural Growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Food Trade	0.000108	0.000187***	0.000310	0.000305	0.000312***	0.000610	−0.000582*
	(0.05)	(3.11)	(0.20)	(0.19)	(4.20)	(0.38)	(2.36)
Cereal_output		0.000000129*	0.000000123*	0.000000162	0.000000158	0.000000160	0.00000225
		(2.23)	(2.17)	(1.80)	(1.72)	(1.76)	(1.63)
Inflation			−0.000398*	−0.000399*	−0.000400*	0.000393*	−0.000693*
			(−2.05)	(−2.05)	(−2.05)	(2.02)	(−1.99)
Cultivated_area				8.37e−08***	−7.36e−08	−7.75e−08	−0.0000863
				(3.53)	(−0.46)	(−0.49)	(−0.11)
Labour_force					0.0186	0.0173	0.0332
					(0.31)	(0.30)	(0.32)
Population growth						0.0241	−0.0362*
						(1.57)	(−2.58)
Tax on international trade							−0.01361***
							(−4.28)
Constant	1.348***	0.650***	0.748	0.822***	−0.0327*	−0.280*	−1.006
	(7.64)	(3.64)	(1.78)	(4.85)	(−2.01)	(2.67)	(−0.37)
N	1452	1360	1191	1185	1185	1185	1185

Source: Author computation, 2023
t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4 presents seven different models, our choice of knowing the influence of some key drivers of agricultural growth influences the inclusion of other intervening variables in the model. The first model shows the relationship between agricultural growth and food trade. The coefficient of food trade in this model was insignificant though the coefficient showed a positive relationship. When cereal output was added to the model the coefficient of both food trade and cereal output were positively significant. This indicated that both variables contributed to agricultural growth in Sub-Saharan Africa. Food trade was significant at a one percent level and cereal output was significant at a 5 percent level of confidence. The coefficient of food trade also showed a significant relationship with agricultural growth in the 5^{th} and 7^{th} models. The result indicated that an increased food trade in Sub-Saharan Africa will increase agriculture growth. Mwangi (2021) suggested that agriculture trade is one of the turbines that powered the economic growth of many developing nations.

Furthermore, the coefficient of inflation is another major variable of concern as shown in the table. The coefficient was negative and significant in models 3–7; the result here indicates a reverse agriculture growth with increased inflation. Inflation has been one important factor militating against growth and development in most countries in SSA. With hikes in food and product prices, most agricultural producers face challenges in production as a result of high input costs and some other operational costs. Also, to ensure the free flow of food in Sub-Saharan Africa, restrictions by the countries affect free trade which invariably retards growth. For instance, total border closure in Nigeria affects commodity trade, other countries have one or more policies that restrict the free flow of commodities within their borders. Expansion of the market within and outside Sub-Saharan Africa and permission for free trade will aid food security and sufficiency within African borders (Asiru and Fanifosi 2023). The coefficient of tax on international trade justifies the claim as the coefficient showed a negative sign and it was significant. The implication of this is that an increase in tax placed on international trade will reduce agricultural growth by 0.00115.

CONCLUSION

This study examined the effect of cereal production on intra-food trade and agricultural growth in Sub-Saharan Africa. The survey covers countries in Sub-Saharan Africa and a cross-sectional panel dataset from 1990 to 2021 was used. The study tested for the stationarity of the variables employing the Im-Pesaran-Shin unit root. Also tested was the correlation between the explanatory variables; multicollinearity, and heteroscedasticity problem. The Hausman test was also used for the choice of the best and appropriate model (fixed or random effect model) for the study. The study showed the significance of cereal production in food intra-trade and agricultural growth in Sub-Saharan Africa. Food intra-trade influences agricultural growth, observing that trade is the main engine of economic growth and development especially in Sub-Saharan Africa, since the agriculture sector is one of the dominating sectors of the economies of these countries. Also, inflation reduces agricultural growth. The result suggests that increasing food intra-trade will open opportunities for agricultural development, and foster food security and sufficiency in Sub-Saharan Africa. To achieve this, the following must be put into consideration:

i) Trade barriers (restriction) need to be favorably adjusted and the need to develop ties through trade-driven policies within the region having in mind the comparative advantages of each country.
ii) At the same time, trade-led agricultural growth would be achieved by encouraging agricultural exports and expanding free trade agreements within the region.
iii) Both institutional support (to enhance the innovation platform) and infrastructural development within the region will facilitate agricultural trade with a food demand-driven force.

CONFLICT OF INTEREST.

The authors declare that there is no conflict interest with respect to the research, authorship, and publication of this article.

ETHICAL COMPLIANCE

The authors have followed ethical standards in conducting the research and preparing the manuscript.

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Appendix: Sub-Saharan African countries

Economic Community of West African States (ECOWAS)

Benin, Burkina Faso, Cape Verde, Côte d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo

East African Communities (EAC)

Republic of Burundi, Republic of Kenya, Republic of Rwanda, Federal Republic of Somalia, Republic of South Sudan, and Republic of Uganda

Southern African Development Community (SADC)

Angola, Botswana, Comoros, Dem. Rep. of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe

Others

Cameroon, Central African Republic, Chad, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Mauritania, and Sao Tome