

# Analyzing the influence of agricultural raw material imports on agricultural growth in 48 Sub-Saharan African countries

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# Abstract

This study examines the impact of agricultural raw material imports (ARMI) on economic growth in 48 Sub-Saharan African countries from 1990 to 2023. Given the critical role of agriculture in the region, the research seeks to understand how access to imported agricultural inputs influences productivity and overall economic development. A gravity model framework is employed to analyze the relationship between ARMI and gross domestic product (GDP). The study incorporates panel data spanning over three decades, controlling for key economic indicators such as gross fixed capital formation and rural population. The results indicate a statistically significant positive correlation between ARMI and GDP, suggesting that imported agricultural inputs play a vital role in enhancing productivity and driving economic performance in the region. The study underscores the importance of facilitating agricultural imports to support sustainable economic development. It highlights the need for a strategic approach to optimize the benefits of ARMI and strengthen the agricultural sector's contribution to GDP growth. Policymakers should implement supportive policies and structural reforms to enhance the effective utilization of agricultural imports. This includes improving trade facilitation, infrastructure, and investment in agricultural value chains to ensure long-term economic prosperity in Sub-Saharan Africa.

Keywords: Agricultural raw material imports, Economic growth, Gravity model, Policy implications, Productivity, Sub-Saharan Africa.

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# 1. Introduction

Agriculture remains the lifeline of Sub-Saharan African economies, contributing significantly to employment, GDP, and food security. It is estimated that over 60% of the region's workforce is engaged in agricultural activities, and the sector contributes nearly 23% of the region's GDP [1]. However, despite its critical importance, agriculture in Sub-Saharan Africa continues to grapple with significant constraints, including low productivity, limited access to advanced technologies, and growing environmental vulnerabilities. These challenges threaten not only the livelihoods of millions but also the economic stability and food security of countries in the region. To address these issues, innovative solutions that boost productivity, strengthen resilience, and drive sustainable growth are urgently needed. One such potential solution lies in the strategic importation of agricultural raw materials—an approach that could transform the region's agricultural landscape.

The productivity of Sub-Saharan African agriculture lags considerably behind global averages. Crop yields in the region are often only a fraction of those achieved in Asia or Latin America, where advances in agricultural technologies have revolutionized production. For example, average cereal yields in Sub-Saharan Africa are approximately 1.5 tons per hectare, compared to over 4 tons per hectare in South Asia and Latin America [2]. This productivity gap can be attributed to several factors, including the limited availability and use of agricultural inputs such as fertilizers, improved seed s, and mechanized equipment. A report by the IFDC (International Fertilizer Development Center) [3] indicates that fertilizer use in Sub-Saharan Africa averages less than 20 kilograms per hectare, far below the recommended minimum of 50 kilograms per hectare for optimal crop yields. The region also lags in the adoption of high-yield seed varieties and irrigation technologies, further limiting its agricultural potential [4].

Climate change compounds these challenges by increasing the frequency and severity of droughts, floods, and other extreme weather events. According to the IFDC (International Fertilizer Development Center) [3], Sub-Saharan Africa is one of the regions most vulnerable to climate change, with projected temperature increases likely to exceed the global average. These environmental pressures exacerbate existing vulnerabilities in the agricultural sector, reducing crop yields, destabilizing food systems, and increasing the risk of food insecurity. For instance, it is estimated that climate change could reduce maize yields by up to 30% in some parts of the region by 2050 [5]. Addressing these multifaceted challenges requires an integrated approach that combines the adoption of modern agricultural technologies with investments in climate -resilient infrastructure and practices.

One promising strategy to enhance agricultural productivity and resilience is the importation of agricultural raw materials. Inputs such as fertilizers, high-yield seeds, pesticides, and advanced machinery are critical for increasing crop yields and improving farm efficiency. In regions where domestic production of these inputs is limited, imports can play a vital role in filling supply gaps and supporting agricultural development. Empirical evidence from other parts of the world underscores the transformative potential of agricultural imports. For example, the Green Revolution in South Asia and Latin America was largely driven by the adoption of imported high-yield seed varieties and chemical fertilizers, which enabled significant increases in agricultural output and rural incomes [6]. Similarly, in Ethiopia, the introduction of imported fertilizers and improved wheat varieties has led to a 30% increase in wheat yields over the past decade [7]. These success stories highlight the importance of agricultural imports as a catalyst for productivity growth and economic development.

Despite the potential benefits, the effectiveness of agricultural raw material imports in Sub-Saharan Africa is not guaranteed and depends on several enabling factors. Adequate infrastructure, such as roads, storage facilities, and irrigation systems, is essential to ensure that imported inputs reach farmers in a timely and efficient manner. However, rural infrastructure in the region remains underdeveloped, with poor road networks and limited access to markets posing significant barriers to the distribution of agricultural inputs [8]. Furthermore, institutional and governance challenges, including corruption, inefficiency, and weak regulatory frameworks, often hinder the effective implementation of agricultural import programs [9]. For instance, subsidy programs intended to make fertilizers more affordable for smallholder farmers have often been undermined by mismanagement and elite capture [10].

Another critical consideration is the economic sustainability of relying on imports for agricultural development. While imports can provide immediate productivity gains, over-reliance on external sources for essential inputs exposes countries to risks such as price volatility, foreign exchange shortages, and supply chain disruptions. The COVID-19 pandemic underscored the fragility of global supply chains, with disruptions leading to shortages of fertilizers and other critical inputs in many African countries [2]. To mitigate these risks, it is essential to balance the use of imports with investments in domestic production capacities and local innovation. For example, countries like Nigeria and Kenya have recently begun developing domestic fertilizer production facilities to reduce dependence on imports and enhance self-sufficiency [3].

The variability of agricultural systems and economic conditions across Sub-Saharan Africa further complicates the relationship between agricultural imports and growth. While countries with relatively advanced agricultural sectors, such as South Africa and Ghana, may be better equipped to leverage imports effectively, others with weaker institutions and infrastructure, such as Chad and the Central African Republic, may struggle to realize the benefits of imported inputs. This variability underscores the need for region-specific studies that account for local conditions and provide tailored policy recommendations.

This article seeks to address this gap by investigating the relationship between agricultural raw material imports and economic growth across 48 Sub-Saharan African countries over the period 1990–2023. While the role of imports in economic development has been widely studied, the specific focus on agricultural raw materials as a driver of growth remains relatively underexplored. This study aims to provide a comprehensive analysis of how these imports interact with key economic factors such as investment, rural population dynamics, and land use to influence the economic trajectories of Sub-Saharan African nations. By utilizing a gravity model framework, the research captures both the short-term and long-term effects of

agricultural imports on economic performance, offering valuable insights into their potential as a tool for fostering sustainable development.

The originality of this study lies in its specific focus on agricultural raw material imports within the Sub-Saharan African context. While previous studies have examined broader relationships between imports and economic growth, few have delved into the unique role of agricultural inputs in enhancing productivity in developing economies. Furthermore, by analyzingdata over a 33-year period, this research captures long-term trends and structural transformations that are often overlooked in shorter-term analyses. The use of a robust methodological framework, coupled with a region -specific focus, allows this study to offer nuanced insights that are directly relevant to policymakers and stakeholders in Sub-Saharan Africa.

In addition to its originality, this study provides significant added value by addressing critical questions about the effectiveness of agricultural imports in promoting growth. The findings not only contribute to academic knowledge but also have practical implications for designing trade policies, agricultural strategies, and investment frameworks that optimize the benefits of imports. For policymakers, the research highlights the conditions under which agricultural imports are most effective, offering guidance on how to align trade policies with broader development goals. For development practitioners, the study underscores the importance of balancing reliance on imports with efforts to build domestic capacities and ensure sustainable agricultural practices.

The central problem addressed in this study revolves around the persistent issue of low agricultural productivity in Sub-Saharan Africa and its implications for economic growth and food security. Despite the significant potential of agricultural raw material imports to enhance productivity, their impact remains uncertain and highly dependent on local conditions. For instance, the effectiveness of these imports can vary based on factors such as infrastructure, governance, and complementary investments in domestic agriculture. This raises critical questions: To what extent do agricultural raw material imports drive economic growth in Sub-Saharan Africa? Under what conditions are these imports most effective? How do they interact with other economic factors to shape development outcomes? These questions form the foundation of this study's investigation and guide its methodological and analytical approach.

To provide a structured and comprehensive response to these questions, the article is organized into several key sections. The Introduction establishes the context of the study, emphasizing the importance of agriculture in Sub-Saharan Africa, the challenges it faces, and the potential of agricultural imports to address these challenges. It also outlines the research objectives, the added value of the study, and its originality within the existing body of literature. The second section, Literature Survey, reviews existing research on the relationship between imports and economic growth, with a specific focus on agricultural raw materials. This section highlights key findings, methodological approaches, and gaps in the literature, setting the stage for the current study's contributions. By synthesizing prior research, it provides a theoretical foundation for understanding the role of agricultural imports in economic development. The Empirical Methodology section outlines the analytical framework and data used in the study. The gravity model, which serves as the primary analytical tool, is explained in detail, including its application to trade flows and economic relationships. The section also describes the variables used in the analysis, the data sources, and the estimation techniques employed. This methodological rigor ensures the reliability and validity of the study's findings. In the fourth section, Empirical Results, the study presents its findings, including descriptive statistics, model estimation outcomes, and the results of robustness checks. This section provides a detailed analysis of the relationships between agricultural imports, economic growth, and other key variables, shedding light on the conditions that influence the effectiveness of imports in driving development. The fifth section, Discussion, interprets the findings within the broader context of Sub-Saharan Africa's unique economic and structural characteristics. It explores the policy implications of the results, addressing questions about trade strategies, investment priorities, and the role of governance in optimizing the benefits of agricultural imports. This section also discusses the limitations of the study and areas for future research, ensuring a balanced and critical perspective. Finally, the article concludes with a Conclusions and Recommendations section, summarizing the key insights derived from the analysis and offering actionable recommendations for policymakers, development practitioners, and researchers. This section emphasizes the importance of strategic policymaking in enhancing access to high-quality agricultural imports, fostering domestic innovation, and promoting regional cooperation to achieve sustainable growth and food security.

#### 2. Literature Survey

The relationship between imports and economic growth, particularly in agriculture, has garnered significant academic and policy interest due to its potential to transform economies. This section reviews the literature addressing the role of imports, with a specific focus on agricultural raw materials, in driving economic and agricultural growth across various regions. Studies range from examining general import-growth dynamics to the specific impact of agricultural imports on productivity and food security. Methodologies such as co-integration analysis, gravity models, and input-output analyses are used, while the time frames and geographic focus vary to capture both short-term and long-term effects. The reviewed works highlight diverse perspectives, revealing both the opportunities and constraints presented by imports in promoting sustainable growth.

#### 2.1. Imports and Growth

The relationship between imports and economic growth has been a central focus of economic research, given its implications for trade policies and sustainable development. Various studies have investigated how imports interact with other economic variables, such as domestic investment, exports, and consumption, to influence growth. The studies reviewed highlight both the opportunities and limitations of imports in driving growth, emphasizing the importance of regional characteristics and the composition of imports. Akermi, et al. [11] analyzed the relationship between imports and economic

growth in Albania from 1996 to 2021, revealing no causal link between the two in either the short or long term. Their findings underscore the need for structural economic reforms to enhance the developmental impact of imports. Similarly, Bakari, et al. [12] found no significant effect of imports on economic growth in Peru (1970–2017), attributing this to challenges in optimizing trade policies and economic organization. These results suggest that structural and policy reforms are essential for leveraging imports in these contexts.

In Canada, Bakari [13] observed a bidirectional causal relationship between imports and economic growth during 1990–2015. However, the study concluded that imports had no significant long-term effect, highlighting the necessity of integrating imports into effective trade strategies. Conversely, [14] found no significant impact of imports on Japan's GDP from 1970 to 2015, identifying domestic investment and exports as the primary drivers of economic growth. These contrasting results emphasize the influence of local economic conditions on the role of imports.

Bakari, et al. [15] studied Brazil's economy (1970–2017) and identified a short-term positive effect of imports on growth, but a negative long-term impact. Similarly, Bakari [16] found that imports in Tunisia positively affected growth in the short term but had negligible long-term effects. These findings underscore the complexities of import dynamics, particularly in developing economies, and the need for balanced trade policies to ensure sustainable growth.

Carrasco and Tovar-García [17] highlighted the significance of import composition in 19 developing countries, demonstrating that high-tech and capital goods imports positively affect growth. Rahman [18] extended this analysis to BRICS and ASEAN countries (1990–2017), revealing that imports contribute to growth through technological and knowledge spillovers, provided supportive policies are in place. These studies underscore the importance of prioritizing the quality and strategic value of imports over their aggregate volume.

Globally, Irwin [19] explored the impact of trade reforms on economic growth, finding that reduced import barriers generally foster growth, though with varying effects across countries. Chen, et al. [20] and Zeng, et al. [21] analyzed import dynamics in China, emphasizing the importance of sectoral and regional variations. Their findings suggest that imports contribute to economic efficiency and growth by strengthening critical industry linkages. The reviewed studies collectively highlight the nuanced relationship between imports and economic growth. While imports can positively influence growth through technological spillovers, efficient resource allocation, and strategic investments, their impact is contingent upon local economic conditions, trade policies, and the composition of imports. Developing economies, in particular, must balance their reliance on imports with structural reforms to achieve sustainable growth. These insights offer valuable guidance for policymakers aiming to optimize the role of imports in economic development.

#### 2.2. Agricultural Raw Materials Imports and Growth

The role of agricultural raw material imports in economic growth has garnered significant attention in recent years, given their importance in improving productivity and addressing food security challenges. Numerous studies have examined how imports such as fertilizers, high-yield seeds, and advanced agricultural inputs contribute to agricultural efficiency, technological advancement, and overall economic development. Fuglie and Rada [22] explored the transformative role of fertilizer imports in sub-Saharan Africa from 1961 to 2010, demonstrating that government subsidy programs in countries like Kenya and Malawiled to significant increases in maize yields, exceeding 30%. Similarly, Pingali [6] examined the Green Revolution in Asia, revealing that imported high-yield variety (HYV) seeds and fertilizers accounted for 50–60% of agricultural growth in India, Pakistan, and the Philippines from 1960 to 2000. Both studies underscored the importance of imported agricultural inputs in addressing food security and fostering economic development.

In Sub-Saharan Africa, Mwangi [23] analyzed the determinants of agricultural imports using panel data from 37 countries (1995–2018). The study highlighted that economic size, arable land endowment, and governance quality positively influenced import flows, while geographical constraints and low domestic productivity posed challenges. These findings emphasized the dual importance of enhancing domestic agricultural productivity and addressing trade barriers to foster growth and food security. Cherkesova, et al. [24] investigated the impact of import substitution policies in Russia's agro-industrial sector under Western sanctions, highlighting the need for a balanced approach that integrates advanced agricultural imports with domestic innovation. Similarly, Baer-Nawrocka and Mrówczyńska-Kamińska [25] examined agricultural sectors in EU countries, revealing an increasing reliance on material imports in developed EU-15 countries while newer EU member states exhibited varied trends. Both studies pointed to the critical role of imports in enhancing agricultural efficiency and aligning with broader economic goals.

In Malaysia, Abidin, et al. [26] found a significant positive relationship between agricultural raw material imports and rice production from 1981 to 2020, highlighting the importance of integrating imports into agricultural policies to meet food security demands. Hye and Muhammad [27] supported the import-led agricultural growth hypothesis in Pakistan (1971–2007), demonstrating bidirectional causality between imports and agricultural growth, further emphasizing the need for policies that facilitate access to high-quality inputs. Bakari [28] conducted a regional analysis in North Africa (Tunisia, Morocco, and Egypt) from 1965 to 2016, finding that agricultural imports had a positive long-term effect on growth. Short-term benefits were also observed in Tunisia and Egypt, showcasing the importance of foreign agricultural raw material imports in enhancing productivity, fostering economic growth, and addressing food security challenges across various regions. While imports offer significant benefits, their effectiveness depends on supportive policies, such as subsidies, infrastructure investments, and trade facilitation measures. A balanced approach that combines imported inputs with domestic innovation is crucial to ensuring sustainable agricultural growth and economic development.

# **3. Empirical Methodology**

This section outlines the empirical methodology employed to analyze the impact of agricultural raw material imports (ARMI) on economic growth across 48 Sub-Saharan African countries (Angola, Benin, Botswana, Burkina Faso, Burundi, Cabo Verde, Cameroon, Central African Republic, Chad, Comoros, Congo, Dem. Rep., Congo, Rep., Côte d'Ivoire, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, Gambia, The, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, São Tomé and Príncipe, Senegal, Sevchelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe) from 1990 to 2023. The analysis utilizes a static gravity model framework, which is well-suited for examining trade flows and their economic implications.

## 3.1. Model Specification

The gravity model is based on the premise that trade between two countries is directly proportional to their economic sizes (measured by GDP) and inversely proportional to the distance between them. In this context, the model can be specified as follows:

Where:

$$Y_{it} = \beta_0 + \beta_1 \cdot GFCF_{it} + \beta_2 \cdot RP_{it} + \beta_3 \cdot AL_{it} + \beta_4 \cdot ARMI_{it} + \beta_5 \cdot OM_{it} + \beta_6 \cdot X_{it} + \epsilon_{it}$$

- $(Y_{it})$  represents the GDP of country (i) at time (t). •
- $(GFCF_{it})$  denotes gross fixed capital formation. •
- $(RP_{it})$  indicates the rural population.
- $(AL_{it})$  refers to agricultural land area.
- $(ARMI_{it})$  signifies a gricultural raw material imports.
- $(OM_{it})$  represents other imports of goods and services.
- $(X_{it})$  denotes exports of goods and services.
- $(\epsilon_{it})$  is the error term.

#### 3.2. Estimation Techniques

To estimate the model, two approaches are employed: the Fixed Effects (FE) and Random Effects (RE) models. The choice between these models is determined using the Hausman test, which assesses whether the unique errors are correlated with the regressors.

- Fixed Effects Model: This model controls time-invariant characteristics of the countries, allowing for the estimation of the impact of variables that change overtime.
- Random Effects Model: This model assumes that the individual-specific effects are uncorrelated with the • independent variables, providing a more efficient estimation when this a ssumption holds.

The Hausman test is conducted as follows:

 $H = (b_{FE} - b_{RE})' \cdot [Var(b_{FE}) - Var(b_{RE})]^{-1} \cdot (b_{FE} - b_{RE})$ Where (b<sub>FE</sub>) and (b<sub>RE</sub>) are the coefficient estimates from the Fixed and Random Effects models, respectively. A significant result (p-value < 0.05) indicates that the Fixed Effects model is preferred.

#### 3.3. Data Sources and Variables

The 1990–2023 period was chosen to capture a significant time span that includes majoreconomic, political, and social developments in Sub-Saharan Africa. This allows us to analyze long-term trends and identify structural changes in the region's economies. The specific time frame also aligns with the availability of consistent and reliable data from the World Development Indicators, ensuring robustness in our analysis. The analysis utilizes data from the World Development Indicators, focusing on the following variables:

- GDP (Y): The total economic output measured in constant 2015 US dollars. •
- Gross Fixed Capital Formation (GFCF): Investment in fixed assets, also in constant 2015 US dollars.
- Rural Population (RP): The number of people living in rural areas.
- Agricultural Land (AL): The total area of agricultural land in square kilometers. •
- Agricultural Raw Material Imports (ARMI): The value of agricultural raw materials imported, measured in constant 2015 US dollars.
- Other Imports (OM): The total value of other imports, measured in constant 2015 US dollars. •
- Exports (X): The total value of exports, measured in constant 2015 US dollars.

The variables were chosen based on their theoretical and empirical relevance to economic growth. GDP, as the dependent variable, serves as a direct measure of economic performance. Independent variables, including gross fixed capital formation (GFCF), rural population (RP), agricultural land area (AL), agricultural raw material imports (ARMI), other imports (OM), and exports (X), were selected to reflect key dimensions of economic activity, resource endowments, and trade flows. This comprehensive set of variables allows for an in-depth exploration of how agricultural imports interact with broader economic factors to influence growth.

The choice of Sub-Saharan African countries stems from the region's unique economic dynamics, reliance on agriculture, and ongoing developmental challenges. The inclusion of 48 countries ensures broad regional representation and facilitates cross-country comparisons, enhancing the study's generalizability.

Table 1.	
Variable descriptions	s

No	Variables	Indicator name	Source
1	OM	Other Imports of goods and services (Constant 2015 US\$)	World Development Indicators
2	Х	Exports of goods and services (Constant 2015 US\$)	World Development Indicators
3	ARMI	Agricultural raw materials imports ((Constant 2015 US\$)	World Development Indicators
4	RL	Rural population	World Development Indicators
5	Y	GDP (Constant 2015 US\$)	World Development Indicators
6	GFCF	Gross fixed capital formation (Constant 2015 US\$)	World Development Indicators
7	AL	Agricultural land (sq. km)	World Development Indicators

Descriptive statistics are computed for each variable to provide insights into the data distribution and variability. Key statistics such as mean, median, maximum, minimum, standard deviation, skewness, and kurtosis are calculated to assess the characteristics of the dataset.

The quality of the model is evaluated using the R-squared and Adjusted R-squared statistics, which indicate the proportion of variance in the dependent variable explained by the independent variables. The F-statistic is also computed to test the overall significance of the model.

$$F = \frac{(SSR/k)}{(SSE/(n-k-1))}$$

Where:

- (SSR) is the sum of squares due to regression.
- (SSE) is the sum of squares due to error.
- (k) is the number of independent variables.
- (n) is the total number of observations.

By focusing on agricultural raw material imports and their impact on economic growth, the study contributes to a nuanced understanding of the factors driving development in Sub-Saharan Africa. The methodology is designed to provide policymakers with insights into optimizing trade strategies and resource allocation to foster sustainable growth across the region.

# 4. Empirical Results

This section presents the empirical results derived from the analysis of the impact of agricultural raw material imports (ARMI) on economic growth across 48 Sub-Saharan African countries from 1990 to 2023. The results are organized into several tables, each providing critical insights into the relationships between the variables under study.

# 4.1. Descriptive Statistics

Table 2 summarizes the descriptive statistics for the key variables included in the analysis: GDP (Y), Gross Fixed Capital Formation (GFCF), Agricultural Land (AL), Agricultural Raw Material Imports (ARMI), Other Imports (OM), Rural Population (RP), and Exports (X). These statistics provide valuable insights into the economic and structural disparities across Sub-Saharan African countries.

The data reveal significant differences in economic performance among the countries. While some economies demonstrate substantial output, many others exhibit much lower levels, reflecting pronounced disparities in development across the region. These variations are further mirrored in the levels of investment in fixed capital, with certain countries displaying significantly higher levels compared to others.

Descriptive statistics results.							
	Y	GFCF	AL	ARMI	ОМ	RP	Χ
Mean	2.68E+10	5.47E+09	197118.9	88451856	7.40E+09	10552232	7.07E+09
Median	1.00E+10	2.05E+09	109452.5	36177400	3.07E+09	7724023.	2.86E+09
Maximum	3.59E+11	6.24E+10	1117499.	1.03E+09	1.01E+11	95055577	9.89E+10
Minimum	5.42E+08	59446774	15.00000	382157.3	49023464	35833.00	42076181
Std. Dev.	5.63E+10	1.02E+10	223799.5	1.67E+08	1.47E+10	13477143	1.56E+10
Skewness	4.252008	3.520227	1.751082	3.765961	4.392941	3.094377	4.295010
Kurtosis	21.88984	16.78736	6.563081	17.57161	24.03083	16.33331	21.75710
Jarque-Bera	13196.18	7369.526	767.5414	8273.642	15974.24	6644.396	13087.74
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	1.98E+13	4.04E+12	1.45E+08	6.53E+10	5.46E+12	7.79E+09	5.22E+12
Sum Sq. Dev.	2.33E+24	7.62E+22	3.69E+13	2.06E+19	1.60E+23	1.34E+17	1.80E+23

Table 2.Descriptive statistics results.

In terms of agricultural resources and imports, considerable heterogeneity is evident. The size of agricultural land, the volume of agricultural raw material imports, and other types of imports vary widely, highlighting structural differences in economic priorities, resource allocation, and trade strategies among the countries analyzed.

Demographic differences are also apparent, particularly in the distribution of rural populations. Some countries are characterized by a high concentration of rural inhabitants, while others show more balanced or urbanized population distributions. Export levels similarly exhibit a wide range, with a few countries accounting for a substantial share of the region's trade, while others lag behind. These patterns underscore the economic and structural diversity within Sub-Saharan Africa, emphasizing the need for tailored approaches to understanding and addressing the unique challenges and opportunities of each country.

## 4.2. Static Gravity Model Estimation Results

Table 3 presents the results of the static gravity model estimation, which is crucial for understanding the relationship between agricultural raw material imports (ARMI) and economic growth, as measured by GDP, across the selected Sub-Saharan African countries. The table compares the outcomes of both the Fixed Effect and Random Effect models, providing insights into the significance and impact of various independent variables on GDP.

In the Fixed Effect Gravity Model, the constant term (C) is estimated at (3.174941) with a p-value of (0.0000), indicating a statistically significant baseline level of GDP when all independent variables are held constant. The coefficient for LOG(GFCF) is (0.428911) (p-value (0.0000)), suggesting that a 1% increase in gross fixed capital formation is associated with a 0.43% increase in GDP. This strong positive relationship underscores the critical role of investment in fixed assets in driving economic growth within the region.

The coefficient for LOG(RP) is (0.229865) (p-value (0.0000)), indicating that an increase in the rural population contributes positively to GDP. This finding reflects the importance of rural labor in agricultural production, which is a significant component of the economies in Sub-Saharan Africa. The LOG(AL) coefficient is (0.023705) (p-value (0.0018)), suggesting that while agricultural land area has a positive effect on GDP, its impact is relatively modest compared to other factors.

The coefficient for LOG(ARMI) is (0.009204) (p-value (0.0471)), indicating a statistically significant positive effect of agricultural raw material imports on GDP. This result highlights the importance of imported agricultural inputs in enhancing productivity and economic growth, suggesting that access to these materials is crucial for agricultural development in the region. Conversely, the coefficient for LOG(OM) is (-0.031819) (p-value (0.4116)), indicating no significant effect of other imports on GDP, which may suggest that not all imports contribute positively to economic growth.

Finally, the coefficient for LOG(X) is (0.384506) (p-value (0.0000)), indicating a strong positive relationship between exports and GDP. This finding emphasizes the importance of export activities in driving economic growth, reflecting the need for countries to enhance their export capabilities.

Dependent variable: LOG(Y)						
Fixed effect gravity mo	odel		Random effect gravity model			
Variable	Coefficient	Prob.	Variable	Coefficient	Prob.	
С	3.174941	0.0000	С	3.728441	0.0000	
LOG(GFCF)	0.428911	0.0000	LOG(GFCF)	0.410569	0.0000	
LOG(RP)	0.229865	0.0000	LOG(RP)	0.236152	0.0000	
LOG(AL)	0.023705	0.0018	LOG(AL)	0.019412	0.0095	
LOG(ARMI)	0.009204	0.0471	LOG(ARMI)	0.011793	0.0344	
LOG(OM)	-0.031819	0.4116	LOG(OM)	-0.125115	0.0003	
LOG(X)	0.384506	0.0000	LOG(X)	0.447918	0.0000	

#### Table 3. Static gravity model estimation results.

In the Random Effect Gravity Model, the coefficients exhibit similar patterns, with LOG(GFCF) at (0.410569) (p-value (0.0000)), LOG(RP) at (0.236152) (p-value (0.0000)), and LOG(AL) at (0.019412) (p-value (0.0095)). The LOG(ARMI) coefficient is slightly higher at (0.011793) (p-value (0.0344)), suggesting that agricultural raw material imports have a more pronounced effect on GDP in this model. The LOG(OM) coefficient is (-0.125115) (p-value (0.0003)), indicating a significant negative relationship, which may reflect the complexities of how other imports interact with the local economy. The LOG(X) coefficient remains strong at (0.447918) (p-value (0.0000)), reinforcing the importance of exports in economic growth.

#### 4.3. Hausman Test Results

Table 4 provides the results of the Hausman test, a critical statistical procedure used to determine the suitability of the Fixed Effect model compared to the Random Effect model in the context of this analysis. The test yields a statistic of (33,589121) with (6) degrees of freedom and a p-value of (0.0000). This highly significant result leads to the rejection of the null hypothesis, which posits that there is no correlation between the unique errors and the regressors in the model.

# Table 4.Hausman test results.

Correlated random effects - Hausman test					
Test period random effects					
Test summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.		
Period random	33.589121	6	0.0000		

As a consequence of this finding, the Fixed Effect model is deemed the preferred choice for this analysis. The implication of selecting the Fixed Effect model is that it offers a more robust estimation of the relationships between agricultural raw material imports and other independent variables on GDP. This model effectively accounts for unobserved heterogeneity across the 48 Sub-Saharan African countries included in the study, thereby enhancing the reliability of the results obtained regarding the impact of agricultural imports on economic growth.

#### 4.4. Model Quality Test Results

Table 5 summarizes the model quality test results, which are crucial for evaluating the effectiveness of the gravity model used in this study. The R-squared value is reported at (0.966843), indicating that approximately (96.68%) of the variance in GDP can be explained by the independent variables included in the model. This high level of explanatory power suggests that the model is highly effective in capturing the relationships between agricultural raw material imports and economic growth across the 48 Sub-Saharan African countries analyzed. The Adjusted R-squared value of (0.965090) further confirms the robustness of the model, as it accounts for the number of predictors, ensuring that the high explanatory power is not merely a result of overfitting.

#### Table 5.

Model quality test results.			
Model quality testing			
R-squared	0.966843		
Adjusted R-squared	0.965090		
F-statistic	551.6679		
Prob. (F-statistic)	0.000000		

Additionally, the F-statistic is reported at (551.6679) with an associated probability of (0.000000). This significant F-statistic indicates that the model provides a better fit to the data than a model with no independent variables, allowing for the rejection of the null hypothesis that all regression coefficients are equal to zero. Collectively, these results affirm the model's robustness and the relevance of the independent variables in understanding the dynamics of agricultural raw material imports and their impact on economic growth, providing valuable insights for policymakers aiming to enhance agricultural productivity and economic development in the region.

# 5. Discussions

The analysis reveals that agricultural raw material imports (ARMI) play a pivotal role in enhancing economic growth across the region. The positive correlation between ARMI and gross domestic product (GDP) underscores the necessity for policymakers to prioritize access to high-quality agricultural inputs. This is particularly crucial in a region where agriculture is not only a significant contributor to GDP but also a primary source of employment for over 60% of the workforce. The findings suggest that the strategic importation of agricultural materials can serve as a catalyst for productivity improvements, thereby addressing the persistent challenges of low agricultural yields and food insecurity that plague many Sub-Sahama African countries.

In exploring the policy implications of these results, it becomes evident that trade strategies must be aligned with broader economic development goals. Policymakers should consider implementing subsidy programs for essential agricultural inputs, such as fertilizers and high-yield seeds, to enhance their accessibility for smallholder farmers. Successful initiatives in countries like Kenya and Malawi serve as models for how targeted subsidies can lead to significant increases in agricultural productivity. Furthermore, enhancing infrastructure for the importation and distribution of these materials is vital. Poor ru ral infrastructure remains a significant barrier to the effective utilization of imported agricultural inputs, and investments in roads, storage facilities, and irrigation systems are essential to ensure that these inputs reach farmers in a timely and efficient manner.

Investment priorities must also reflect the findings of this study. The significant positive relationship between gross fixed capital formation (GFCF) and GDP indicates that investment in fixed assets is crucial for driving economic growth. Therefore, it is imperative for governments to create an enabling environment that encourages both local and foreign investments in the agricultural sector. This includes fostering a regulatory framework that minimizes bureaucratic hurdles and enhances the overall business climate. By doing so, countries can attract the necessary capital to develop agricultural technologies and improve productivity.

The role of governance cannot be overstated in optimizing the benefits of agricultural imports. The study highlights that effective governance structures are essential for the successful implementation of agricultural import programs. Issues such as corruption, inefficiency, and weak regulatory frameworks can undermine the potential benefits of imports. Therefore, strengthening governance and institutional capacities should be a priority for policymakers. This includes enhancing

transparency in subsidy programs and ensuring that resources are allocated effectively to support agricultural development.

Despite the promising findings, the study acknowledges several limitations that warrant consideration. The variability of agricultural systems and economic conditions across Sub-Saharan Africa complicates the relationship between agricultural imports and growth. While countries with more developed agricultural sectors may leverage imports effectively, those with weaker institutions and infrastructure may struggle to realize the benefits. This variability underscores the need for region - specific studies that account for local conditions and provide tailored policy recommendations.

Future research should focus on longitudinal studies that examine the long-term impacts of agricultural imports on economic growth, particularly in the context of changing global trade dynamics and climate change. Additionally, exploring the interactions between agricultural imports and other economic factors, such as domestic investment and export performance, could provide deeper insights into the mechanisms through which imports influence growth. By addressing these areas, future studies can contribute to a more nuanced understanding of the role of agricultural imports in fostering sustainable development in Sub-Saharan Africa.

The findings of this study emphasize the critical importance of agricultural raw material imports in driving economic growth within Sub-Saharan Africa. By implementing targeted policies that enhance access to these imports, alongside structural reforms and regional cooperation, policymakers can cultivate a more conducive environment for sustainable agricultural development and economic prosperity in the region. The insights derived from this research provide a valuable foundation for future studies and policy discussions aimed at optimizing the role of agricultural imports in addressing food security challenges and promoting economic growth across Sub-Saharan Africa.

# 6. Conclusions and Recommendations

The comprehensive analysis conducted in this study elucidates the pivotal role that agricultural raw material imports (ARMI) play in stimulating economic growth across 48 Sub-Saharan African countries from 1990 to 2023. The empirical findings reveal a statistically significant positive correlation between ARMI and gross domestic product (GDP), underscoring the critical importance of access to imported agricultural inputs in enhancing productivity and driving economic development within the region. This conclusion is consistent with prior research that has emphasized the transformative effects of agricultural imports, particularly fertilizers and high-yield seeds, on agricultural efficiency and food security [6, 22]. The results indicate that while imports serve as essential resources for agricultural growth, their effectiveness is inherently linked to the implementation of supportive policies and structural reforms that facilitate their optimal utilization.

Furthermore, the empirical results highlight that gross fixed capital formation (GFCF) and rural population (RP) are also significant determinants of economic growth. This reinforces the notion that investment in fixed assets and the active participation of the rural labor force are crucial strategies for promoting sustainable economic growth in Sub-Saharan Africa. The positive coefficients associated with these variables suggest that enhancing domestic investment and effectively leveraging the rural workforce are vital for fostering agricultural productivity and overall economic advancement. Conversely, the observed negative relationship with other imports (OM) underscores the complexities inherent in trade dynamics, indicating that not all imports yield positive economic outcomes. This finding necessitates a nuanced approach to trade policy that prioritizes the quality and strategic value of imports over their sheer volume.

In light of these conclusions, several actionable recommendations can be proposed for policymakers in Sub-Saharan Africa. First and foremost, it is imperative to develop and implement policies that facilitate access to high-quality agricultural raw materials. This could involve the establishment of subsidy programs for fertilizers and advanced agricultural inputs, as evidenced by successful initiatives in countries such as Kenya and Malawi [22]. Additionally, enhancing the infrastructure necessary for the importation and distribution of agricultural inputs can significantly improve their accessibility to farmers, thereby bolstering productivity and economic output.

Secondly, there exists an urgent need for structural reforms that address the fundamental challenges confronting the agricultural sector. This encompasses improving the quality of governance, reducing trade barriers, and fostering an environment that is conducive to domestic investment. Policymakers should prioritize the creation of a regulatory framework that encourages both local and foreign investments in agriculture, which can catalyze technological advancements and enhance productivity levels.

Thirdly, it is essential to promote research and development initiatives aimed at bolstering domestic agricultural innovation. By investing in local agricultural research institutions and fostering partnerships with international organizations, countries can cultivate homegrown solutions that complement imported technologies. This balanced approach not only mitigates the risks associated with over-reliance on imports but also enhances local capacities and fosters sustainable agricultural practices.

Finally, regional cooperation among Sub-Saharan African countries is vital for optimizing agricultural imports and fostering economic growth. Collaborative efforts to harmonize trade policies, share best practices, and develop joint agricultural initiatives can significantly enhance the region's overall competitiveness in the global market. By working collectively, countries can leverage their shared strengths to address common challenges and capitalize on opportunities for growth.

The findings of this study underscore the critical importance of agricultural raw material imports in driving economic growth within Sub-Saharan Africa. By implementing targeted policies that enhance access to these imports, alongside structural reforms and regional cooperation, policymakers can cultivate a more conducive environment for sustainable agricultural development and economic prosperity in the region. The insights derived from this research provide a valuable foundation for future studies and policy discussions aimed at optimizing the role of agricultural imports in f ostering growth and addressing food security challenges across Sub-Saharan Africa.

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