Agricultural Land Endowments, Agricultural Sector Productivity and Food Exports in Sub-Saharan Africa

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Abstract

This research work investigates the association between agricultural land endowments, agricultural sector productivity, and food exports in Sub-Saharan Africa (SSA). Using a fixed effects model, the analysis reveals a statistically insignificant relationship between the lag of agricultural land and food exports in SSA; however, upon stratification based on income group, a negative relationship is observed in the region's low-income countries, whereas a positive relationship is observed in middle-income countries. Furthermore, the findings show a significant positive relationship between the lag of agricultural sector productivity and food exports, which does not vary between the two income groups. The findings are robust to the exclusion of six countries with the highest agricultural sector productivity and the two emerging countries in SSA with the largest agricultural land, Nigeria and South Africa.

Key words: Agricultural land endowments, productivity, food exports, fixed effects model

JEL classifications: Q24, Q17, Q18, C33

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Chapter 1

Introduction

With the global population approaching 7.8 billion in 2020 and with a projection to further increase to 9.7 billion by 2050 (World Population Prospect, 2019; Population Reference Bureau, 2020), the global demand for food will increase rapidly. Hence, countries that are richly endowed with large amounts of uncultivated agricultural land are likely to benefit by producing significantly large amounts of food for export to meet this pressing demand. Despite this, the consequences of climate change add a diverse aspect to this matter, affecting the availability and long-term viability of agricultural land (Gbetnkom and Khan, 2020; Abolagba et al. 2017).

Sub-Saharan Africa (SSA hereafter) is among the regions in the world with an abundance of natural resources in terms of vast agricultural land but are not fully exploited for agricultural production unlike in other regions (Food and Agriculture Organization, 2020). For example, Latin America, the Caribbean, Europe, and Central Asia have a substantial proportion of agricultural land that is utilized extensively for mechanized farming to boost food production for both local consumption and export. The prospect of utilizing this potential to enhance the export of food products has drawn significant attention among policymakers. In Nigeria, for instance, attention has been shifted away from the oil sector to the agricultural sector with the sole aim of increasing foreign exchange earnings through the export of agricultural products (Central Bank of Nigeria Economic Report, 2021).

Agricultural products are the primary export in SSA. Despite having the third largest share of agricultural land as a percentage of total land area in the world, at 42.54% in 2018, its food import bill of $43 billion in 2019 has continued to be above its food exports of $35 billion in the same year (FAO, 2020). The African Development Bank (2020) has projected that Africa's food imports will reach $90 billion by 2030; this has generated concern among scholars on why it is so difficult for SSA to feed

itself even with an abundance of unutilized agricultural land. Furthermore, its share of food exports as a percentage of merchandise exports is only 14.54% in 2018, while Latin America and the Caribbean have a smaller share of agricultural land (35.56%), but a higher share of food exports (22.49%) (FAO, 2020). In order to address the aforementioned concern, it is imperative to undertake a comprehensive study within the context of SSA. This investigation fulfills the essential role of guiding policymakers' attention towards the formulation of strategic frameworks with the objective of enhancing land tenure and utilization.

Much recent discussion on the determinants of agricultural exports, such as Sayeh, Sirine and Ahmed (2020), Eshetu and Mehare (2020), Idsardi (2015) and others, has focused on the influence of variables such as the labour force, industrialization, foreign direct investment, the exchange rate, technology, and market size on agricultural exports. This research project is innovative as it will contribute to the empirical debate by introducing new variables, namely agricultural land and agricultural sector productivity, to determine their impact on food exports in SSA. The significance of these variables lies in their intrinsic relevance to the agrarian feature of SSA countries. With the abundant availability of agricultural land, they are intended to serve as the primary providers of food imports to both developing and developed regions of the world. The fundamental role of agricultural land has been neglected due to its fixed characteristics. Nevertheless, it is important to note that the share of agricultural land to total land area experiences significant variation over time, as demonstrated by the figures presented in the appendix. Urbanization, economic growth, shifting cultivation, and the dismantling of structures are factors accountable for the variations in the decline and growth of agricultural land. This phenomenon makes agricultural land an intriguing topic for scholarly exploration.

In order to provide a comprehensive analysis of these dynamics, the study utilizes a fixed effects model to control for time-invariant country characteristics. Using a sample of 42 SSA countries from 1990 to

2021, the findings of the analysis unveiled a statistically insignificant inverse relationship between the lag of agricultural land and food exports. In contrast, there exists a significant positive relationship between the lag of agricultural sector productivity and food exports. As well, a more disaggregated analysis reveals notable disparities between two income groups in the region. In the low-income countries of SSA, the empirical analysis uncovered an inverse association between the lag of agricultural land and food exports. On the other hand, within the middle-income countries of the region, an unexpected positive relationship is identified. However, the significant positive relationship between the lag of agricultural sector productivity and food exports did not vary between the two income groups. These results are robust to the exclusion of six countries exhibiting the highest productivity in the agricultural sector and two countries possessing the largest agricultural land. Significantly, despite these exclusions, the fundamental findings persist, thereby enhancing the credibility of the applicability of the outcomes to a wide range of countries in Sub-Saharan Africa. The findings have major implications for policymakers, researchers, and stakeholders in the agriculture sector. The absence of a statistically significant positive link between agricultural land and food exports underscores the need for meticulous assessment of land use policies, as the presence of more agricultural land might not automatically ensure a boost in the ability to export food. On the other hand, the strong connection between agricultural sector productivity and food exports emphasizes the importance of increasing productivity in order to enhance the potential for exporting food products.

The rest of the thesis is structured as follows. The second section provides some background and discusses the related literature. The third section covers the conceptual and theoretical framework. The fourth section focuses on data sources and measurement. The model and results are presented and discussed in the fifth section. Test for robustness are performed in the sixth section. Finally, the conclusion and policy implications are drawn in the seventh section.

Chapter 2

Background and Related Literature

The bulk of the population derives their livelihoods from agriculture, which also contributes significantly to the region's economy by reducing poverty, promoting rural development, and fostering general economic growth (Kinda et al. 2022). Wood (2002) argues that Africa will always have a larger primary sector and a smaller manufacturing sector than the land-scarce regions of Asia and Europe. This is because Africa has an abundance of land. According to Cleaver (1985), agriculture plays a significant role in SSA, generating between 20% and 60% of a country's GDP, on average 80% of employment, and 50–90% of exports. Sixty percent of the labour force in Sub-Saharan Africa is primarily engaged in agricultural practices, although crude oil reliant nations such as Nigeria, South Africa, and Ivory Coast, along with Cameroon and the Gulf of Guinea, are exceptions to this trend (World Bank, 2015).

Sub-Saharan Africa has a wide range of land endowments, with some countries having an abundance of arable land, while others have problems with land availability and quality. Agro-ecological zones that are distinct in Sub-Saharan Africa give rise to variances in the distribution of agricultural land. Due to their size and favourable agro-climatic conditions, nations like Nigeria, Ethiopia, and the Democratic Republic of the Congo have larger land tracts ideal for agriculture. Comparatively, nations in dry or semi-arid regions, like Niger and Mali, may have a limited amount of arable land, with agricultural operations concentrated in more fertile parts or near water sources (FAO, 2021).

Primary commodities continue to make up the majority of Africa's exports, with agriculture comprising a notably smaller proportion of SSA's overall exports compared to four decades ago (Tesfaye, 2014). The unsatisfactory export outcomes in the agricultural arena of Sub-Saharan Africa have been linked to inadequate domestic policies and the fragmented land holdings that are prevalent in SSA (Ndip et al. 2023). The region's capacity to augment its exports is also limited due to inflexible production capacity,

inadequate infrastructure, and institutional obstacles that impede trade. These challenges are exacerbated by an overpriced exchange rate and unfavourable policies toward the agricultural industry (Biggs, 2007; Kandiero and Randa, 2004; Alemayehu, 1999).

Numerous research studies explore the factors that impact agricultural exports in different regions and in a particular country, and SSA is one area that has been closely analyzed. While certain researchers focus on how macroeconomic variables influence agriculture, others give importance to industry-specific factors.

Multi-Country Studies

Tesfaye (2014) evaluates the factors impacting agricultural exports in 47 countries across SSA from both the demand and supply sides. The study employs a fixed effects estimation technique using panel data and finds that various supply-side factors, including current and past real GDP of the exporting country and past agricultural input usage, have a significant and positive impact on the agricultural export of Sub-Saharan African nations. The positive and significant impact of the per capita GDP of the US, which is a major trading partner of SSA nations, is observed on the demand side. The general outcome emphasizes that agricultural export performance in SSA nations is influenced equally by factors related to supply and demand. Fonchamnyo and Akame (2017) conduct a similar study on export diversification in Sub-Saharan Africa (SSA) by analyzing panel data from 32 countries spanning from 1995 to 2013. Through their empirical analysis, it reveals that trade openness, value added in agriculture and manufacturing, and foreign direct investment are key factors that greatly contributed to the promotion and determination of overall export diversification. On the other hand, they discover that GDP per capita is a notable barrier to export diversification in the SSA region. The selected economies have export diversification that is not significantly affected by foreign aid, the official exchange rate, or gross domestic investment, according to additional findings.

Instead of examining agricultural exports in Sub-Saharan Africa, Mwangi (2021) flips the script and analyzes the factors affecting agricultural imports in the region. To achieve this, he uses an enhanced gravity model to analyze a panel dataset comprising 37 countries in the region from 1995 to 2018. The findings indicate that agricultural imports are significantly impacted by several factors, including the country's economic size, arable land available, involvement in regional trade agreements, cultural similarities such as sharing a language, inflation, and quality of government. All of these variables have a positive influence on the volume of agricultural imports. The flow of agricultural imports in Sub-Saharan Africa is negatively affected by several other factors including population growth of trading partners, proximity between trading nations, transport cost, and the productivity of the importing country's agriculture.

In contrast to previous studies, Kinda et al. (2022) analyze the impact of land acquisition on food security over a period of 18 years, from 2000 to 2018, instead of focusing on food exports, which is the main gap the present study intends to fill. After conducting econometric analyses on panel data from 32 countries in Sub-Saharan Africa, the result shows that land grabs have a negative impact on cereal production and contribute to higher rates of malnutrition. What's particularly captivating in their study is that food security is not determined by the utilization of land. Between 2001 and 2016, Osinubi and Apanisile (2021) analyze the impact of agricultural investment and institutions on food security in 24 Sub-Saharan African (SSA) nations. Using a GMM estimation technique, the study finds that investment in agriculture enhances food security in the chosen SSA nations. Also, food security is positively affected by indicators of governance, such as internal and external conflicts.

Uysal and Mohamoud (2018) examine the influential factors affecting the export performance of seven nations in East Africa during the period spanning from 1990 to 2014. The research findings indicate that the export value is positively affected by factors such as the labour force, industrialization, foreign direct

investment, and the exchange rate. However, the export performance of East African countries is adversely affected by inflation, while the only variable that has no impact on the value of exports is GDP growth.

Single-Country Studies

Turning to single-country studies, Abolagba et al. (2017) examine the factors that influence agricultural exports with specific reference to cocoa and rubber. The results from OLS analysis indicate that the export of rubber is greatly impacted by various factors such as domestic rubber production, the producer price, the exchange rate, domestic consumption, and the interest rate. Similarly, the OLS analysis suggests that cocoa exports are significantly influenced by factors including cocoa output, domestic consumption, and rainfall. Folawewo and Olakojo (2010) study the determinants of agricultural exports in an oil exporting economy and find that the world price for Nigeria's agricultural commodities, world income and Nigeria's past agricultural output were determinants of agricultural exports. Idsardi (2015) extends the study to the South African economy and finds that economic market size, supply capacity and physical market size have a significant impact on trade flows. In another related study carried out in Ghana, Boansi, OdilonKounagbéLokonon and Appah (2014) find that both the volume and the value of agricultural exports have a positive association with production, openness to trade, and the index of competitiveness. Tulu (2020) analyzes the factors that influence the export performance of Ethiopia's agricultural products in both the short and long term. The study indicates that factors such as inflation, foreign direct investment, the real effective exchange rate, trade openness, infrastructure improvement and fertilization input have a significant positive influence on agricultural export performance in the long term. In the short term, there is no notable impact of either inflation or foreign direct investment on the agricultural export's performance. Gbetnkom and Khan (2020) explore the factors affecting the export of cocoa, coffee and bananas from Cameroon during the period of 1971/72 to 1995/1996. The

outcomes from utilizing the OLS estimation technique demonstrate that the export supply of all crops react positively to alterations in relative prices, albeit the degree of significance is moderate. The export supply of cocoa, coffee, and bananas experiences a favorable impact due to modifications made to the structure of the transportation system. Increase in credit provided to crop exporters has a notable and advantageous impact on the exportation level of all types of crops. The impact of rainfall on the growth of the three goods is optimistic, although it is only remarkable for cocoa and coffee.

According to research conducted by Bonansi (2014) in Chad, the growth in exports is greatly influenced by factors such as the production of cotton, the competitiveness of the country in exporting the commodity, the quantity of global exports of the commodity, and the export price faced by the country. Bakari et al. (2020) also find that the growth in gross domestic product, agricultural imports, bank loans allocated to the agricultural sector, and imports of farming machinery have a favourable impact on agricultural exports in the long run. On the other hand, investing locally in agriculture and utilizing agricultural land have an unfavourable impact on the exportation of agricultural products over a prolonged period. Hosseini and Homayounpour (2013) suggest that certain factors, including the relative price index, the real exchange rate, the commercial exchange relationship, the added value of trade, commercial agriculture, and GDP in partner countries, have a significant and positive impact on the index measuring the value of agricultural exports. Eshetu and Mehare (2020) show that the significant factors influencing the export of agricultural goods in Ethiopia include the country's gross domestic product, exchange rates, road infrastructure, a corruption index, the previous export value, indirect taxes, and domestic savings. On the other hand, there is a significant negative relationship between Ethiopian agricultural exports and foreign direct investment as well as the labour force. In their research, Zhi-lu and Xian-de (2018) utilize an enhanced gravity model of global trade to gauge the trade margins of Chinese agricultural exports to ASEAN, as well as their underlying factors. According to their findings, the trade margins of Chinese agricultural exports to ASEAN are significantly impacted by

various factors including economic and population scales, agricultural export capacity, trade integration, the global financial crisis, and shared borders. Abdullahi et al. (2022) employ Stochastic Frontier Analysis (SFA) on an augmented gravity model to investigate the efficiency and crucial factors behind China's agricultural exports to 114 importing countries during the years 2000 to 2019. The study shows that China's agricultural exports are influenced positively by factors such as its GDP, its importing countries, the Belt and Road Initiative, shared borders, and the use of the Chinese language. On the contrary, the findings indicate that various factors such as per capita GDP, currency depreciation, distance, and landlocked status have a negative impact on China's agricultural exports. Shunsuke and Karemera (2005) analyze the impact of various factors such as technology and efficiency, factor endowments, prices, and environmental risks on agricultural exports. According to their discoveries, significant factors influencing export proportions are the alteration in technology and the prices of goods produced. Shane, Roe, and Somwaru (2016) estimate the real trade-weighted exchange rate and trade partner income effects on US agricultural exports for the period 1970–2006 and find that a one percent annual increase in trade partners' income increases total agricultural exports by about 0.75 percent, while a one percent appreciation of the dollar relative to trade partner trade-weighted currencies decreases total agricultural exports by about 0.5 percent. Linh et al. (2019) conduct an evaluation on the factors that could influence Vietnam's prospective exports to the European Union, specifically focusing on agricultural goods as a case study. The study reveals that Vietnam's potential agricultural exports to the EU can be positively influenced by various factors like the development of financial markets, trade freedom, technological readiness, and labour freedom.

Research Novelty

Based on the literature review, numerous scholars have examined the factors that influence agricultural exports, utilizing variables such as the exchange rate, foreign direct investment, the inflation rate,

political instability, the labour force, trade openness, population growth, market demand, technology, infrastructure and GDP. Regrettably, the influence of agricultural land and productivity on agricultural exports remains insufficiently explored, despite the fact that Sub-Saharan Africa possesses the world's third-largest area of unutilized arable land.

The investigation of the relationship between agricultural land endowments and agricultural exports may have been overlooked in previous research due to concerns regarding the fixed nature of land supply. Concerns regarding the reliability and robustness of analytical outcomes arise due to the inherent characteristic of a fixed land supply. Nevertheless, it should be noted that the share of agricultural land to the overall land area is a dynamic measure that experiences fluctuations over time. These changes occur as a result of building certain infrastructures and structures such as roads, commercial and residential buildings, schools, hospitals and factories on agricultural land, which leads to a decline in the portion of land available for agriculture. In the same way, there are situations in which big agricultural investors may acquire and dismantle existing buildings with the purpose of using the land for agriculture, thus increasing the amount of agricultural land. Furthermore, there is the possibility that land abandoned as a result of shifting cultivation and land under trees grown for wood or timber, which the Food and Agriculture Organization (FAO) has classified as distinct from conventional agricultural land, may be converted into agricultural land, thereby increasing the amount of agricultural land.

The temporal variation in the measure renders it suitable and pertinent for conducting academic research, as it has the potential to produce reliable and significant findings. Integrating this dynamic aspect into the analysis through the utilization of suitable estimation techniques like the fixed effects model and first difference model holds promise in yielding more dependable and refined conclusions concerning the intricate interplay between agricultural land endowments and food exports. Not considering agricultural land as a variable when evaluating food exports may lead to biased or

inaccurate results in economic models. In order to prevent inaccurate conclusions about the factors influencing food exports, it is vital to consider agricultural land which is a critical input in the production process. If other variables, such as credit to the private sector, the exchange rate, the inflation rate, trade openness, GDP growth, the labour force and employment concentration in agriculture, are examined independently without considering the foundational resource of agricultural land, there is a risk of incorrectly attributing upward shifts in food exports to these factors. In reality, these changes may possibly be influenced by fluctuations in the availability or utilization of agricultural land. This facilitates comprehension of the genuine implications of additional factors devoid of the effects stemming from variations in land resources.

The current study therefore aims to fill in the gap in literature and provide comprehensive insights into the factors that contribute to food exports in SSA with specific interest on agricultural land endowments and agricultural sector productivity. Table 1, below, summarizes the variables employed in the studies described in this chapter.

Table 1: Summary of Existing Studies

Empirical Studies	Variables Employed
Tesfaye (2014)	Real GDP of the exporting countries, GDP per capita of the US, exchange rate, institution quality, infrastructure, trade openness, foreign direct investment inflows, diversification index, trade policy proxied by import tariff imposed on agricultural commodities from SSA by (US and EU), inputs proxied by fertilizer consumption.
Fonchamnyo and Akame (2017)	Trade openness, value added in agriculture and manufacturing, foreign direct investment, GDP per capita, foreign aid, official exchange rate, and gross domestic investment.
Mwangi (2021)	Economic size, arable land, regional trade agreements, common language, inflation, quality of government, population growth of trading partners, proximity between trading nations, transport cost, and the productivity of the importing country's agriculture.
Uysal and Mohamoud (2018)	Labour force, industrialization, foreign direct investment, inflation, GDP growth and exchange rate
Abolagba et al. (2017)	Domestic rubber production, producer price, exchange rates, domestic consumption, interest rates, cocoa output, domestic consumption, and rainfall.
Folawewo and Olakojo (2010)	World price for Nigeria's agricultural commodities, world income and Nigeria's past agricultural output.
Idsardi (2015)	Economic market size, supply capacity and physical market size
Boansi, OdilonKounagbéLokonon and Appah (2014)	Production, openness to trade, and the index of competitiveness
Tulu (2020)	Inflation, foreign direct investment, real effective exchange rate, trade openness, infrastructure improvement and inflation, foreign direct investment and fertilization input.
Gbetnkom and Khan (2020)	Relative prices, transportation system, credit and rainfall.

Chapter 3

Conceptual and Theoretical Framework

The Nexus between Agricultural Land, Agricultural Sector Productivity and Food Exports

One of the most important elements in establishing a country's comparative advantage in food production is its endowment of agricultural land. A greater predisposition for agricultural specialisation and food exports exists in nations with ample agricultural land compared to other elements of production. Increased agricultural output is made possible by the presence of fertile land, creating a surplus of food that can be exported to other countries (Kinda et al. 2022).

The Heckscher-Ohlin theory sheds light on how factor endowments and global trade patterns are related. This idea states that nations will import goods that need the use of scarce components and export those that heavily utilise their abundant factors of production (Leontief, 1953). We can better understand how a country's agricultural land availability affects its export patterns in the food sector by applying this theory to the relationship between agricultural land endowments and food exports.

According to the Heckscher-Ohlin theory, a nation with an advantage in agricultural land endowments will typically export food items that utilize a lot of land. This implies that the focus of their export activities will be on crops that require a significant amount of land for cultivation. For instance, nations with sizable tracts of arable land may specialise in exporting widely produced cereal crops like wheat, maize or rice, which need a lot of land to be grown. The theory is related to this study, as it explains how a region like SSA that is richly endowed with vast agricultural land will focus more on utilizing it effectively to boost agricultural sector productivity and food exports.

Furthermore, factor intensity has a significant effect on trade, based on the Heckscher-Ohlin hypothesis. Factor intensity in this sense refers to the proportionate usage of various production elements, such as

land, labour, and capital, in the manufacturing process. A land-intensive production structure in the food sector is likely to be seen in nations that have a comparative advantage in agricultural land endowments. This suggests that a greater proportion of agricultural production is dependent on land than on other resources like labour or capital.

By considering the demand for food items on the global market, it can help to clarify the connection between agricultural land endowments and food exports. Meeting the domestic food demand may be difficult for nations with little arable land or unfavourable climatic conditions. As a result, they start to rely on imported food to fill the gap in domestic supply and demand (Mwangi, 2021). On the other hand, nations with a lot of arable land may be able to produce more food than they need and export that surplus to nations with higher food demands or lower agricultural output (Mwangi, 2021).

On the relationship between agricultural sector productivity and food exports, increased agricultural efficiency results in an enhanced ability to produce food, thereby empowering nations to broaden their food exports. An increase in agricultural productivity can be influenced by several factors such as technological progress, effective resource distribution, infrastructure enhancement, and institutional aid (Fonchamnyo and Akame, 2017). As a nation's agricultural sector becomes more productive, it is able to produce a surplus of food beyond what is required for domestic consumption. The excess can be sent to other nations, helping to stimulate economic progress and advancement.

Boosting agricultural productivity leads to a rise in the amount of output produced by each input, such as land, labour, and capital. Abolagba et al. (2017) posit that smart utilization of sophisticated agricultural methods, superior quality seeds, effective irrigation infrastructure, automated processes, and enhanced managerial tactics can lead to higher productivity. Increasing productivity in agriculture enables the sector to yield a greater quantity of food utilizing the same resources, or to maintain the same quantity of food while utilizing fewer resources. Increased agricultural productivity allows

countries to produce more food than they need for their own consumption, resulting in surplus production. The excessive production provides an avenue for food exports, as the surplus can be sent to global markets to fulfill the requirements of other nations. The excess serves as a protective measure to guarantee sustained availability of food domestically in the event of irregular changes in production or unfavorable weather circumstances.

Nations that excel in agricultural productivity tend to have a greater edge in global food markets due to their competitiveness (Abolagba et al, 2017). By enhancing their efficiency, they are able to present food items at advantageous rates, thereby raising their market penetration and the chance to expand abroad. Furthermore, a nation's dependability as an exporter is reinforced by its capability to consistently provide a substantial amount of food items that are of excellent quality. The enhanced productivity of the agricultural sector can lead to a rise in food exports, which is likely to have a positive impact on a country's economic progress. Exporting food contributes to a country's overall foreign exchange earnings, boosts export revenues, and strengthens the trade balance. The surplus income can be employed to invest in various areas, promote infrastructure growth, and encourage overall economic variety.

Enhancements in agricultural productivity frequently result from the distribution and innovation of novel technologies and knowledge, which are known as technological spillovers and knowledge transfer. The dissemination of technology and exchange of knowledge can yield favorable outcomes for the overall economy, surpassing the confines of the agricultural field. The implementation of novel technologies and methods can result in increased productivity in interconnected sectors, enhance the quality of life in rural areas, and catalyze holistic economic growth (Shunsuke and Karemera, 2005).

The connections between the productivity of the agricultural sector and food exports, and also the allocation of agricultural land and food exports, are bi-directional and can be accurately described as

mutually influential, with both factors impacting and building upon each other. This could result to potential issue of endogeneity, that is, a situation of reverse causality. This complex connection plays a crucial role in advancing the agricultural sector and its capacity to fulfill the requirements of food exports.

An improvement in agricultural productivity leads to a rise in the export of food products. As agricultural productivity enhances, farmers can increase their crop output without expanding their land area, making better use of their resources to improve efficiency and effectiveness. By enhancing productivity, there is a possibility of generating excess agricultural output that can be sold to global markets. Productivity enhancement among farmers can lead to meeting the increasing demands of the growing population and surplus gain for exportation, which is beneficial to the economy by augmenting agricultural trade.

On the other hand, enhanced agricultural production can be triggered by a rise in food exports. When farmers are able to sell their products in international markets, they are encouraged to increase their efficiency and output to satisfy the needs of those markets. The urge to fulfill export demands motivates farmers to allocate resources for research and development, implement current farming techniques, and strive for ongoing enhancement in their activities. This leads to an increase in agricultural output, which strengthens the favourable cycle of productivity and the export of food.

Similarly, a comparable trend can be observed in the correlation between food exports and the amount of agricultural land available. The expansion of land dedicated to agriculture opens up more cultivation possibilities for farmers, ultimately resulting in higher food exports (Mwangi, 2021). If there is an increase in the amount of available land for farming, farmers can grow their businesses, boost output, and effectively fulfill the growing needs for both local consumption and export. By allocating more land resources, it is possible to encourage specialization among regions in producing specific agricultural

products, which can ultimately enhance their exporting capabilities. In the same vein, a rise in foreign exchange earnings that comes from the export of food can motivate farmers to expand their farming operations and acquire more land. Export earnings can enable farmers to acquire more land, upgrade their infrastructure, or embrace progressive agricultural practices by offering them the essential capital.

Other Determinants of Food Exports

However, it is important to note that a nation's capability to export food products is not solely dependent on the amount of agricultural land and productivity of the sector. Various other factors such as credit to the private sector, the exchange rate, the inflation rate, trade openness, GDP, the labour force, and the employment concentration in agriculture, all have significant impacts.

- Providing more credit to farmers could encourage the adoption of mechanized large-scale agriculture, leading to higher levels of food exports (Gbetnkom and Khan, 2020).
- International trade can be significantly influenced by fluctuations in currency valuation, bearing a substantial impact on the volume of food items exported to foreign nations. Abolagba et al. (2017) are of the view that when a nation's currency has a lower value compared to other countries' currencies, it can benefit agriculture by allowing farmers to sell more produce internationally due to its affordability. Conversely, they opine that when a nation's currency possesses a higher value, the challenge of marketing food items to other nations increases, as the elevated prices become a deterring factor.
- Severe inflation can increase production costs and lessen the competitiveness of food exports. On the other hand, when inflation rates are low, production costs are relatively lower, promoting the expansion of viable food exports (Uysal and Mohamoud, 2018).
- The idea of trade openness concerns a country's involvement in international trading endeavours. Unrestricted trade offers benefits to food exports by enabling access to new markets and

increased profits through intensified competition. Boansi, OdilonKounagbéLokonon and Appah (2014) point to the fact that reducing trade barriers promotes the seamless movement of food exports, leading to a boost in production and shipping levels. Of course, a rise in trade openness could be associated with a rise in any part of merchandise exports, so the impact on the ratio of food exports to total merchandise exports is indeterminate.

- The food export capacity of a country is largely influenced by its Gross Domestic Product (GDP). A robust economy, indicated by higher GDP growth, is commonly associated with enhanced food output and export potential. Having strong GDP growth is crucial for making investments in agriculture, including but not limited to improving infrastructure, conducting research and development, and embracing new technologies. Making these investments can boost agricultural efficiency, enhance the quality of food items and amplify export competitiveness on the global market. A country's ability to import required inputs and fulfill domestic food requirements, while also having a surplus for export, is made possible by high GDP growth, which indicates greater purchasing power.
- The agricultural productivity and food export capacity of a nation are influenced by the size and expertise of its workforce. A skilled and extensive workforce is capable of enhancing agricultural yield by utilizing productive farming techniques, managing land appropriately, and executing proficient post-harvest preservation methods. Having a sufficient workforce available enables agricultural activities to be carried out promptly and smoothly, resulting in the highest possible level of output. In addition, proficient workers in the agriculture industry can utilize advanced methods and technologies to increase efficiency and excellence, thereby making global purchasers more interested in importing food products (Uysal and Mohamoud, 2018). On the other hand, a lack of labour or insufficient expertise could impede farming activities, causing a decline in the ability to export food.

- The proportion of jobs in farming indicates the importance of agriculture in an economy. A significant proportion of the workforce being employed in agriculture indicates a significant dependence on the sector for both income and financial security. The exportation of food products can be crucial in creating revenue, enhancing a trade surplus, and fostering overall economic development in such instances. Uysal and Mohamoud (2018) observe that a significant proportion of the workforce engaged in farming activities might imply a reduced degree of industrial development or variety in the economy, ultimately restricting the funding opportunities for enhancing agricultural output. To achieve economic sustainability, nations must strike a balance between creating job prospects in agriculture and advocating for growth in alternate industries.

In order to enhance our understanding of the complex mechanisms involved, this study incorporates a wide range of macroeconomic indicators. A comprehensive selection of variables that include credit to the private sector, the exchange rate, the inflation rate, trade openness, GDP growth, the labour force, and the employment concentration in agriculture has been meticulously chosen to encompass the diverse aspects of the agricultural domain. Although there are other influencing factors like outward foreign direct investment, rainfall and fertilizer usage that impact food exports, they have been excluded from the analysis because data for the majority of Sub-Saharan African countries are unavailable. To improve the analysis, the study strives to integrate these variables and assess their theoretical connections with food exports.

Chapter 4

Data Sources and Measurement

This section provides an overview of the sources of data and definitions of variables used in the study. The study analyzes annual data from 42 countries in Sub-Saharan Africa (SSA) from 1990 to 2021. The rationale for choosing this specific time frame is predominantly driven by the accessibility and availability of relevant data sources.

The focal variable within this study is food exports, specifically denoting the percentage of food exports in relation to total merchandise exports. The choice to use the percentage of food exports in relation to total merchandise exports as against using the volume of food exports in measuring food exports for this study is based on a thoughtful evaluation of the diverse aspects present in global trade. The volume of food exports may appear to be more relevant and directly reflect trade quantities, but measuring the percentage of food exports allows for the assessment of a country's focus on agriculture. Furthermore, the percentage-based method considers the differences in the size of economies and trade activities across the countries examined in the study. Using the actual volume of food exports may create a distorted view of the relative significance of food exports to different economies due to variations in economic size and trade volume among countries. On the other hand, expressing food exports as a proportion of overall merchandise exports provides a more accurate representation of the relative importance of food trade in relation to other trading activities within each country. A greater reliance on agricultural commodities for international trade is indicated by a higher proportion of food exports. The principal independent variables under consideration are agricultural land and agricultural sector productivity. The variables employed for control in this study encompass credit to the private sector, the exchange rate, the inflation rate, the degree of trade openness, gross domestic product (GDP) growth, the labour force, and the employment concentration in agriculture.

The data used in the study are collected from multiple sources. Data from the World Development Indicators (2021) are used to gather information on various factors, including food exports, agricultural land, productivity in the agricultural sector, credit to the private sector, the exchange rate, the inflation rate, trade openness, GDP growth and the labour force. The data on employment concentration in agriculture are collected from the Food and Agriculture Organization statistical database (2021).

The study aims to investigate the determinants of the proportion of food exports in total merchandise exports. The proportion of agricultural land to the overall land area is used as a measure of agricultural land endowments. Agricultural sector productivity is defined as the value added in agriculture as a percentage of GDP. Credit to the private sector is defined as the domestic credit provided by banks to the private sector such as through loans, purchases of non-equity securities, trade credits and other accounts receivable, that establish a claim for repayment, as a percentage of GDP. The exchange rate is commonly assessed in terms of its connection with the United States Dollar. The inflation rate is determined by the consumer price index on a yearly basis. Trade openness is expressed by the ratio of imports and exports to GDP. Gross Domestic Product (GDP) is evaluated as the rate of growth of a nation's total economic output. The labour force denotes the proportion of individuals aged 15 and older in relation to the overall population. This study focuses on the measure of employment concentration, specifically examining the percentage of employment within the agricultural sector in relation to overall total employment.

Chapter 5

Model and Results

In this chapter, we explore the empirical model and results of the study, specifically using the fixed effects estimation method to analyze important factors related to agricultural land, agricultural sector productivity, and food exports in Sub-Saharan Africa.

Fixed effects models incorporate unobserved individual-specific effects that are constant over time and serve to mitigate potential complications stemming from serial correlation in the error term. Fixed effects enable the adjustment for unobservable disparities among countries, encompassing factors specific to each country that might impact the association between the variables under study and food exports. This method improves the credibility of the study and allows for addressing potential bias from overlooked factors.

The study also takes into account the problem of endogeneity and potential reverse causality between agricultural land, agricultural sector productivity, and food export by including past values of the key independent variables in the analysis. The study aims to reduce the chances of reverse causality and endogeneity biases by including lagged variables, which helps to consider the potential feedback effects between agricultural factors and food exports.

The Empirical Model

Fixed Effects Estimation Model

The fixed effects model addresses unobserved dissimilarities among countries by incorporating country-specific elements that could affect the correlation between the independent variables and the food export ratio. The fixed effects model is presented as follows:

$$\text{Food Export Ratio}_{it} = \beta_0 + \beta_1 \text{Agricultural Land}_{i,t-1} + \beta_2 \text{Agricultural Productivity}_{i,t-1} + \beta_3 \text{Credit Private Sector}_{it} + \beta_4 \text{Exchange Rate}_{it} + \beta_5 \text{Inflation Rate}_{it} + \beta_6 \text{Trade Openness}_{it} + \beta_7 \text{GDP}_{it} + \beta_8 \text{Labour Force}_{it} + \beta_9 \text{Employment Concentration}_{it} + \mu_i + x_t + \varepsilon_{it}$$

Where:

$\text{Food Export Ratio}_{it}$ represents food exports relative to total manufacturing exports for country i in year t.

$\text{Agricultural Land}_{i,t-1}$ represents the lagged agricultural land variable for country i in year t-1.

$\text{Agricultural Productivity}_{i,t-1}$ represents the lagged agricultural sector productivity variable for country i in year t-1.

$_{it}$ represents the variables for country i in year t.

$\beta_0, \beta_1, \beta_2, ..., \beta_9$ are the coefficients to be estimated.

μ_i represents the country fixed effects capturing unobserved heterogeneity.

x_t indicates time fixed effects.

ε_{it} represents the error term.

The fixed effects estimation model takes into account the specific characteristics of each country by including individual fixed effects (μ_i) for every country in the analysis. The model enables the capture of specific attributes and differences among countries that could impact the relationship between the independent variables and food exports.

Concerns related to endogeneity are effectively handled by this model, as it considers preceding values of the key independent variables to determine the impact of past values on current food exports. Looking at the connection between agricultural land and food exports, we can effectively tackle the problem of reverse causality or endogeneity by treating the lag of agricultural land as an exogenous factor. It can be reasonably assumed that the delay in agricultural land availability is independent in this context because farmers decide how to use land before determining the quantity of food that will be exported. This suggests that past decisions on land allocation are not affected by temporary changes in the amount of food being exported. Furthermore, when it comes to land allocation choices, there is a tendency for it to remain fairly constant in the immediate period. The decisions regarding land utilization come from major concerns such as the amount of rainfall, the market demand for different crops, and the availability of new machinery. These bigger concerns don't change suddenly because of an increase in food exports. This indicates that the delay in agricultural land response to fluctuations in food export levels is minimal.

The decision to only incorporate the delayed effects of agricultural land endowments and agricultural sector productivity in the model is aimed at isolating these essential elements of interest from potential complications arising from other variables being introduced simultaneously. The chosen method enables a more precise assessment of the sequence in which changes in agricultural land and productivity occur when compared to variations in food exports. This strategic decision helps to focus on the main factors of interest and reduces any potential interference or complications from introducing the control

variables. By effectively incorporating lagged variables, the study aims to explore the potential reverse causality connection between agricultural land, agricultural sector productivity, and food exports.

Regression Results

In order to provide confirmation of the strength of the results, we carefully carried out a range of thorough examinations. The regression analysis involves intentionally leaving out specific countries from the model in order to thoroughly assess the dependability and uniformity of the findings. This step plays a vital role in enhancing the credibility of the results and ensuring their broader applicability.

Table 2: Fixed Effects Model

Variables	**(1)**	**(2)**	**(3)**	**(4)**
Agricultural Land	-0.512***	-0.150	-0.330*	-0.080
	(0.109)	(0.181)	(0.183)	(0.193)
Agricultural Productivity	0.367***	0.308**	0.070	0.273**
	(0.094)	(0.129)	(0.131)	(0.136)
Credit to Private Sector		0.297***	0.303***	0.462***
		(0.079)	(0.074)	(0.103)
Exchange Rate		-6.369***	-6.211***	-7.228***
		(1.477)	(1.420)	(1.650)
Inflation Rate		0.132***	0.032	0.133***
		(0.042)	(0.044)	(0.043)
Trade Openness		-0.112***	-0.072**	-0.102***
		(0.036)	(0.033)	(0.038)
GDP Growth		-0.309***	-0.327***	-0.285**
		(0.119)	(0.117)	(0.125)
Labour Force		-0.118	-0.148	-0.191
		(0.242)	(0.231)	(0.256)
Employment		-0.006	0.080	0.050
		(0.139)	(0.132)	(0.147)
Constant	53.946***	68.537***	76.623***	70.239***
	(6.274)	(21.822)	(20.988)	(23.573)
R-squared	0.054	0.164	0.136	0.187
Number of Countries	42	42	36	40
Number of Observations	945	737	684	685

Note: The dependent variable is food exports as a share of total merchandise exports. *** indicates 1% significance; ** indicates 5% significance; and * indicates 10% significance. Standard errors are reported in parentheses. Agricultural land and productivity are lagged by one year.

Table 2 exhibits the outcomes obtained from employing the fixed effects model to examine the relationship between agricultural land, productivity, and food exports in Sub-Saharan Africa (SSA). Model 1 includes only the main explanatory variables; Model 2 adds the control variables; Model 3 drops the six countries (Ethiopia, Guinea-Bissau, Liberia, Sierra Leone, Sudan and Burundi) with the highest agricultural sector productivity; and Model 4 excludes Nigeria and South Africa, which have the largest agricultural land.

Model 1 demonstrates that, holding constant productivity, the presence of agricultural land has a substantial adverse impact on the export of food products. This implies that despite the abundant agricultural land in the Sub-Saharan Africa (SSA) region, there is no corresponding increase in the ratio of food exports. Nevertheless, it can be argued that agricultural productivity exerts a favourable and substantial influence, thereby implying a positive relationship between heightened productivity levels and increased food exports ratio. This underscores the significance of enhancing productivity in the agricultural sector as a means of bolstering food exports.

The second model incorporates control variables in addition to the variables representing agricultural land and productivity. The empirical findings indicate that there exists a statistically insignificant and negative association between agricultural land and the food export ratio. This observation substantiates the principal discovery made by Bakari et al.'s (2020) research. Similarly, an incremental one percentage point rise in the lag of agricultural sector productivity is associated with a corresponding increase of 0.3 percentage points in food exports relative to total merchandise exports. This positive and significant relationship agrees with the findings of Fonchamnyo and Akame (2017), Abolagba et al (2017) and Folawewo and Olakojo (2010).

Turning to the control variables, we find that credit to the private sector and the inflation rate exert a substantial positive impact on food exports ratio, whereas the exchange rate, trade openness, and GDP

growth, demonstrate a negative relationship with the food export ratio. The labour force and the employment concentration in the agricultural sector do not impact the food export ratio.

The relationship between credit to the private sector and the food export ratio indicates that the financial sector is successful in providing credit to the foreign trade sector, leading to positive outcomes. This is in line with the findings of Gbetnkom and Khan (2020), Bakari et al (2020) and Linh et al (2019). The value of the local currency in relation to US dollars has a negative impact on food exports, as a decrease in the exchange rate leads to an increase in the food export ratio. The study conducted by Shane, Roe and Sowaru (2016) also finds a negative relationship between the exchange rate and agricultural exports. The outcome is as predicted, as the local currencies in most countries in Sub-Saharan Africa have declined in value compared to the US dollar during the study period. In Tanzania, Uganda, Madagascar, and Burundi, the average exchange rate with the US dollars between 1990 and 2021 is 1220, 2054, 1832, and 1024, respectively. However, Guinea and Sierra Leone have significantly higher average exchange rates of 4156 and 3502, respectively. Essentially, when the value of the local currency decreases, it becomes less expensive for foreigners to buy exports. As a result, the demand for food exports tends to increase. The impact of the inflation rate on the food export ratio is positive and significant, and is in conformity with the finding of Tulu (2020). A considerable number of SSA countries experience high levels of inflation and the descriptive statistics show an average level of 19% within the study period, yet remarkably, this does not result in a decline in the export of food products. There is a possibility that this is due to the fact that food is a basic necessity for survival, and with the growing global population, the demand for food products is always present. Therefore, even as the inflation rate continues to swell in the region's food sector, there is consistently high demand for their products.

The findings of the analysis suggest that there is a negative relationship between trade openness and the food export ratio. This is at odds with the findings of Fonchamnyo and Akame (2017), Tulu (2020), and Linh et al. (2019) that reveal a positive relationship between openness to trade and agricultural exports. According to economic theory, when an economy increases its trade openness, there is a tendency for it to increase its exports. This analysis contradicts the outcome by stating that the food export ratio decreased due to openness. Surprisingly, contrary to expectations, the relationship between GDP growth and the food export ratio is strongly negative, indicating that as countries develop, their food exports decrease as a share of total merchandise exports. This is contrary to the outcomes of Tesfaye (2014), Bakari et al (2020) and Eshetu and Mehare (2020) that reveal a positive association. This adverse correlation might occur due to the reallocation of resources. A greater GDP can result in a shift of resources from agriculture to more profitable sectors like manufacturing, mining, and services. The allocation of resources, such as land and labour, to these sectors could potentially restrict the agricultural sector's ability to produce food for export.

A similar inverse relationship is observed between the labour force and the food export ratio, as well as between employment concentration and the food export ratio. This inverse relationship between the labour force and the food export ratio does not support the findings of Uysal and Mohamoud (2018) and Linh et al. (2019), who find a positive relationship. The connection between the labour force, employment concentration in the agricultural sector, and the food export ratio in SSA could be adversely affected by factors such as subsistence farming and fragmented land holdings that have been a common practice in most SSA countries (AFDB, 2020). A significant portion of the workforce in several SSA countries is involved in subsistence farming. Subsistence farming prioritizes fulfilling the essential food requirements of the farming family, as opposed to generating products for profit or trade. Therefore, a considerable proportion of the workforce may not be engaged in the production of excess food for international markets. Land fragmentation is a common occurrence in SSA, given that small-scale farms

are the general practice. Farmers face difficulties in achieving economies of scale due to fragmented land holdings, resulting in lower productivity and limited surplus production for export.

Model 3 excludes the six countries in Sub-Saharan Africa (SSA) that have the highest agricultural sector productivity. Dropping these countries causes the agricultural productivity variable to become insignificant. Agricultural land becomes significant although only at the 10% level, and the coefficient is still negative. Model 4 offers a more refined approach by excluding the countries of Nigeria and South Africa from the analysis. The coefficients pertaining to agricultural land and productivity are similar to Model 2, thus highlighting their unwavering influence on the food export ratio. The outcomes pertaining to the control variables did not seem to behave differently even after excluding these two major economies.

Comparing the outcomes of the models, it becomes evident that agricultural productivity displays a positive correlation with the food export ratio. The present study demonstrates an inverse relationship between agricultural land and the food export ratio, indicating the necessity for implementing sustainable land management strategies and optimizing resource utilization in order to mitigate potential adverse effects on food exports. The findings derived from Model 3 and Model 4 serve to fortify the resilience of the key findings, even in cases where highly productive nations are excluded. This signifies the potential applicability of the findings to various countries within Sub-Saharan Africa, irrespective of their scale and economic standing.

Chapter 6

Robustness Checks

Disaggregated Analysis Based on Income Groups

The study also conducts a disaggregated analysis that specifically focuses on low-and middle-income countries in Sub-Saharan Africa (SSA) to further enhance the robustness of the findings. Low-income countries, often referred to as LICs, are countries that have a scarcity of economic resources and a low per capita gross national income (GNI) of $1,135 or less (World Bank, 2022). These countries often encounter obstacles related to economic progress, infrastructure, healthcare, education, and overall quality of life.

Middle-income countries, also known as MICs, refer to countries that lie within the middle range of income levels, positioned between low-income and high-income countries based on their per capita gross national income (GNI). These countries demonstrate a moderate level of economic progress and can be classified into lower-middle-income and upper-middle-income countries, determined by their per capita Gross National Income which is between $1,136 and $4,465, and between $4,466 and $13,845, respectively (World Bank, 2022). These countries typically have better infrastructure, improved living standards, and increased access to social services when compared to low-income countries, although they may still encounter specific developmental obstacles. The analysis of these sub-groups allows us to determine if the results vary or remain the same between the two income groups.

Table 3: Fixed Effects Model for Middle-Income and Low-Income Countries in SSA

	MIC		LIC	
Variables	**(1)**	**(2)**	**(1)**	**(2)**
Agricultural Land	0.074	0.458*	-0.658***	-0.124
	(0.220)	(0.271)	(0.131)	(0.272)
Agricultural Productivity	0.310**	0.709***	0.385***	0.320*
	(0.148)	(0.209)	(0.122)	(0.170)
Credit to Private Sector		0.372***		0.492**
		(0.083)		(0.230)
Exchange Rate		-5.519***		-7.897***
		(1.858)		(2.511)
Inflation Rate		0.311***		0.053
		(0.072)		(0.052)
Trade Openness		-0.017		-0.162**
		(0.042)		(0.070)
GDP Growth		-0.278		-0.289*
		(0.169)		(0.169)
Labour Force		-0.292		0.111
		(0.389)		(0.318)
Employment		-0.679***		0.255
		(0.248)		(0.181)
Constant	22.199**	39.840	65.680***	60.850*
	(10.847)	(28.104)	(8.619)	(36.196)
R-squared	0.010	0.294	0.098	0.253
Number of Countries	20	20	22	22
Number of Observations	457	373	488	364

Note: The dependent variable is food exports as a share of total merchandise exports. *** indicates 1% significance; ** indicates 5% significance; and * indicates 10% significance. Standard errors are reported in parentheses. Agricultural land and productivity are lagged by one year.

According to the findings presented in Table 3, there is a positive and significant relationship between agricultural land and the food export ratio in middle-income countries. However, in low-income countries, this relationship is statistically insignificant. This indicates that in middle-income countries, having more agricultural land resulted in a higher food export ratio, whereas in low-income countries, having more agricultural land corresponded to no change in the food export ratio. This suggests that middle-income countries potentially have enough financial resources to exploit additional land and adopt mechanized farming methods, leading to a beneficial connection between agricultural land and the food export ratio. On the other hand, low-income nations often depend heavily on subsistence farming,

which can result in a detrimental link between agricultural land and the food export ratio. In relation to agricultural sector productivity, there is a positive and significant relationship between agricultural productivity and the food export ratio in both middle-income and low-income countries. However, this relationship is more pronounced in middle-income countries compared to low-income countries. This emphasizes the significance of enhancing agricultural productivity for both income categories in order to increase the exportation of food.

There is a strong connection between credit to the private sector and the food export ratio in both middle-income and low-income countries, with a positive and notable correlation. This finding aligns with the outcome presented in the comprehensive analysis within Table 2. This implies that providing more credit opportunities to private businesses encourages the growth of the food export ratio in both middle-and low-income groups. The connection between the exchange rate and the food export ratio remains consistent across both middle-income and low-income countries. The findings align with the main outcome, as a lower value of the local currency is linked to a rise in exports of food products. The connection between the inflation rate and the food export ratio is strong and positive in middle-income countries, but it is not statistically significant in low-income countries. This suggests that middle-income countries are more affected by inflation rates in terms of their food export ratio. Middle-income nations with more developed economies may experience high levels of inflation, resulting in a greater influence of inflation rates on the food export ratio in comparison to low-income countries. In low-income countries, the extent of trade has a negative impact on the food export ratio, while in middle-income countries, the extent of trade does not considerably influence the food export ratio. Both middle-income and low-income nations demonstrate an inverse relationship between gross domestic product (GDP) growth and the food export ratio, implying that higher economic growth results in a decreased food export ratio. Nevertheless, this correlation is significant in low-income countries. The relationship between the labour force and the food export ratio is statistically insignificant in both middle-income

and low-income countries. However, it is negative in middle-income countries but positive in low-income countries. This corroborates the result of the employment concentration in which middle-income countries exhibit a significant negative relationship between employment and the food export ratio, while low-income countries show a positive and statistically insignificant relationship.

One potential reason to contemplate for these differences is the stage of development and economic structure in these countries. Middle-income countries, which have a strong industrial and diversified economy, could have less reliance on agriculture for their exports. This situation may cause an inverse relationship between labour force and food exports. In contrast, in low-income countries where agriculture may be a major sector, the relationship between the labour force and the food export ratio appears to be positive.

First Difference Estimation Model

The connections between agricultural land, agricultural sector productivity, and food exports are further explored in this study through the utilization of the first difference estimation technique. The study utilizes the method of first difference estimation by calculating the year-to-year difference of the variables to ensure that the findings are very robust to alternative specifications. The major reason for utilizing this approach is because trends can have an impact on the dependent variable in time-series panel data. By calculating the initial change, we have the ability to eliminate time-dependent patterns, enabling us to concentrate on variations in variables throughout time rather than their absolute values. Furthermore, utilizing first differencing allows for the mitigation of time-varying unobserved factors that may potentially impact the dependent variable. Through the process of differencing the data, we are able to effectively observe and account for any alterations in the variables, while simultaneously reducing the impact of any undisclosed factors that may vary over time.

It is important to note that in panel regression analysis, the utilization of the first differences (FD) methodology is deemed efficient, contingent upon the assumption that the error term adheres to a random walk pattern. Nevertheless, it is imperative to substantiate this assumption in order to guarantee the suitability of employing the First Difference (FD) method. In order to evaluate the existence of a random walk component in the error term, it is customary among researchers to carry out a regression analysis that regresses the error term on its previous value.

This study aims to examine the association between the error term and its lag by employing a regression model. Specifically, the regression model estimates the relationship between the error term of the first differences regression at time 't' and the error term at time 't-1'. If the coefficient associated with the lagged error term is significantly different from zero, it implies the existence of serial correlation, thus indicating that the first difference (FD) method may not be an optimal approach.

The following representation depicts the model of the first difference estimation technique;

$$\Delta\text{Food Export Ratio}_{it} = \beta_0 + \beta_1\Delta\text{Agricultural Land}_{it} + \beta_2\Delta\text{Agricultural Productivity}_{it} + \beta_3\Delta\text{Credit Private Sector}_{it} + \beta_4\Delta\text{Exchange Rate}_{it} + \beta_5\Delta\text{Inflation Rate}_{it} + \beta_6\Delta\text{Trade Openness}_{it} + \beta_7\Delta\text{GDP Growth}_{it} + \beta_8\Delta\text{Labour Force}_{it} + \beta_9\Delta\text{Employment Concentration}_{it} + \varepsilon_{it}$$

Where:

Δ indicates that the variable is in first differences for country i in year t.

$\beta_0, \beta_1, \beta_2, ..., \beta_9$ are the coefficients to be estimated.

ε_{it} represents the error term.

The model takes into consideration multiple factors, such as changes in agricultural land, the influence of productivity in the agricultural sector, and other controlling variables, to evaluate fluctuations in food

exports, giving special attention to the unique effects in each country. The results are presented in Table 4.

Table 4: First Difference Estimation Results

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Agricultural Land	-0.027	0.292	0.026	0.523	0.209	0.307
	(0.163)	(0.306)	(0.279)	(0.569)	(0.284)	(0.328)
Agricultural Productivity	0.162	0.206	0.211	0.206	0.058	0.216
	(0.126)	(0.150)	(0.205)	(0.218)	(0.145)	(0.160)
Credit to Private Sector		-0.007	-0.007	-0.004	0.011	0.007
		(0.116)	(0.083)	(0.387)	(0.106)	(0.162)
Exchange Rate		1.953	1.643	1.281	1.348	2.416
		(3.231)	(2.605)	(7.430)	(3.068)	(3.867)
Inflation Rate		0.009	0.059	0.002	-0.008	0.008
		(0.030)	(0.048)	(0.043)	(0.029)	(0.032)
Trade Openness		-0.046	-0.054	-0.051	-0.024	-0.047
		(0.048)	(0.042)	(0.096)	(0.044)	(0.051)
GDP Growth		-0.209***	-0.090	-0.254*	-0.100	-0.214**
		(0.083)	(0.085)	(0.141)	(0.081)	(0.088)
Labour Force		-0.588	-0.171	-1.133	-0.446	-0.661
		(0.568)	(0.546)	(0.997)	(0.519)	(0.645)
Employment		0.250	-0.377	0.819	0.177	0.283
		(0.353)	(0.336)	(0.631)	(0.325)	(0.378)
Constant	-0.166	-0.225	-0.363	0.003	-0.272	-0.250
	(0.347)	(0.479)	(0.430)	(0.917)	(0.444)	(0.522)
R-squared	0.002	0.021	0.021	0.031	0.007	0.022
Number of Countries	42	42	20	22	36	40
Number of Observations	873	679	344	335	630	630

Note: The dependent variable is food exports as a share of total merchandise exports. *** indicates 1% significance; ** indicates 5% significance; and * indicates 10% significance. Standard errors are reported in parentheses. Agricultural land and productivity are lagged by one year. All variables are in their first difference.

The regression results for various models using the first differences method are shown in Table 4. Model 1 explores the relationship between food exports ratio and the key variables of agricultural land and agricultural sector productivity. In Model 2, we enhance the analysis by incorporating the control variables. Models 3 and 4 are the results for middle-income countries and low-income countries, respectively. Model 5 excludes the six countries with the highest agricultural sector productivity, while

Model 6 excludes Nigeria and South Africa, which have the largest economy and agricultural land in SSA.

In the first model, the results show that there is no significant relationship between agricultural land and the food export ratio, and the relationship is negative. In the same vein, there is a positive relationship between agricultural sector productivity and the food export ratio; however, it lacks statistical significance. The results suggest that changes in the food export ratio are not strongly correlated with alterations in agricultural land and productivity of the agricultural sector. The addition of control variables in Model 2 reveals that only GDP growth shows a significant relationship with the food export ratio; this is the same for Models 4 and 6. There are no remarkable connections observed between the food export ratio and variables such as private sector credit, the exchange rate, the inflation rate, trade openness, the labour force, and employment concentration.

Diagnostic Assessment Test on the Efficacy of the First Difference Model

Table 5: Diagnostic Test

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Lag of the	-0.298***	-0.270***	-0.272***	-0.262***	-0.339***	-0.270***
Error Term	(0.031)	(0.037)	(0.037)	(0.037)	(0.039)	(0.039)
Constant	-0.003	-0.041	-0.102	-0.066	0.136	-0.046
	(0.323)	(0.377)	(0.377)	(0.380)	(0.361)	(0.406)
Number of Observations	812	626	626	626	581	580

Note: The dependent variable is the error term from the regressions in Table 4. *** indicates 1% significance; ** indicates 5% significance; and * indicates 10% significance. Standard errors are reported in parentheses.

To ascertain the suitability of the first differences approach as an alternative estimation technique for the analysis, we perform a diagnostic test in Table 5. In particular, we analyze the relationship between the error term in all of the first difference models and the lag of that error term. If the statistical significance of the coefficient on the lagged error term is established, it indicates that using the first difference approach might not be an effective technique for the estimation. Furthermore, the absence of a random

walk pattern in the lagged error term in all the models provides further evidence that utilizing the first differences approach is not effective for the study. Therefore, we choose to base the research findings on the fixed effects model.

In as much as the first difference model is not suitable as an alternative estimation method for testing the strength of the results, the results of the fixed effects model in Table 2 demonstrate that the findings remain robust even after excluding six countries with the highest agricultural sector productivity and the two emerging countries in SSA with the largest agricultural land, Nigeria and South Africa.

Implications of the Findings

The lack of a statistically significant positive relationship between agricultural land and the food export ratio emphasizes the necessity for a comprehensive and rigorous assessment of prevailing land use policies like the fragmented land holding which is a common practice in Africa that limits investment in large scale commercial agriculture (Ndip et al. 2023). This discovery provides clarification that a mere increase in agricultural land may not necessarily ensure a proportional increase in the ability to export food. As a result, it is necessary to perform a thorough and meticulous assessment of land use policies, shifting away from a basic concentration on expanding agricultural land and towards an approach that prioritizes judicious land allocation, sustainable practices, and efficient resource management. Conversely, the significant positive connection identified between agricultural sector productivity and the food export ratio underscores the vital importance of increasing productivity to boost the potential for exporting food products.

Moreover, these findings align with wider international sustainability targets. The necessity for the implementation of land use policies that are optimized is in tandem with the Sustainable Development Goals (SDGs) of the United Nations, particularly Goal 15, known as "Life on Land", which underscores the importance of safeguarding, revitalizing, and promoting sustainable use of land. Similarly, the focus

on improving agricultural sector productivity is in line with the objectives of Goal 2 (Zero Hunger), which aims to achieve food security, improve nutrition, and promote sustainable agriculture.

Chapter 7

Conclusion

This study explores the complex connection between agricultural land endowments, agricultural sector productivity, and food exports in Sub-Saharan Africa (SSA). For a considerable time, SSA has been recognized as a region with extensive possibilities for agriculture. In theory, with its abundant fertile land and beneficial climate, the continent should have the potential to become a significant contributor to global food exports. Nevertheless, even with these natural resources, SSA has been importing more food than they export, which highlights the necessity for investigating this phenomenon.

Based on the utilization of the fixed effects model, the results of the analysis demonstrate that there exists a statistically insignificant and negative relationship between agricultural land and food exports in SSA. Nevertheless, when examining income groups, it becomes apparent that the trend masks a notable disparity; in middle-income countries, the relationship is positive and significant.

On the other hand, we observed a positive and significant relationship between agricultural sector productivity and food exports, and this does not vary between the two income groups. This emphasizes the significance of enhancing agricultural productivity as a global approach to strengthen the ability to export food. The findings remain robust, even after excluding six countries with the highest agricultural sector productivity and the two emerging economies in SSA with the largest amount of agricultural land, Nigeria and South Africa. This validates the widespread relevance of the findings in various countries within the region.

Through the implementation of targeted policies and employing strategic interventions, SSA has the potential to navigate a transformative trajectory towards achieving food security, fostering economic prosperity, and attaining international recognition in the global agricultural trade arena. The study

reveals a significant positive relationship between agricultural sector productivity and food exports in the Sub-Saharan Africa region. Hence, it is imperative for policymakers to accord greater importance to allocating more resources towards agricultural research, extension services, and the adoption of modern technology as a means to enhance productivity levels within the region. By embracing progressive agricultural methods and enhancing accessibility to state-of-the-art techniques, Sub-Saharan Africa can augment its agricultural production and enhance its competitive advantage in global markets.

The significance of creating awareness assumes a critical role in the light of the abundant agricultural land within the region which turns out to be negative and insignificant. Increasing public awareness both locally and internationally can be instrumental in fostering more responsible and discerning land use decisions.

Efforts aimed at enhancing market access and trade facilitation can play a pivotal role in bolstering the food export capabilities of Sub-Saharan Africa. Policymakers ought to promote equitable trade practices, diminish trade obstacles, and engage in advantageous negotiations regarding market access agreements with international counterparts. The emergence of new export opportunities will be facilitated by the expansion of SSA in emerging markets.

In conclusion, the study highlights the imperative of implementing all-encompassing policy interventions aimed at augmenting agricultural productivity and ensuring effective land utilization. By implementing the aforementioned policy recommendations, Sub-Saharan Africa can unlock its vast agricultural potential, enhance its standing in global food exporting, and attain sustainable food security and economic development.

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Appendix

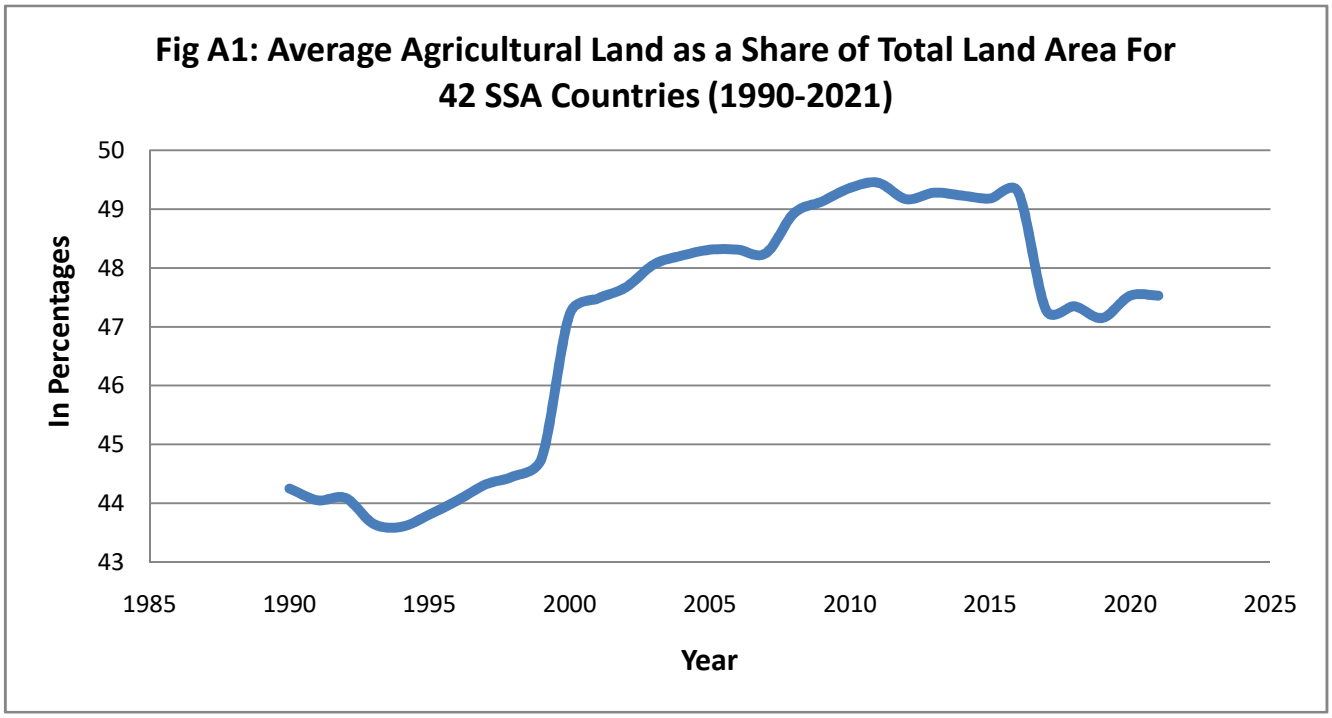


Fig A1: Average Agricultural Land as a Share of Total Land Area For 42 SSA Countries (1990-2021)
In Percentages
50
49
48
47
46
45
44
43
1985
1990
1995
2000
2005
2010
2015
2020
2025
Year

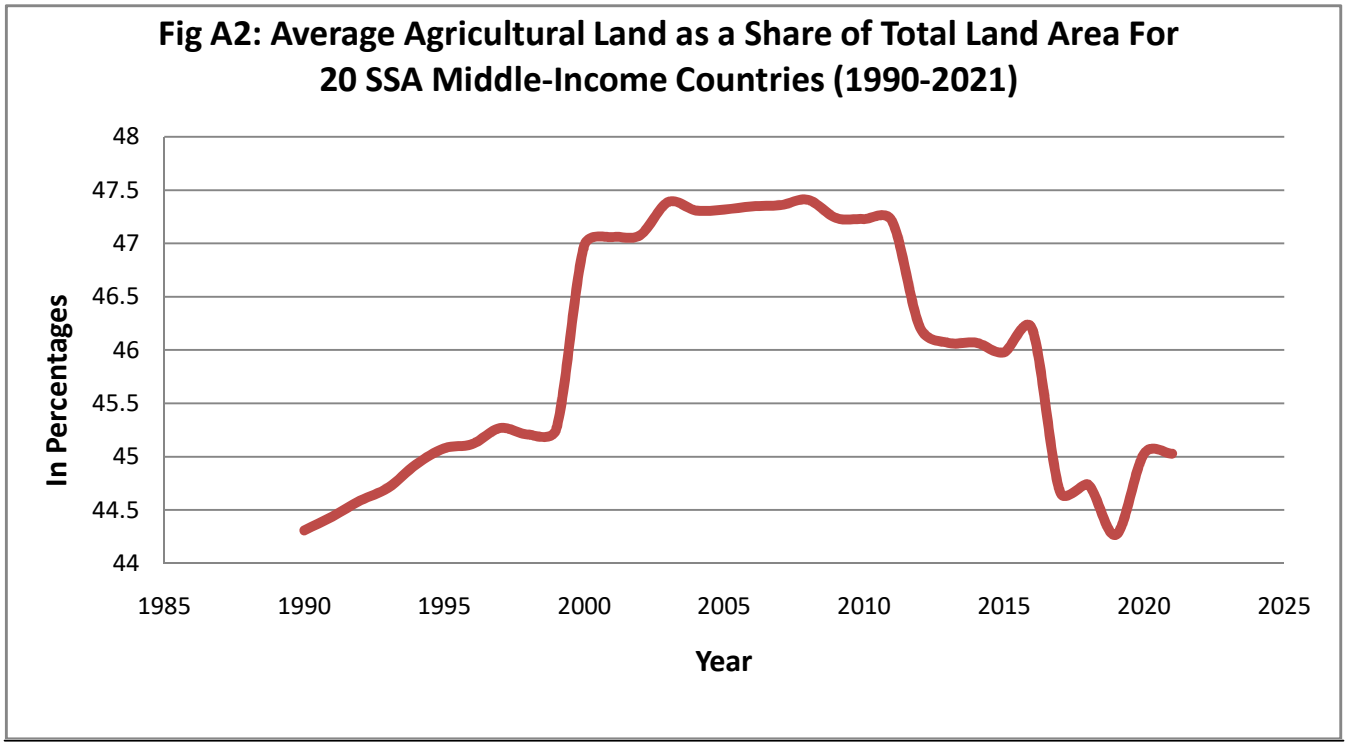
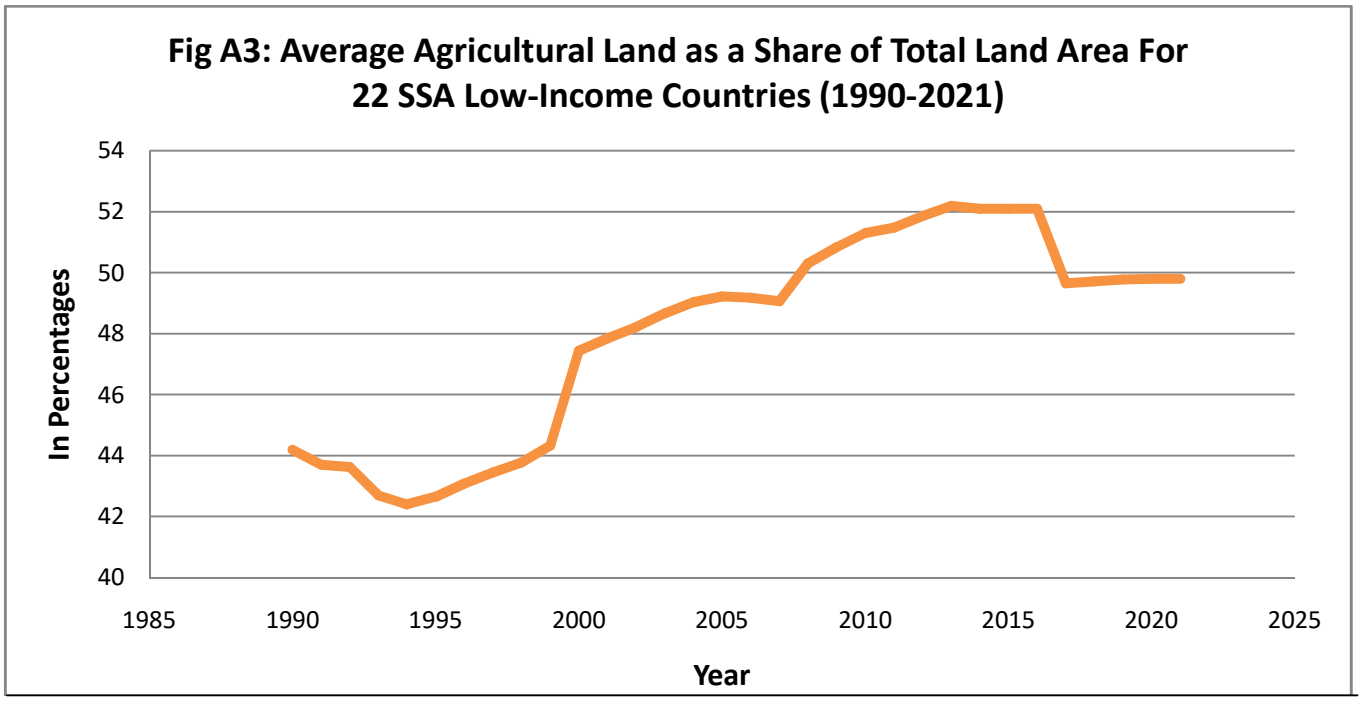


Fig A2: Average Agricultural Land as a Share of Total Land Area For 20 SSA Middle-Income Countries (1990-2021)
In Percentages
48
47.5
47
46.5
46
45.5
45
44.5
44
1985
1990
1995
2000
2005
2010
2015
2020
2025
Year



List of Tables

Table A1: Correlation Analysis

	fexp	agrland	agp	cps	exgr	infr	tro	gdpgr	lfc	emp
fexp	1.0000									
agrland	0.1965	1.0000								
agp	0.3783	0.1497	1.0000							
cps	-0.1327	0.1698	-0.5064	1.0000						
exgr	0.0851	0.1134	0.2755	-0.2248	1.0000					
infr	0.0067	0.0352	0.0135	-0.0817	-0.0141	1.0000				
tro	-0.2693	-0.1421	-0.5578	0.2002	-0.1681	-0.0555	1.0000			
gdpgr	-0.0110	0.0022	0.1135	-0.0967	0.0014	-0.1195	-0.0571	1.0000		
lfc	0.0852	-0.0393	0.3453	-0.2218	0.1947	0.0373	-0.2836	0.0240	1.0000	
emp	0.1987	0.0269	0.7181	-0.5835	0.3408	0.0757	-0.5821	0.1071	0.6159	1.0000

Table A2: Descriptive Statistics

Variables	Observations	Mean	Std. Dev.	Min	Max
Food Exports	971	36.31828	29.34359	0.015658	99.94004
Agricultural Land	1,344	47.01329	19.71699	3.26087	85.639
Agricultural Sector Productivity	1,293	23.10311	14.32373	1.721781	79.04236
Credit to Private Sector	1,195	19.67147	22.60596	0.402581	160.1248
Exchange Rate	1,325	5072229	1.85e+08	2.99e-08	6.72e+09
Inflation Rate	1,195	19.49297	152.9397	-11.6861	4145.106
Trade Openness	1,232	68.75758	36.36271	0.756876	311.3541
GDP Growth	1,321	3.66405	5.165314	-50.24807	35.22408
Labour Force	1,312	65.42321	11.46758	40.557	90.122
Employment Concentration	1,271	52.59095	20.83509	5.1	92.6

Table A3: Description of Variables

Variables	Symbols	Measurement	Source
Food Export	FEXP	% of total merchandise export	World Development indicators 2021
Agricultural Land	AGRLAND	% of total land area	World Development indicators 2021
Agricultural Sector Productivity	AGP	% of GDP	World Development indicators 2021
Credit to the Private Sector	CPS	% of GDP	World Development indicators 2021
Exchange Rate	EXGR	In relation to the US dollars	World Development indicators 2021
Inflation Rate	INFR	Annual percentage rate	World Development indicators 2021
Trade Openness	TRO	Export plus import as a % of GDP	World Development indicators 2021
Gross Domestic Product Growth	GDPGR	At growth rate	World Development indicators 2021
Labour Force	LFC	% of population ages 15+	World Development indicators 2021
Employment Concentration	EMP	Share of employment in agriculture to total employment	Food and Agriculture Organization (FAO) report 2021

Table A4: List of Sub-Saharan African Countries Included in the Sample

S/N	Country
	Middle-Income Countries (MIC)
1	Angola
2	Botswana
3	Cabo Verde
4	Cameroon
5	Congo Rep
6	Cote d' Ivoire
7	Eswatini
8	Gabon
9	Ghana
10	Kenya
11	Lesotho
12	Mauritania
13	Mauritius
14	Namibia
15	Nigeria
16	Sao Tome and Principe
17	Seychelles
18	South Africa
19	Sudan
20	Zambia
	Low-Income Countries (LIC)
21	Benin
22	Burkina Faso
23	Burundi
24	Central African Republic
25	Comoros
26	Ethiopia
27	Gambia
28	Guinea
29	Guinea-Bissau
30	Liberia
31	Madagascar
32	Malawi
33	Mali
34	Mozambique
35	Niger
36	Rwanda
37	Senegal
38	Sierra-Leone
39	Tanzania
40	Togo
41	Uganda
42	Zimbabwe