INTRA-AFRICA AGRICULTURAL TRADE AND HUNGER REDUCTION: AFRICA ECONOMIC ANALYSIS

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Abstract
Using a time series but cross-sectional data from 1995 to 2018, this paper examines the impact of intra-Africa agricultural trade (export and import) and, hunger reduction mirrored by the Global Hunger Index [GHI], on economic growth per capita in the continent. The Balanced Panel data estimation technique is used as aided tool of analysis. However, the descriptive statistics and the Panel unit root test preceded the estimation of the three-stage Panel of Pooled Ordinary Least Square [POLS], Fixed Effect [FE] and Random Effect [RE] while decision taken is based on the Hausman test result. Findings show that the second-stage testing of FE was found to be most appropriate in explaining economic growth per capita. Specifically, the FE result shows that a negative coefficient is exhibited between intra-Africa agricultural trade - export (IAAE) and that of hunger index [HI] but not intra-Africa agricultural trade – import (IAAI). By implication, IAAE does not account for earlier allusion that the intra-African agriculture trade relationship is substantial at improving hunger and growth per head. Stiffer sanction against trade policy defaulters is the suggested recommendation.

Keywords: Intra-Trade, Agriculture, Import/Export, Hunger, Panel Analysis.

JEL Classifications: A12, D60, F16, Q17

Introduction

Trade can be described as the exchange of goods and services for mutual benefits. Trade can be within one's local boundary and when this happens, it is referred to as local trade. Once trade goes beyond local boundaries cutting across foreign neighbours, it is referred to as international trade. As trade crosses outside one's local boundary but is within reasonable geographical distance, industry, sector, region or race, it would be referred to as intra-trade (Bouet, Cosnard, & Sadibou Fall, 2020; Odjo, Traore, & Zaki, 2019). According to African Development Bank [AfDB] (2017, 2018) and Tatenda (2019), Africa houses 65 percent of the world's arable land devoid of natural disaster and provides 87 percent of the world's composite natural and mineral resources. Yet, the Global Hunger Index [GHI] (2020), Food Agriculture Organization [FAO] (2020) and that of Regional Strategic Analysts and Knowledge Support System [ReSAKSS] (2020) put the hunger index of the continent at 128 percent in 2019. This figure is far above the threshold of 50 index rate of extreme hunger. The implication is that the continent has more hungry people in the world after Asia (leveraging only on population difference). The comprehensive African Agricultural Development [CAADP] and that of Africa Free Trade Zone Agreement [AFTZ] particularly represent a milestone in the continent's aspiration at reducing hunger and ultimately, growing the economy. In Africa, the treaty that intra-African agricultural trade represents a potential tool capable of catalyzing the continent into an enviable position remains a pendulum in public discourse. This goal is yet to be fully realized especially when compared with the enormity of expectations anchored on the multifaceted and inexcusable presence of the continent's agro-industry potentials. Juxtaposing this reality with the continent being classified among the worlds hungriest also calls for reflection (Tatenda, 2019).

To x-ray the potentials that are submerged in the intra-African agricultural trade memorandum of understanding and treaties entered into by member States remains cardinal in Africa economic growth process. Thus, empirical evidences of the successes or otherwise of the Union goals in this direction was the main objective to which this study was committed. As such, the study first attempted at ascertaining the presence of significant relationship between intra-Africa agriculture export/import trade and per capita income on the continent. Also, it examined the extent of the level of hunger reduction against the continent's economic growth per head. It was expected that the study would contribute to the on-going continental policy drive aimed at improving regional cooperation and integration especially, as in relation to agriculture and hunger reduction (Okunlola, Babajide & Adetiloye, 2020).

In its attempt at achieving the objectives, the study is arranged in this order. The literature review follows the introduction above and then the methodology. The results, conclusion and recommendations follow accordingly.

Literature review

The benefit of intra-trade cannot be over-emphasized. This is particularly so when such trade relation is sectorial/industry based. Specifically, intra-industry or sectorial trade as Bouet et al. (2020), Odjo et al. (2019) AfDB, (2019) put it, has the advantages of increasing specialization through comparative production, improved income earnings, and can also facilitate quick border exchange in terms of labour mobility, technological sharing, hunger reduction, brotherhood and intra-regional development. Intra-trade also brings with it trade relations that can lead to improved transportation system and ultimately bring about economic prosperity (Okunlola, Osuma, & Omankhanlen, 2019a, b).

Africa has had a long history of brotherhood that cuts across, social, cultural and economic relations. In spite of her over a thousand languages, the continent still prides herself in the Pan-African mentality. Long has the continent desired a much more robust integration especially in her agricultural commodity exchanges. This desire became visibly clear in her 2003 Maputo, Mozambique declaration that birthed the Comprehensive Africa Agricultural Development Programme [CAADP]. The declaration makes it imperative for all signatory States to finance agriculture and allied supportive segments to the tune of 10 percent year-on-year budget to grow the continent's economic aspiration. Similarly, cardinal to the agreement was also the goal to reduce her food dependency rate and ultimately, reduce hunger (Food and Agricultural Organization [FAO], 2020).

Accounting for this policy implication twenty-one [21] years after comes with mixed reports. Indeed, several authors have compiled their summations and observations on not too impressive note. For instance, while Odjo et al. (2019) and Bouet et al. (2020), observed that the share of African trade exports in the global trade had increased, the implication from the reverse end suggests that the continent placed priority in sharing her trade potentials outside Africa. Similarly, Rampa, (2012), Torres and van Seters, (2016), Schmieg, (2016), Lekgau, Matlou, & Lubinga, (2017), Okunlola et al. (2020) observed that intra-African agricultural trade also trended upwards, but not significant enough to meet the 2025 food sufficiency timeline. This situation was further worsened with the advent of the COVID-19 pandemic. On the import side, the twin organs of the African agriculture trade monitor - Regional Strategic Analysis and Knowledge Support System [ReSAKSS] (2020) and, The African Growth and Development Policy Modelling Consortium [AGRODEP] (2019) affirmed that the taste for import drive in the continent had more than doubled owing to the continent's food need. Specifically, Africa agricultural import deficit increased and the shortfall augmented to the tune of 120 percent from external imports. This dependency breeds possible hunger owing to contraption on the available food as evident in the GHI (2020) report.

Africa agricultural commodity trade

Essentially, Africa agricultural trade cuts across all forms of agricultural commodities or produces which are commonly found across regions or specific to particular regions based on the peculiar conditions to which the commodities can be produced. Table 1 represents agricultural commodities for each of the regions.

Table 1: Africa Agricultural Produce by Regions

Western Africa Countries [WAC]	Eastern Africa Countries [EAC]	Central African Countries [CAC]	Northern Africa	Southern Africa
Cassava	Beef	Cassava	Cereal	Castrol Oil
Camel	Cassava	Common Beans	Citrus Fruits	Cereal
Cattle	Cashew nut	Cooking Banana	Cork	Chicory Roots
Cashew	Dairy	Cucumber	Cotton	Fibre crops
Cocoa	Legumes	Eggplant	Figs	Grape fruits
Cotton	Maize	Peanuts	Dates	Green maize
Coffee	Millet	Pepper	Maize	Pears
Donkey	Fruits & vegetables	Sweet Potato	Olive	Sisal
Goats	Pyrethrum		Rice	
Groundnuts	Sorghum			
Livestock	Sisal			
Horses	Tea			
Palm oil	Wheat			
Peanut				
Pig				
Poultry				
Rice				
Sorghum				
Sheep				

Source: ReSAKSS, (2020). AfDB, (2019), FAO, (2020)

Each region is naturally endowed in its agricultural commodities. As shown in Table 1, some agricultural produces/commodities are common in some regions while, some are mainly specific to particular regions based on earlier mentioned observations. For instance, cassava is common among WAC, EAC and CAC, while dates and sisal are specific to NAC and SAC. Above all, these commodities are still catered for in their respective countries (AfDB, 2019, FAO, 2020).

Intra- agricultural trade import/export trend

Intra-agriculture trade import comprises the composite of agricultural trade across regions. It typically explains the movement in intra-agricultural trade trends.

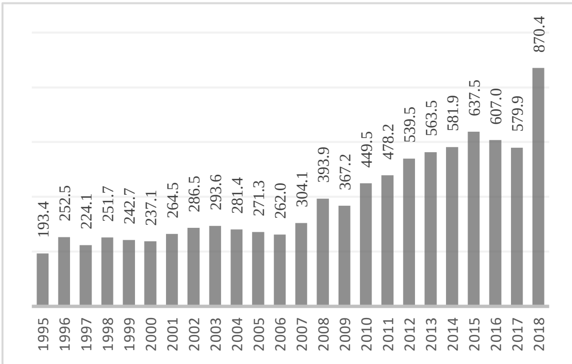

Figure 1 Intra-Africa Agric Import [AfW]
Source: ReSAKSS, (2020)

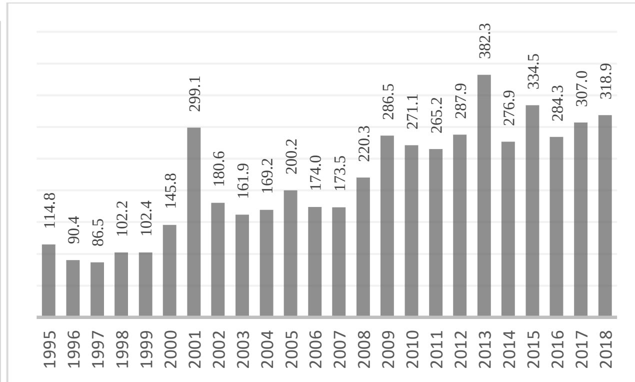

Figure 2 Intra-Africa Agric Import [WAC]
Source: ReSAKSS, (2020)

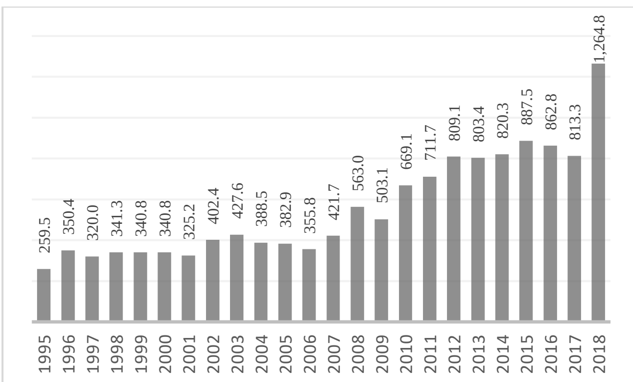

Figure 3 Intra-Africa Agric Import [SAC]
Source: ReSAKSS, (2020)

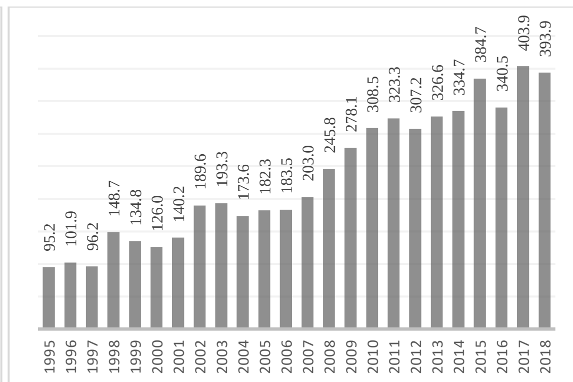

Figure 4 Intra-Africa Agric Import [NAC]
Source: ReSAKSS, (2020)

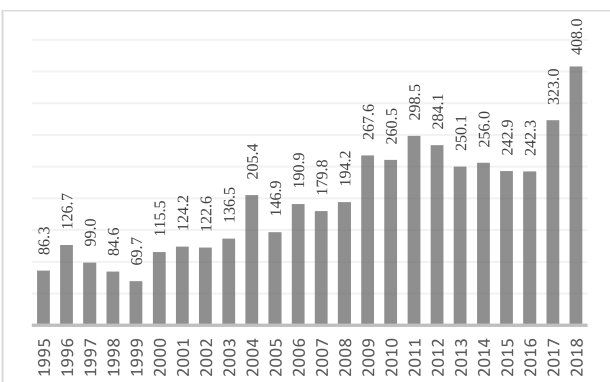

Figure 5 Intra-Africa Agric Import [EAC]
Source: ReSAKSS, (2020)

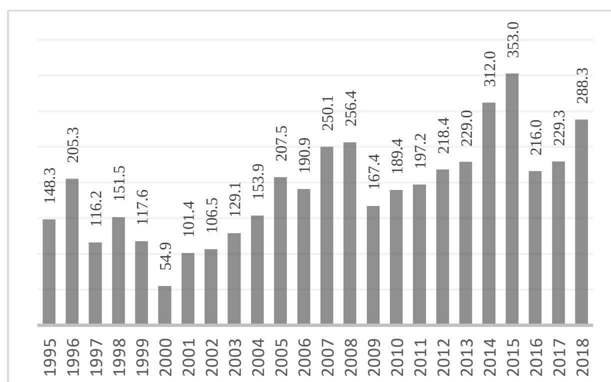

Figure 6 Intra-Africa Agric Import [CAC]
Source: ReSAKSS, (2020)

Figures 1 to 6 represent each region intra-agricultural trade in value terms. Intra-Africa agricultural import trade Africa-wide depicted a relatively but steady rise. Though minor fluctuations were visible, trend showed that there had been considerable rise over the period in review. Specifically, from a point of $193.4 billion in 1995, the trade strengthened to the tune of $870.4 in 2018. However, regional comparative analysis showed that SAC $259.5 had the highest import in 1995. This was closely followed by CAC at $148.3, WAC at $114.8, while NAC and EAC had the least intra-Africa agricultural import at $95.2 and $86.3 respectively for the same period. The intra-Africa agricultural import trend slightly rose within the spate of twenty-four years across the regions with slight modification to the trend nomenclature. This time, SAC maintained its dominance at $1, 2264.8 million. The EAC came second at $408.0 million, NAC at $393.9. This was also followed by WAC at $318.9 and CAC at $288.3 (ReSAKSS, 2020).

Intra-Africa Agricultural Export

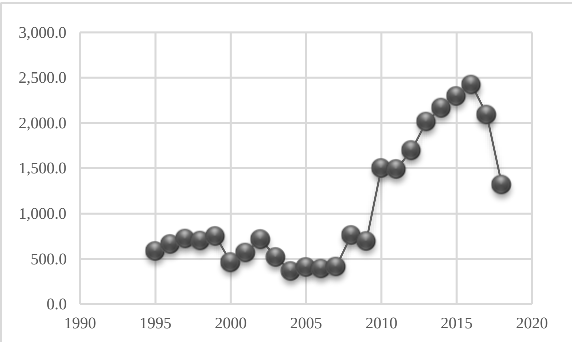

Figure 7 Intra-Africa Agric Export [AfW]
Source: ReSAKSS, (2020)

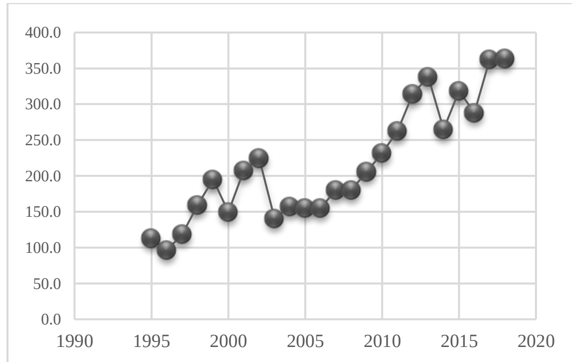

Figure 8 Intra-Africa Agric Export [WAC]
Source: ReSAKSS, (2020)

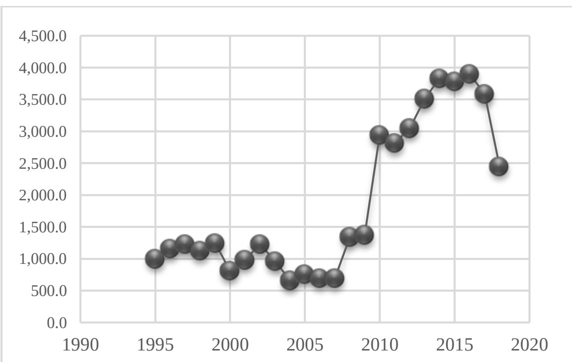

Figure 9 Intra-Africa Agric Export [SAC]
Source: ReSAKSS, (2020)

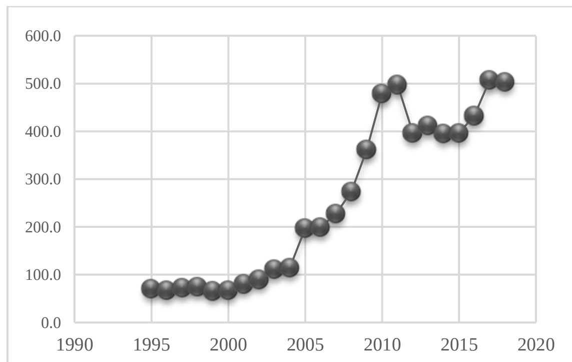

Figure 10 Intra-Africa Agric Export [NAC]
Source: ReSAKSS, (2020)

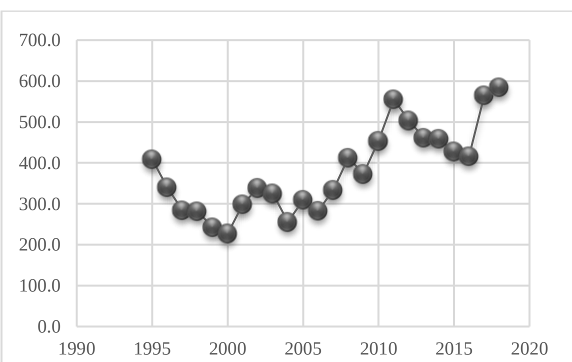

Figure 11 Intra-Africa Agric Export [SAC]
Source: ReSAKSS, (2020)

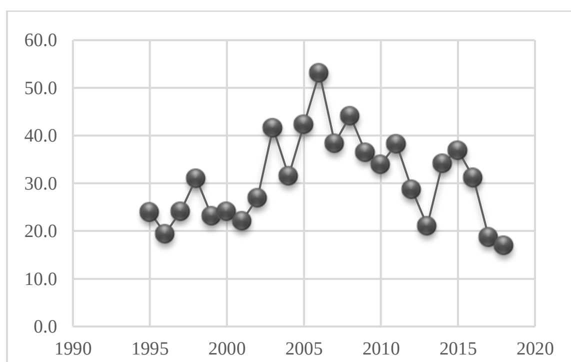

Figure 12 Intra-Africa Agric Export [NAC]
Source: ReSAKSS, (2020)

Also, presented in Figures 7 to Figure 12 is each region's intra-agricultural trade export. From the Figures, Africa-wide perspective, intra-Africa agricultural export showed that it was on the decline specifically from the period slightly away from 2015 to 2020. This clearly conforms with the observations of Bouet et al. (2020) and that of Odjo et al. (2019) on general trade relations in Africa. The Figure further substantiated the claim that Africa exported more of her agricultural produce outside Africa than within the continent. On regional basis, all the regions demonstrted an oscillatory trend in their export relations. This is particularly visible in CAC and EAC. That of SAC somewhat trended upward from 2015 until it nose-dived sharply in 2016 till date. Evidently, only WAC and NAC slightly showed minor flucntuation throughout the period in review.

Global – Africa hunger index

Food lacking basic nutrients or nutritional values can be referred to as basic nuttritional food insufficiency [Food and Agriculture Organization, [FAO], (2020) and GHI, (2020). The implication is that, one may have access to food, but the question would be, 'what kind of food?' In other words, food lacking in sufficient nutrients could cause certain undernourishment, poor manultrition or acute hunger. Whatever form of hunger, any nation lacking the basic food nutrient is classified as hungry. In other words, understanding the metrics behind measuring hunger plays a key role in determining the extent to which a country or region may be classified as hungry. Global hunger tool [Global Hunger Index - GHI], a metric that had its establishment in 2006 under International Food Policy Research Institute [IFPRI] supervision is, specifically designed to represent a multidimensional measure of national, regional and global hunger through a metric called an index. Accordingly, an index rate represents yearly degree to which any nation may be classified as hungry. As such, an index between 0.0 to 100 percent measurement is ascribed in the following manner. First, between 0.0 to 9.9 is classified lowly hungry countries. 10.00 – 19.99 is moderately hungry countries, between 20.00 – 34.99 is classified as seriously hungry, between 35.00 – 49.99 is alarmingly hungry and between 50.00 – 100 is extremely hungry. In Africa, ReSAKSS (2018, 2020) report of Global Hunger Index (2020) indicated that, cummulatively, Africa hunger index was 128 percent in 2018 with all the regions topping the list of seriously hungry regions at > 20 index except for moderately hungry NAC at 12.7 index.

Table 2 Five-Year Summary of Hunger Index in Africa

	NAC	SAC	CAC	EAC	WAC	AfW
2014	13.1	27.7	33.6	32.7	29.3	27.3
2015	13.0	27.0	32.9	31.7	28.6	26.7
2016	12.8	26.2	32.2	30.8	27.9	26.0
2017	12.6	25.4	31.5	29.8	27.2	25.3
2018	12.7	25.3	31.8	30.0	28.2	25.7

Source: ReSAKSS, (2020).

Presented in Table 2 is the five-year summary of the global hunger index for each of the regions in Africa as measured by GHI, (2020). The figure in 2018 , shows that CAC region is placed first in the list of the hungriest region in the continent, having shown that their hunger was serious at 31.8 percent. This was closely followed by the EAC bloc with a value of 30.0. WAC bloc was next in that order showing that their hunger was equally serious at 28.2 percent. However, NAC and SAC came next in reverse order where hunger in NAC was 12.7 hence, it was moderate, while that of SAC was serious as well, indicating a 25.3 percent.

Theoretical underpinning

Without doubt, one of the most reverberating concepts of countries advancement is embedded in its economic growth concepts and theories. In development economics, countries advancement has been accounted for based on the economic growth theories or models they have adopted or adapted. Out of the several available economic growth theories, countries adopt any with minor or major modification that best suits their economic concerns. Among varying economic growth theories are Keynes demand induced theory, Rostow's Growth stages, Lewis Turning Point [LTP], the endogenous model of Solow Growth theory, Harrod-Domar Growth Theory, cumulative causation theory, Heckscher-Ohlin Factor endowment theory among others (Tiebout, 1956, Poon, 1997, Xue, 2010, Lam, 2015, Gong, 2016, Okunlola et al. 2019a, Tejvan, 2019) Onoh, 2007; Keynes, 1933. Rostow, 1960).

Commonly discoursed trade theories are that of the Mercantilism trade theory - absolute advantage and that of Heckscher-Ohlin trade theory. However, the latter constitutes the backbone of this study. For mercantilism trade theory, countries are expected to use tariffs and quotas mechanisms to discourage imports alongside with mechanisms of export subsidies in order to encourage exports so as to maintain a favourable balance of trade. This theory is based on the assumption that the entire globe has a predetermined but restricted amount of wealth. By implication, it is regarded as either a 'zero-sum game', or a 'win-lose game' theory where any gain made by a country might translate to a resultant loss to the other nation involved in the trade (Tiebout, 1956; Poon, 1997; Xue, 2010; Lam, 2015; Verter, 2015).

On the other hand, absolute advantage trade theory is credited to Adam Smith in 1776. The theory is described as the process by which a nation can manufacture a product at a cheaper cost than the other. With this, such a country can seize opportunity in specializing in the product and exchange such with another weaker advantage in similar product but with a better absolute advantage in another product. He terms this to mean having an absolute advantage and postulates that specialization will increase output and, invariably, will increase income (Xue, 2010; Verter, 2015). Also, Heckscher-Ohlin theory postulation occurred around 1920s and 1980s but its application is evergreen (Lam, 2015). Four postulations are imbedded in its application. First, is the equalization in factor-price. There is also the Stolper-Samuelson version of it. There is also the Rybczynski theory and the Heckscher-Ohlin theory version (Lam, 2015; Verter, 2015). In its generalized form, some of Heckscher-Ohlin theory basic assumptions are also contained in the generalized document to which Africa Union intended to achieve its economic growth aspiration using the intra-Africa agricultural trade tool. Among these assumptions are:

a. Removal of trade restrictions among regions in order to reduce transportation cost. This is also contained in the Union growth aspirations that Regional Economies [RE] reduce transportation cost through tariff reduction and other excise duties (Odjo et al. 2019).
b. Presence of perfect competition, where there are free entry and exit. That is, designated markets are made free devoid of any form of hindrances. This is a typical assumption behind the setting-up of the Africa Free Trade Zone by the Union.
c. Presence of homogeneity of commodity, actions and constant return to scale. The homogeneity stems from the fact that, products involved are agricultural products/commodities.
d. Production function differential but with mutual exchange factor.

These assumptions are summed-up for the basis of this study. In other words, the intra-trade relationship of the study is anchored upon the basic assumptions of the Heckscher-Ohlin theory and as also contained in the Union aspirations

Empirical review

Studies on agriculture in Africa are unbounded in literature (Douillet, 2012; Addae-Korankye, 2014; Lekgau et al. 2017; Okunlola et al. 2019a; Dimaranan, & Larbode, 2020). However, related studies on the issues concerning intra-African agricultural trade are scantily available, to the least, on regional basis while Africa-wide often appears as a commissioned study. Where available, most have reached somewhat similar conclusion on the roles that intra-African agriculture trade can play in the development of African economy. For instance, the Economic Commission for Africa [ECA] (2012) policy report observed that the key to Africa transformation agenda is to bootstrap its intra-trade relations through identifying its challenges and opportunities. Accordingly, the Organization believes that with the tackling of impediment to the progress of trade relations, associated and other sectorial trade would ordinarily find rhythm in Africa growth path. As a consequence, the Organization proposes, firm intra-trade policy in order to achieve the vision and agenda 2025 among others.

Similarly, Iyoha, 1996 study followed the line of ECA, where it asserted that it was the unbundling of the marginalization effect to Africa trade mechanism that could bring about the desired development to the continent. His study criticized the low impact of intra-Africa trade on its economy as a result of certain global practices such as food subsidies by Western world and other allied conditions which the continent could have taken advantage of. The study rather suggested an export processing zone and structural transformation as a form of policy drive for maximizing intra-regional trade therein. In similar vein, the role that regional infrastructure can play in enhancing trade, improving or reducing hunger and poverty and, ultimately, growing the economy was the concern of Jouanjean, Gachassin and Willem te Velde, (2015) study. Their study laid claim on three critical Sub- Saharan Africa infrastructure dilemma. First, they asked whether the provision of regional infrastructure had impacted, ultimately, on economic growth of the region through enhanced trade relationships, trading cost, improvement in hunger and reduction in poverty. Secondly, a critical insight was also unveiled on the possibility of further worsening hunger and poverty rate through possible labour migration consequent upon improved infrastructure. And, lastly, they asked whether regional policy can actually provide the solution to reducing hunger and poverty. In their findings from the surveyed document, they suggested that it was very likely that hunger and poverty would reduce as a consequence of an improved regional infrastructure in both direct (export/import) and indirect (import/export) ways in spite of low evidence to back regional infrastructure claim up.

Also, Okunlola et al. (2019 b) examined the importance of agriculture from two separate studies. First, they estimated the possibilities of prioritizing agriculture produce based on specific commodity with the most contributory impact to an economy. The study followed step-wise regression analysis estimation and concluded that, agricultural finance must be prioritized based on commodity contribution to the overall growth in Nigeria. Similarly, the second paper, which employed the Autoregressive Distributed Lag [ARDL] technique further clarified the reason why agricultural investment is so essential in growing Africa economy, especially that of Nigeria. Its submission was also not different from the first study.

Lekgau et al. (2017) study analyzed trade relations trend in Africa agricultural business investment and its associated benefits for ten years (2005 - 2015). Specifically, two pertinent issues were source of concern to them. First, was the sufficiency in intra-Africa trade and the second, was the need for Africa agricultural trade relationship. The study adopted the use of Panel data analysis owing to the fact that data was collected on a twelve (12) cross-sectional (countries) basis. Their findings suggested that there was low intra-Africa agricultural trade within the continent compared with trading of Africa with the rest of the world. Okunlola et al. (2020) study also performed a more robust empirical insight by increasing the number of cross-sectional countries to all countries with their regional classification in order to ascertain each region's contribution to the overall economic growth in Africa. This time, Panel co integration estimation technique was used. Findings showed that, intra –Africa agricultural trade has no long run relationship among the variables examined. This submission was also confirmed in the case of Bouet et al. (2020) and Odjo et al. (2019) studies.

Further corroborations on the insignificant relationship subsisting with intra-African agricultural trade were also found in the submission of the United Nations AID [USAID], (2020) report. Accordingly, the body found that though trade relations appeared to be on the increase, this increase was however not significant to explain the Union 2025 target for the continent economic growth aspirations. It compared the agricultural trade trend with the Comprehensive Africa Agricultural Development Programme [CAADP] and affirmed variance in meeting the aspirations as spelt out in the document. Further supporting claims on the role of intra-agricultural trade but low performance and increase poverty and hunger level was also found in the studies of Edeme, Ifelunini & Nkalu, (2016), Sertoglu, Ugural and Bekun, (2017), Ehiakpor, Adzawala & Danso-Abbeam, (2016), Mose, (2019), Tatenda, (2019), Gero and Egbendewe, (2020).

The claims that intra-Africa agricultural trade relation is low are also evident in the inability of the continent to feed itself. The variance leaves a vacuum described in Tatenda, (2019), that Africa supplies a composite of 87 percent of world's natural and mineral resources including agriculture yet, poor. Specifically, AfDB, (2017, 2018) affirmed that Africa food import reached a 102 percent rise against 71 percent exports in the share of global trade as of 2019 report. Invariably, this leaves the continent to be among the list of the hungriest continent in the world with a 128 (extreme) index rate as Global Hunger Index [GHI], (2020) and according to ReSAKSS, (2020) description of it.

Materials and methods

Time series but cross-sectional data were sourced from Regional Strategic Analysts and Knowledge Support System [ReSAKSS] and the World Bank Indicator [WDI]. This was due to the nature of variables that were included in the study. Data sourced include: intra-Africa agriculture trade - export [IAAE], intra-Africa agriculture trade – import [IAAI], global hunger index [GHI] representing the independent variables. And gross domestic product per capita [GDPpc], representing the dependent variable. Data sets covered 1995 to 2018 representing twenty-three years period of the declaration of agricultural support in Maputo, Mozambique. Also, because of the number of States that make up the continent, the study made a regionalized classification into Northern Africa Countries [NAC], Southern Africa Countries [SAC], Eastern Africa Countries [EAC], Western African Countries [WAC] and Central African Countries [CAC]. Similarly, the study estimation method was staggered to accommodate descriptive analysis for normality test for the variables in the study. It also performed a Panel unit root test for unit root conformity while taking majority decision under the Levine, Lin and Chu, [LLC] (2000), Im, Pesaran and Shin [PS], (2003), Fischer-Type test and Bretung [BT], (2000) (Baltagi, 2013). It then proceeded to affirm the appropriateness of the three-stage Panel estimation of pooled ordinary least square regression [POLS], fixed effect [FE] and random effect [RE], while adopting the Hausman test criterion for decision making.

Model specification

In the ordinary course of specifying a Panel model, where for instance, a γ_{kl} and f_{kl} represents the cross-sectional series which are found in $_k$ = i…, N for $_l$ =1 …, *L*. γ_{kl} and f_{kl} with assumption that they are of order one I(1) for each member k and that ξ_{kl} also assume no cointegration in the residual. α_k and βkl represent the series parametres in the fixed effects [FE] specifics where the deterministic trend is, while, π_k is the slope of the model (Pesaran, Shin & Smith, 2001, and Los & Gardebroek, 2016). Thus, the panel is as specified herein;

$$\gamma_{kl} = \alpha_k + \beta_{kl} + \chi_k + f_{kl}\pi_k + \xi_{kl} \qquad 1$$

Descriptive statistic specified

For most economic data, it is precautionary that their normality characteristics are ascertained to identify whether they are either long/left tail or are normally distributed. The study used the Skewness, Kurtosis and Jarque-Bera statistics for this purpose. The Skewness is a measure of asymmetry distribution that ascertains whether any given series is/are 0, + or -. That is, a 0 outcome indicates that the series is symmetry and normally distributed. A (+) outcome means the series has a long-right tail and that of (-), indicates that the series has a long-left tail. Similarly, Kurtosis is a measure of flatness and peakness of series in a given study. Thus, a Kurtosis outcome of = 3, means that it is mesokurtic. That of value >3, means, the series is peak (leptokurtic). When Kurtosis value is < 3, then it is flat (platykurtic). Finally, the Jarque-Bera statistics is judged by comparing the corresponding probabilities in the outcome.

Descriptive statistics is derived as follows:

$$\textit{Skewness}: \ Sk = \frac{\sum f(\pi - m)]\ 3}{\lambda 3} \qquad 2$$

Where: Sk = Skewness; f = mean of the distribution m = parameter λ = standard deviation

$$\textit{Kurtosis} = K = \frac{\sum f(\pi - m)4}{\lambda 4} \qquad 3$$

$$\textit{Jarque-Bera} = \text{JB} = \eta\,[\frac{(\kappa l1)2}{6} + \frac{(l2-3)2}{24}] \qquad 4$$

Where: $l1$ = coefficient, $l2$ = kurtosis coefficient

Panel unit root

In Baltagi, (2013); Los and Gardebroek, (2016), Ferdaous, (2016), Pesaran, Shin and Smith, [PS], (1999, 2001) there are underlying criteria at which panel unit root test could be determined. The criteria include: Levin, Lin and Chu [LLC] (2000) criteria, Bretung, [BT], (2000) criteria, Pesaran, et al, (1999, 2001) criteria and the Fischer Test criteria. Taking a panel unit root test decision is however based on the general outcome common to the majority of the criteria. To derive a generalized Panel unit root test, a lag order (q) is often specified in the model below.

$\Delta \mathcal{P}_{k\ell} = q_k \mathcal{P}_{k\ell-1} + \Sigma^{qk}_{\beta=1} \wp_{i\beta} \Delta \mathcal{P}_{k\ell-\beta} + \acute{\alpha} \lambda_{nk} \delta_{n\ell} + \upsilon_{k\ell.}$ 5

Where: $\Delta \mathcal{P}_{k\ell}$ is cross-sectional dependent variable against $\Delta \mathcal{P}_{k\ell-\beta}$ series (independent) and $\delta_{n\ell}$ in order to get $\upsilon_{k\ell}$ residual. Similarly, the $\mathcal{P}_{k\ell-1}$ is examined against $\Delta \mathcal{P}_{k\ell-\beta}$ and λ_{nk} in order to arrive at the cross-sectional residual as in LLC t* and BT, whereas, PS is derived by only computing the average per unit series of the unit root statistics.

Panel pooled regression (POLS)

In the assumption of a POLS in Panel data analysis, the following model is specified.

$\Psi_{it} = \alpha_0 + \lambda_1 \wp_{1it} + \lambda_2 \wp_{2it} + \lambda_1 \wp_{3it} + \upsilon_{it}$ 6

Where: Ψ_{it} is cross sections dependent variable and λ_i and λ_t country time and invariant effect. λ_{it} vector of explanatory variables ($_i$)…1…5 and ($_t$)…. n. $\lambda_{1...3}$ scalar vector of coefficients. The strength of the POLS is that it assumes homogeneity across sections by pooling all the series as if it were identical. The crux of this is that the strength is as equal as to its weakness. This is because no two countries are identically the same. In order words, POLS homogeneity treatment of series is also its weakness.

Fixed effect [FE] model

Unlike in POLS, The FE simply observes and treats the heterogeneity characteristics expected in a cross-section series. It does this simply by fixing the unobserved characteristics in POLS.in order words, it brings to the fore the individual country specifics through cross sectional intercept exempted in POLS (Ferdaous, 2016). FE model is specified as;

$\Psi_{it} = \chi^{!}_{it} \wp + \eta_i + \xi_t + \upsilon_{it}$ 7

Where: ξ_t has the missing series that is constant over the cross-sections, at every time point $_t$.

Random effect [RE] model

This is the third verification stage of the panel data analysis. Here, the presence of the variance decomposition [random] makes the treatment of the heterogeneity and time effect possible because of the specific uncorrected effect in time across sections. This action is performed under the Generalized Least Square [GLS] as a basis of control. Again, the RE can be derived as follows;

RE = $\Psi_{it} = \alpha + \chi^{!}_{it} \wp + \upsilon_{it}$ where the error term is discomposed into $\upsilon_{it} = \alpha_i + \chi^{!}_{it}$ 8

Hausman test

Decision on whether to accept FE or RE is often made under the assumption of Hausman test criterion selection. In 1978, Hausman opined that since decision product by either the FE or RE varies, it is essential that decision leading to select the most appropriate method is designed. As such, he proposed a Ho & Ha selection proposition as below.

H_0: Random Effects (RE) model is appropriate

H_a: Fixed Effects (FE) model is appropriate

The implication is that, if Ho is significant then at 0.05, then, RE, is appropriate otherwise it is FE.

Results and discussion

Descriptive result

Table 3 Descriptive Result

	GDPPC	IMPORT	EXPORT	HI
Mean	1887.856	279.3413	552.7876	32.12214
Median	1408.862	242.6160	282.4059	34.24971
Maximum	3857.304	1264.792	3898.785	50.92150
Minimum	526.5621	54.90284	16.98580	12.59146
Std. Dev.	1167.300	196.2855	861.8018	10.39597
Skewness	0.407651	2.239863	2.701811	-0.545015
Kurtosis	1.501468	9.219120	9.640555	2.342026
Jarque-Bera	14.55158	293.7270	366.4805	8.105476
Probability	0.000692	0.000000	0.000000	0.017375
Sum	226542.8	33520.95	66334.51	3854.657
Sum Sq. Dev.	1.62E+08	4584829.	88381571	12861.07
Observations	120	120	120	120

Source: Authors' computation (2020) from E-views output

To affirm the normality characteristics of any variable in a study, the descriptive statistic is often carried out. In other words, the statistic lends itself to determining the normality properties of the series or otherwise. For the purpose of this study, three relevant descriptive statistics as specified in materials and method will be examined. First, the Skewness, which is referred to as the normality distribution that lay credence to asymmetric characteristics of the variables in the study is examined. In other words, the Skewness is explained on the premise that series turn out 0, + or -. By implication, GDPpc = 0.4, intra-Africa agricultural trade – import = + and 2.2, export = + and 2.7 while, hunger = - and 0.5. With this, GDPpc was symmetric while import and export were long right-tail series except for hunger that was long left-tail having turned negative. Also, the Kurtosis scenario indicated that import and export was peak having shown a figure $\geq$ 3. While GDPpc and Hunger index were flat, having displayed a series of $\leq$ 3. On the whole, the Jarque-Bera statistic which was ascertained through its associated properties as indicated in the table shows that all series displayed positive and significant relationship.

Panel unit root result

Table 4: Panel Unit Root Affirmation

Variables	Cross Sections	Obs		Method				
				LLC t*	PS	ADF-Fisher	PP - Fisher	Order
D(GDPpc)	5	110	Statistic	-4.99540	-4.70590	40.6312	40.0556	I(1)
			Prob**	0.0000	0.0000	0.0000	0.0000	
D(Import)	5	109	Statistic	-9.47695	-9.46288	82.7922	129.291	I(1)
			Prob**	0.0000	0.0000	0.0000	0.0000	
D(Export)	5	110	Statistic	-9.07409	-7.99613	69.4772	72.5504	I(1)
			Prob**	0.0000	0.0000	0.0000	0.0000	
D(HI)	5	84	Statistic	-15.8500	-13.9806	123.463	317.962	I(1)
			Prob**	0.0000	0.0000	0.0000	0.0000	

Source: Authors' (2020) E-view computation

The assumption of identifying the stationarity status of variables is embedded in the argument of Baltagi, (2013); Los and Gardebroek, (2016) and Ferdaous, (2016). However, the study went further to either accept or refute the claim by carrying out the stationarity examination of the series using the regular Panel unit root testing kit assumptions identified earlier under the material and methods of the study. Accordingly, Table 4 indicates the outcome of the series. First, gross domestic product per capita result showed that the variable did not become stationary at level under the various criteria. As a result, the variables were differenced in their first order hence, becoming stationary at I(1). That is, GDPpc at LLC t*, PS, Fischer-type and PP-Fischer all became stationary at first difference. Similarly, intra-African agricultural import (D(import)) and export (D(export)) also did not become stationary at their order level but after they were differenced. Also, these series exhibited same stationarity trend at LLC, PS, Fischer-type and PP-Fischer. Finally, hunger index also indicated a no stationarity status at level testing. This however changed after going for the first difference testing. By implication, all series exhibited first difference outcome. As a result, the study staggered the analysis by employing the three stage Panel testing estimating as specified earlier under material and method.

Panel POLS

Table: 5: Panel POLS Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3623.730	256.3059	14.13830	0.0000
IMPORT	0.386483	0.636419	0.607279	0.5449
EXPORT	0.642959	0.140547	4.574704	0.0000
HI	-68.46535	5.724637	-11.95977	0.0000
R-squared	0.740902	Mean dependent var		1887.856
Adjusted R-squared	0.734201	S.D. dependent var		1167.300
S.E. of regression	601.8099	Akaike info criterion		15.67053
Sum squared resid	42012314	Schwarz criterion		15.76344
Log likelihood	-936.2315	Hannan-Quinn criter.		15.70826
F-statistic	110.5689	Durbin-Watson stat		0.072578
Prob(F-statistic)	0.000000			

Source: Authors (2020) E-view output

Panel estimation which involves the determination of POLS is mentioned ab inito. The result of Table 5 indicates the outcome. Specifically, the POLS indicates that two series: intra-African agricultural trade – import and hunger indexes were statistically significant to explain Africa's gross domestic product per capital [GDPpc] judging by the output while, hunger index was not significant. However, the strength of this relationship was weakened judging by the homogeneity treatment that POLS ascribed to all series in the study. In other words, POLS treated all series as if they were of same entity. These were all the observable cross – elements: NAC, SAC, WAC, EAC and CAC. This, however, weakened the POLS stage of the panel data analysis.

Panel fixed effect

Table 6: FE Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2166.592	207.8115	10.42576	0.0000
IMPORT	1.090002	0.247650	4.401382	0.0000
EXPORT	-0.002630	0.049679	-0.052943	0.9579
HI	-18.11100	5.134416	-3.527372	0.0006

Sources: Author's (2020) E-view Compilation

Again, in order to correct for the weakened association present in POLS, the second stage process of Panel analysis – Fixed Effect Model was established. In essence, the homogeneity treatment of series across-sections was relaxed in the Fixed Effect such that the unobservable heterogeneity was taken into consideration in time and period. By implication, the FE is often time-invariant. To this end, the individual characteristics subsisting among cross-sections – Northern African Countries [NAC], Southern African Countries [SAC], Eastern African Countries [EAC] and Central African countries [CAC] were considered in the FE, model. Thus, the result of the table indicates a reversed position to that of the POLS. Accordingly, intra – African agricultural trade – import and hunger indexes were the two significant series to explain gross domestic product per capita, while intra-African agricultural trade – export was insignificant to explain gross domestic product per capita across sections. Similarly, the coefficient of export and hunger index showed that they were inversely significant to explain gross domestic product per capita.

Panel random effect

Table 7: Random effect model result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3212.139	125.9744	25.49835	0.0000
IMPORT	0.406528	0.211110	1.925666	0.0566
EXPORT	0.313007	0.046906	6.673073	0.0000
HI	-50.14825	2.957637	-16.95551	0.0000

Source: Authors (2020) E-view output

Similarly, the Random Effect [RE] model is the third version in testing Panel analysis. What Random Effect does, unlike in the FE, where individual specific effect is correlated, RE is to randomized parameters which are hitherto fixed in FE to arrive at some sort of systematic effect. In others words, the basic assumption of RE is that the individual – specific effects are uncorrelated with the independent variable. Thus, from the result, having performed the RE, it shows that export and hunger indexes were the only two independent variables that were statistically significant in explaining the dependent variable. However, that of hunger index showed a negative relationship. Also, intra-African agricultural relationship showed a positive effect but it is insignificantly related to gross domestic product per capita. Having performed the RE and cross-check with FE, it became imperative that a decision leading to policy or forecasting expository was imperative. More so, the two instances FE and RE presented variance in their outcome. The Hausman test (1978) is often used as tool for determining the most appropriate model to adopt in this regard.

Hausman test

Table 7: Hausman Test Result

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	501.156018	3	0.0000

Source: Authors' computation

On deciding whether it was the Fixed Effect [FE] Model or Random Effect [RE] Model that was appropriate in explaining the scenario in the study, literature proposes that the Hausman Test be conducted. Ab initio, the Hausman test proposes an alternative choice based on 0.05 percent level of significant whereby either the H_o, which signifies that RE as the null or the FE as the alternative H_a be used as the determinant to decide which of the models should be accepted. By implication if H_o is significant, then, H_a is not, otherwise it is H_a. Thus, from the result of the Hausman test, the probability result indicated that there was 0.000 outcome hence, the null RE was rejected and the alternative FE was accepted. In this case, the alternative FE indicates that across regions Northern African countries [NAC], Southern African countries [SAC], Eastern African countries [EAC], Western African countries [WAC] and Central African countries [CAC] showed that intra-African agricultural trade import was significant at 0.000 percent level to explain gross domestic product per capita. Similarly, Hunger index was also significant at 0.0006 level but negatively signed. The implication here was that there was a negative relationship with the continent growth as measured by growth per capita. Also, that of intra-African agricultural trade – export simply indicated a no significant relationship between growth as well. This also showed a negative relationship as well with gross domestic product per capita. What this means is that, the rate at which Africa countries inter-trade in agriculture in export among them was relatively weak compared with the way they trade [export] among the rest of the world. This is typical of the observation in AfDB, (2018), FAO, (2020), Bouet, et al, (2020) and African Agricultural Trade Status Report [AAT], (2017)

Conclusion

The poor economic state of Africa, her unimpressive economic conditions notwithstanding evidences of intra trade activities among member nations necessitated this study. The study however paid special attention to agricultural trade, being a cardinal anchor to improving her economic growth per head and to which all member states agreed to in Maputo, Mozambique in 2003/2004. The outcome of the study underscores the import of carrying out studies on accounting for intra-Africa agricultural trade and hunger reduction: Africa economic analysis. Intra-Africa agricultural trade – [import] and intra-African agricultural trade – [export], and hunger index [HI] were mirrored as the independent variables while, gross domestic product per capital (GDPpc) was mirrored as the dependent variable of the study. Having followed a four-stage steps of empirical report writing, the study concluded based on the cross-sectional methodology specified in material and methods that the Fixed Effect [FE] Model is appropriate in explaining the relationship between intra-African agricultural trade import/export, Africa Hunger Index [HI] and gross domestic product per capital. Specifically, a negative coefficient was exhibited between intra-Africa agricultural trade [export] and that of African hunger index [AHI]. The implication of the conclusion is that intra- African trade relationship especially in agriculture does not account for earlier insinuation that the intra-African agriculture [import/export] trade relationship is substantial at improving hunger and, ultimately improve growth per head.

Upon the conclusion of this study, it is important to highlight that agricultural trade relationship requires concerted efforts towards taking it beyond mere policy expression but gainful actions with visible economic gains for all. Two propelling factors seem to be present in this scenario. First being, agricultural trade – production [volume] leading to exchange [import/export] and second, economic gains, leading to hunger reductions for ultimate economic growth benefits. If this be, then, it is imperative that regions engage only on agricultural products with capacity to produce needed volume for maximum economic gains within regions. With this, it is recommended that each region solely produce such agricultural products with large production volume potential for mutual economic gains and for exchange. Similarly, other products may serve as addendum in value-chain where they are allowed to move freely on the notion that the parties will benefit both in the production process and its value addition. Ultimately, stiffer and appropriate sanction may be agreed upon in which defaulter to agricultural trade - liberation may be placed on embargo of some sorts. The study has examined intra-Africa agricultural trade, hunger reduction cum impact on economic growth per head in Africa. This was done using aggregated trade (export and import) provision. Further studies may be done using specific but disaggregated agriculture trade positions to further provide a micro perspective to the discourse. Similarly, an external comparative of other emerging economies in this regard may also be a step for future studies. One key limitation of the study rests on the fact that it is concentrated on a specific period of time (1995 to 2018). Another time in period may be considered and this may lead to different summation for the study.

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