UNIVERSITI PUTRA MALAYSIA

IMPACT OF INFRASTRUCTURE ON TRADE, FOOD SECURITY AND ECONOMIC GROWTH IN AFRICAN COUNTRIES

AUWAL YAHAYA

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IMPACT OF INFRASTRUCTURE ON TRADE, FOOD SECURITY AND ECONOMIC GROWTH IN AFRICAN COUNTRIES

By

AUWAL YAHAYA

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

November 2018

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DEDICATION

This work is dedicated to my late grandfather, Alh. Sa`ad Muhammad, my parents, Alh. Yahaya Sa`ad and Maimunatu Yusuf, my beloved and ever-supportive wife, Amina Usman Yusuf and my daughters Amina Auwal Yahaya and Maimunatu Auwal Yahaya.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

IMPACT OF INFRASTRUCTURE ON TRADE, FOOD SECURITY AND ECONOMIC GROWTH IN AFRICAN COUNTRIES

By

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November 2018

Chairman : Associate Professor Nomaz Wana Ismail, PhD
Faculty : Economics and Management

In line with the theoretical and empirical discussions on the relevance of infrastructure to sustainable growth and development, the first objective of this study examined the impact of hard infrastructure facilities such as road, ICT and the soft infrastructure (documents per shipment to export/import, cost levied on 20 foot container and time necessary to export/import) on the export volume in the African countries. In the second objective, the study determined the impact of infrastructure- road, clean water and improved sanitation on food security in African countries. Whereas in the third objective, the impact of infrastructure (power, road, water & sanitation and ICT) on economic growth in African countries was assessed. Moreover, the study went further and assessed the indirect effect of infrastructure on economic growth through, health and education outcomes- life expectancy and mean years of schooling. The traditional panel methods of pooled OLS, fixed and random effect estimators are used in the first objective; while for the second and third objectives, the generalized method of moments (GMM) was employed.

Giving the first objective, results showed a significant positive relationship between road infrastructure and export of the African countries, but not ICT. This may have to do with the nature of the products that generally dominate the African countries` export- primary commodities that could still be produced even with less use of the ICT. On the soft infrastructure indicators, only number of documents and the cost per container for export are found to influence the region`s export, negatively; albeit only in the exporting countries. By implication, the provision of a well-developed infrastructure (hard and soft) might be a key to the successful accomplishment of the continent`s target of increasing its competitiveness and trade share in the global market.

Findings in the second objective found that access to sanitation due improve food insecurity, but not water and road infrastructure. Based on the present specifications, no significant relation between access to water and the dependent variables was found. On the positive coefficient found for the road infrastructure, it could be said that the road infrastructure indicator used may not have suited the true picture of the common mode of commuting in the rural and sub-urban centers across the continent- footpaths. Thus, other than the traditional notion of increasing the domestic food production, access to better infrastructure (water & sanitation) can help reduce the high prevalence of food insecurity across the African countries.

In the third objective, a positive and significant relationship between infrastructure-power, road, water & sanitation and ICT and economic growth in the countries is obtained. Further investigations also revealed that the infrastructure variables positively impact on economic growth of the African countries, through the channels of health and education outcomes. It has hence confirmed on the existence of a positive link between infrastructure access and achieving health and education outcomes; and also, that health and education outcomes do improve economic growth of nations. Impliedly, the current findings highlighted on some sort of complementarity between building of better infrastructure for achieving economic growth and policies meant to improve life expectancy and mean years of schooling. Similarly, ensuring the provision of a better road access that will link rural and urban settlements could save the government from building of more health or education outlets across the countries.

For policy implication, the study suggest for the need of more efforts from both the regional and national governments in Africa to ensure people get access to basic infrastructure services in order to achieve an inclusive economic growth in the region.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

INFRASTRUKTUR DAN IMPAKNYA TERHADAP PERDAGANGAN, KESELAMATAN MAKANAN DAN PERTUMBUHAN EKONOMI NEGARA-NEGARA AFRIKA

Oleh

AUWAL YAHAYA

November 2018

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Selaras dengan perbincangan teoritis dan empirikal mengenai kerelevanan infrastruktur untuk mencapai pertumbuhan dan pembangunan mampan, objektif pertama kajian ini adalah untuk meneliti impak kemudahan infrastruktur yang pejal seperti jalan raya, dan ICT, dan infrastruktur tidak pejal (dokumen setiap penghantaran untuk tujuan eksport/import, kos yang dikenakan terhadap kontena 20 kaki, dan masa yang diperlukan untuk mengeksport/mengimport) terhadap jumlah eksport di negara-negara Afrika. Objektif kedua adalah untuk menentukan impak infrastruktur—jalan raya, air bersih dan sanitasi yang lebih baik—terhadap jaminan makanan di negara-negara Afrika. Akhir sekali, objektif ketiga bertujuan menilai impak infrastruktur (kuasa, jalan, air dan sanitasi, dan ICT) terhadap pertumbuhan ekonomi di negara-negara Afrika. Kajian ini juga menyiasat kesan tidak langsung infrastruktur terhadap pertumbuhan ekonomi melalui hasil kesihatan dan pendidikan—jangkaan jangka hayat dan tahun persekolahan. Kaedah panel tradisional OLS yang disatukan, iaitu penganggar kesan tetap dan rawak, digunakan untuk mencapai objektif pertama manakala objektif kedua dan ketiga telah dicapai dengan menggunakan kaedah momen umum (GMM).

Untuk objektif pertama, dapat kajian menunjukkan hubungan positif yang signifikan antara infrastruktur jalan dan eksport negara-negara Afrika, tetapi bukan ICT. Ini mungkin ada kaitan dengan sifat produk yang secara umumnya menguasai negara-negara Afrika eksport—komoditi utama yang masih boleh dihasilkan walaupun permintaan untuk ICT adalah sedikit. Mengenai penunjuk infrastruktur yang tidak pejal, hanya bilangan dokumen dan kos bagi setiap kontena untuk tujuan eksport didapati mempengaruhi eksport rantau ini secara negatif walaupun hanya di negara-negara pengeksport. Secara implikasi, penyediaan infrastruktur yang baik (pejal dan

tidak pejal) mungkin menjadi kunci untuk mencapai sasaran benua berkenaan untuk meningkatkan daya saing dan bahagian perdagangan dalam pasaran global.

Bagi objektif kedua, akses kepada sanitasi dilihat meningkatkan jaminan makanan, tetapi tidak infrastruktur air dan jalan. Berdasarkan spesifikasi semasa, tiada hubungan yang signifikan antara akses kepada air dan pemboleh ubah bersandar. Mengenai pekali positif infrastruktur jalan raya yang positif, dapat dikatakan bahawa penunjuk infrastruktur jalan yang digunakan mungkin tidak memberikan gambaran yang sebenar mengenai mod ulang alik di pusat-pusat luar bandar dan pinggir banda di serata benua—pejalan kaki. Oleh itu, selain daripada tanggapan tradisional dalam meningkatkan pengeluaran makanan domestik, akses kepada infrastruktur yang lebih baik (air dan sanitasi) dapat membantu mengurangkan ketidakjaminan makanan yang lazim berlaku di seluruh negara Afrika.

Untuk objektif ketiga, hubungan positif dan signifikan antara infrastruktur—kuasa, jalan, air dan sanitasi, ICT, dan pertumbuhan ekonomi di negara-negara telah diperolehi. Siasatan lanjut juga mendedahkan bahawa pemboleh ubah infrastruktur memberi kesan positif terhadap pertumbuhan ekonomi negara-negara Afrika melalui saluran kesihatan dan hasil pendidikan. Di samping itu, dapatan kajian turut menunjukkan hubungan positif antara akses infrastruktur dan pencapaian hasil kesihatan dan pendidikan. Hasil kesihatan dan pendidikan turut didedahkan dapat meningkatkan pertumbuhan ekonomi negara. Penemuan semasa menyerlahkan kesesuaian antara beberapa jenis dasar yang bertujuan untuk meningkatkan jangka hayat dan tahun persekolahan, yang bermakna bahawa akses jalan yang lebih baik yang dapat menghubungkan penempatan luar bandar dan bandar dapat menjimatkan kerajaan daripada membina lebih banyak pusat kesihatan atau pendidikan di seluruh negara.

Untuk implikasi dasar, kajian mencadangkan perlunya usaha lanjut oleh kerajaan serantau dan di setiap negara di Afrika untuk memastikan agar orang ramai mendapat akses kepada perkhidmatan infrastruktur asas untuk mencapai pertumbuhan ekonomi yang inklusif di rantau ini.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

AFDB	African Development Bank
WDI	World Development Indicators
GDP	Gross Domestic Product
ICT	Information and Communication Technology
AIDI	Africa Infrastructure Development Index
UNCTAD	United Nations Conference on Trade AND DEVELOPMENT
ETI	Enabling Trade Index
BRICS	Brazil, Russia, India and South Africa
ACC	Administrative Committee on Coordination
SCN	Subcommittee on Nutrition
FAO	Food and Agriculture Organization of the United Nations
IFAD	International Fund for Agricultural Development
WFP	World Food Program
OECD	Organization for Economic Co-Oporation and Development
UNDP	United Nations Development Program
TFP	Total Factor Productivity
USD	United State Dollars
WFP:	World Food Product
USA	United State of America
FDI	Foreing Direct Investment
VEC	Vector Error Correction
OIC	Organization of Islamic Countries
CES	Constant Elasticity of Demand
HS	Harmonized System
DIST	Distance
LOCKED	Landlockness
LNG	Common Language
COMCOL	Common Colony

POP	Population
DOC	Documents
OLS	Ordinary Least Square
LSDV	Least Square Dummy Variable
LM	Langarage Multiplier
RE	Rondom Effect
FE	Fixed Effect
INF	Array of Infrastructure Variables
CV	Control Variable
FPI	Food Production Index
GDPC	Gross Domestic Product Per Capita
FMP	Food Import
POPG	Population Growth
DFPI	Domestic Food Price Index
PoU	Prevalence of Undernourishment
DFD	Depth of Food Deficit
TI	Transport Index
WSI	Water and Sanitation Index
FPI	Food Price Index
HTH	Health Outcome
EDU	Education Outcome
EI	Electricity Index
LIFE	Life Expectancy
AIDI	Afirca Infrastructure Index
FD	Financial Development
TRADE	Trade Openness
GMM	Generalize Method of Moment
CEPII	Centre D`Etudes Prospectives Et D`Informations Internationales
INDV	Individuals
DOCUM	Documents

POPG	Population Growth
SNT	Sanitation Infrastructure
WTR	Water Infrastructure
FPI	Food Production Index
DFPI	Domestic Food Price Index
MDGs	Millenium Development Goals

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

This thesis consists of three independent issues that contribute to understanding the importance of infrastructure to trade, food security and economic growth in the African countries. The first issue examines the impact of infrastructure on trade in Africa; while the second issue examines the impact of infrastructure on food security; and lastly, the third issue investigates the impact of infrastructure on economic growth, precisely through the effects of infrastructure on health and education outcomes.

1.1.1 Overview of the African Region

Africa is a continent of significant scale and diversity, covering about 54 countries each with its unique geographical, economic, and culturally distinctive. In addition to its rapid urbanisation, Africa has been with the fastest growing population, exceeding 1 billion since 2011 (AFDB, 2014b). However, the continuous increase in the population in Africa has not been followed by a proportional improvement in the peoples` lives quality. For instance, despite how important infrastructure is highlighted to be on the general wellbeing of people and the economy at large, estimates given indicate the need for an annual infrastructure investment of at least $93 billion in order for Africa to catch up with the rest of developing world in terms of infrastructure development (AFDB, 2014a). Virtually, across all of the countries in the region, infrastructure has continued being one of the major obstacles to doing business, the realisation of the countries` potentials in agriculture, and limiting firms productivity that consequently hampers growth in the long run (AFDB, 2014).

Haven increasingly attracted more investors into the region than decades in the past, Africa has emerged as a frontier market with its export amounting to 641 billion in 2012 (AFDB, 2014b). However, because of the poor trade facilitation measures that added to the physical infrastructure deficits in the region, both its within and international trade share in the global market is seen low in comparison with other world developing regions. Specifically, the intra-African trade as the percentage of the total was as low as 16 per cent in the year 2014. On the other hand, although agriculture still serves as the primary source of employment and hence income to the significant portion of the population in Africa, yet statistics have indicated how still the agricultural sector in the region is poorly mechanised. Therefore, it has not been surprising, even with a significant number of its population working on the farm, Africa often fails to produce enough for its subsistence, and hence remains one of the unsecured food regions (AFDB, 2014b).

Generally, regarding economic growth, the continent had been almost stagnant decades before the year 2000. With the beginning of the new millennium, however, impressive progress has been recorded where on average, the real domestic product for the continent rose from above 2 per cent in 1980-90s to an average of about 5 per cent in 2000-2013, though with some slackens in the momentum during the recent global commodity price swings. Nevertheless, even though the region`s growth performance underwent a dramatic improvement, Africa remains the least developing region among its world counterparts as could be observed in figure 1.1. The regions with better performance are South and East Asia, followed by Europe and the Middle East. Even so, with a higher percentage of its population being youth, Africa has a great opportunity that if properly harnessed, the continent could turn its adversities into blessings. Nevertheless, seizing this opportunity will depend on the ability of national governments to diligently develop and utilise this workforce through access to better education and skills, and ensure a qualitative public investment in infrastructure that could aid in enhancing the competitiveness of the region.

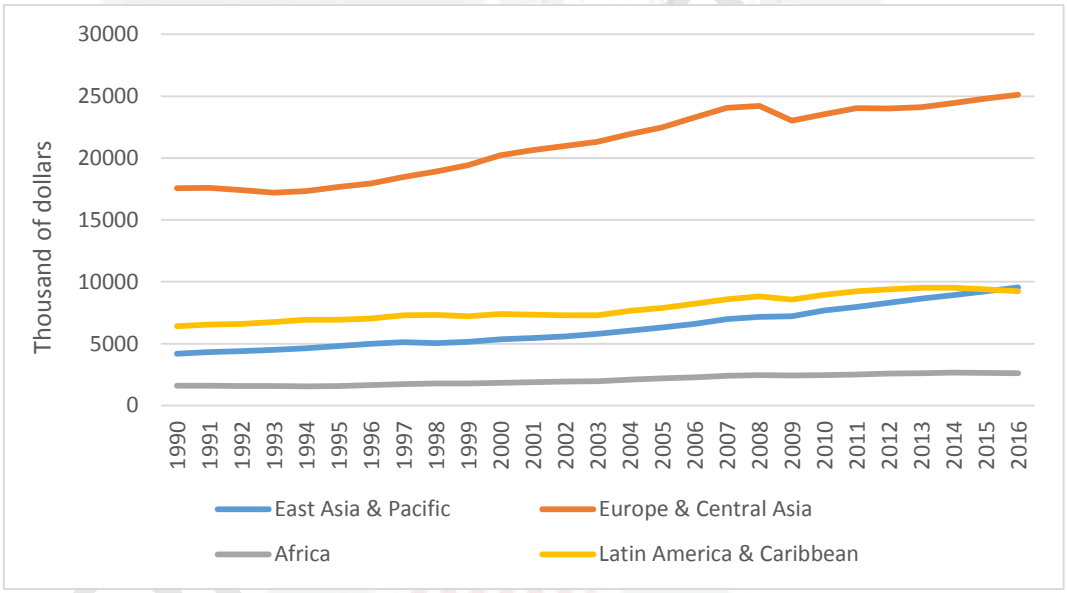

Figure 1.1 : GDP per capita for Regions
(Source: Based on WDI.)

1.1.2 Understanding Infrastructure

Although the idea surrounding the concept of infrastructure could be as old as one might think of, it was not until the 1980s to 1990s that it surfaced in the literature. Specifically, the term was in the first instance traced to what was regarded as war logistics during the Second World War (Jerome, 1999). Described by Prud'homme (2004), infrastructure is vast and thus, differs in its definitions that even the meaning has been extended so much that it no longer means much. Nonetheless, infrastructure is regarded to encompass activities that share technical features such as economies of scale, the feature of non-excludability (World Bank, 1994); and as well generate

externalities in its usage. Therefore, the infrastructure in this work is taken along its two divisions considered in the field of economic literature- "Hard Infrastructure" and the "Soft Infrastructure" dimensions (Portugal-Perez & Wilson, 2012).

In line with the argument by Ayogu (2007), infrastructure generally serves two main purposes: it increases citizen`s welfare when consumed directly, and also provides services with the help of labour and other vital inputs in production processes. The hard infrastructure that is sometimes referred to as physical or core-infrastructure, constitutes roads, highways, railroads, airports, seaports, electricity, ICT, clean water, improved sanitation, Ports, waterways, drainage and airports (World Bank, 1994; Fourie, 2006; Ayogu, 2007; Portugal-Perez & Wilson, 2012). Even though some among these categories are of the exception (power and water), hard infrastructure mostly involves market failure. In other words, regardless of which amongst the known hard infrastructure, they are in most instances objects with non-rivalry and non-excludability in its usage. In that regards, when defining Hard/Core/ and or, Physical infrastructure, they are typically identified by the attributes of being immovable capital goods that are consumed as inputs for the services they provide.

On the other hand, the "Soft infrastructure" being as well vast in its meaning could constitute different services ranging from, on the border and transport efficiency, business environment (Portugal-Perez & Wilson, 2012); to various institutions such as schools, libraries, universities, clinics, hospitals, playgrounds, etc. (Fourie, 2006). Nevertheless, as presented in Portugal-Perez & Wilson, soft infrastructure referred to in this study deals with the border management procedures and other regulations that affect in/out of trade or flow of foreign investments. For that reason, border and transport infrastructure, therefore, ensures the application of the internationally recognised practice and standards in border crossing; while the business environment, on the other hand, deals with the transparency and regulatory aspects that guarantee corrupt-free business practices.

1.1.3 Infrastructure in Africa

At a time when most of the infrastructure policy debates in countries around Eastern Europe and Central Asia concern about improving its services quality, the scenario in Africa is still on how to provide the region with the basic infrastructure needed for development (Banerjee et al., 2008). That is why, despite the fall in the tariff barrier to trade in recent decades, trade within and across the border for the African continent is continuously being hampered by the poor trade infrastructure in the continent (AfDB/OECD/UNDP, 2018). Involving 'on the border' procedures in trade, soft infrastructure is shown to play an essential role in easing movements of goods across borders, and hence increase trade volume (Gnangnon, 2017). Thus, trade flow and volume are not only influenced by the access and, or quality of the infrastructure in the hinterland. The availability of modern trade infrastructure on the border is vital as well- a simulation conducted revealed that improving only border administration, transport and ICT infrastructure halfway to that of Singapore could yield an increase of $1.6 trillion in global exports (14.5 per cent) (AfDB/OECD/UNDP, 2018).

Table 1.1 : Trade Facilitation for some World Regions

	2005			2010			2014		
	Doc.	Cost	Time	Doc.	Cost	Time	Doc.	Cost	Time
Africa	8.03	1922	36.1	7.4	2416.6	30.5	7.4	2595	28.63
Latin America & Caribbean	5.61	1368	21.5	5.6	1465.1	17.6	5.6	1665	16.71
Europe & Central Asia	5.93	1372	23.3	5.5	1517.1	18.5	5.5	1822	17.59
East Asia & Pacific	5.83	947	22.0	5.5	827.8	19.0	5.5	901	18.69

Notes: Doc indicates documents for export in the respective regions.
Cost means levied on a 20-foot container in the respective regions.
Time implies time needed for making an export in the respective regions.

However, going by the three most employed soft infrastructure indicators in empirical studies, the continent of Africa is portrayed with the highest number of documents required for export/import, cost levied on a 20-foot container or time needed to comply with the necessary procedures to export/import (table 1.1). In line with the argument in Gnangnon, (2017), due to the non-usage of modern trade facilitation measures on the border, majority of the African countries are faced with the problems of complex customs and administrative procedures on the borders- which as a result adds to the poor hard infrastructure in the hinterland and leads to high cost of export/import for the continent (AfDB/OECD/UNDP, 2015, 2018). Specifically, in addition to the problem of lack of capacity to handle large vessels, activities in the majority of ports across the continent are thwarted by the poor and inadequate hard infrastructure that links up with the ports.

And so, at the centre of the hard infrastructural stock deficit in the African continent is the power (AfDB/OECD/UNDP, 2018). Whether measured regarding the capacity of its generation, supply reliability or percentage of people with access, the services obtained in the energy sector in Africa is a fraction of what is obtainable in other developing regions (Foster & Briceño-garmendia, 2010). As argued by the AfDB, more than 640 million Africans have no access to electricity- only fewer than 40 per cent of the population has access to electricity in Africa (figure 1.2). Going by the trend as portrayed in figure 1.2, for almost two decades now, only little improvement is achieved by the national and regional governments to develop and utilise the enormous energy potential in the African continent.

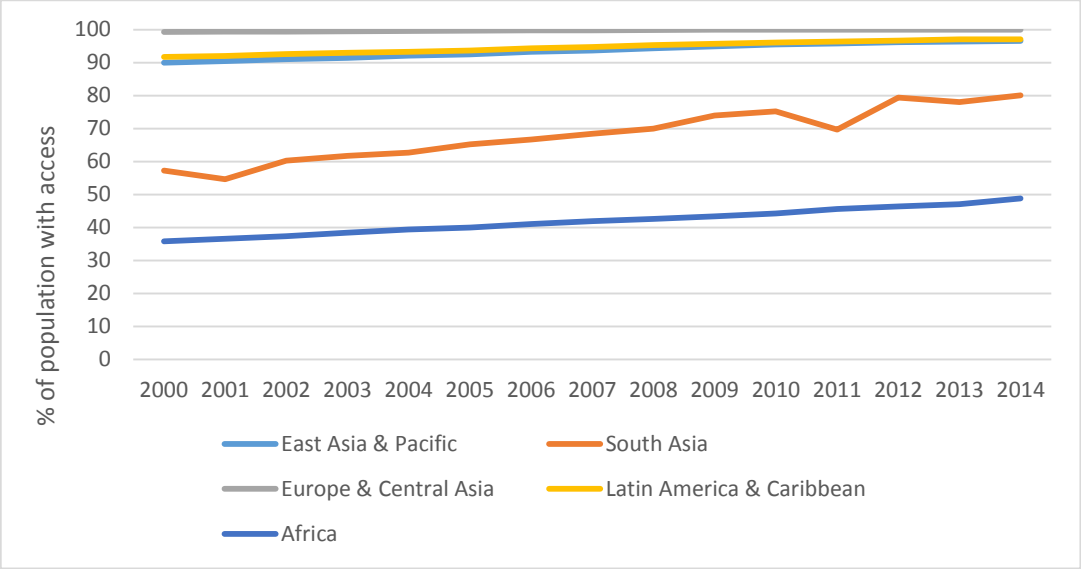

Figure 1.2 : Access to Electricity
(Source**:** Data based on World Development Indicators.)

Perhaps due to the continuous upsurge in the population across the region, the progress made in developing the energy sector of the continent over the past two decades revealed nothing encouraging. Based on figure 1.2, about 35 per cent of the population in Africa had access to electricity as far back as the late 1980s; yet, until date, not up to 50 per cent of the population in Africa is provided with electricity- the least in the world. Also, for example, except South Africa, the per capita energy consumption in sub-Saharan African countries is set at only 180 kWh, as against 6500 kWh & 13000 kWh in the Europe and America, respectively. Consequently, part of the recent efforts shown by the authorities to end the power problem in the continent is the vision 2025 that targets 100 per cent urban and 95 per cent rural electrifications across Africa. However, as noted, part of the significant challenges for the region has always been the funding. In order for the African countries to realise the year 2025 deal, it was estimated that about 30-50 billion dollars are needed annually.

Moreover, despite the road being the predominant mode of commuting both goods and people across the African countries, more than 50 per cent of the total roads in the region are unpaved (AfDB, OECD, 2018). This may limit peoples` access to the basic daily needs of life, such as healthcare, education, trade centres and other economic opportunities in general. And the sorry state of the road infrastructure has also been linked to why Africa is regarded the worst on road safety. In that regard, comparably, using the data for 2013 based on the AfDB statistics, Africa is with the least number of kilometre of paved roads per 100 km^2 of land area (2km), amongst the regions of Asia, Europe and Latin America.

Furthermore, regarding access to water and sanitation, still, Africa happens to be with the least percentage of people with access to both clean water and improved sanitary services. Even though there is variation across the rural and urban centres within the

continent, but as a whole, the percentage of people with access to clean water and improved sanitation in 2015 were 70 and 36 per cent, respectively (AfDB, 2015). These are the lowest when compared to the other regions in figures 1.3 & 1.4; whereas as noted in the work of Metwally et al., (2006), the lack of proper drinking water and improved sanitation on the other hand, have the tendencies of causing diarrheal illnesses, dehydration, malnutrition and death among children.

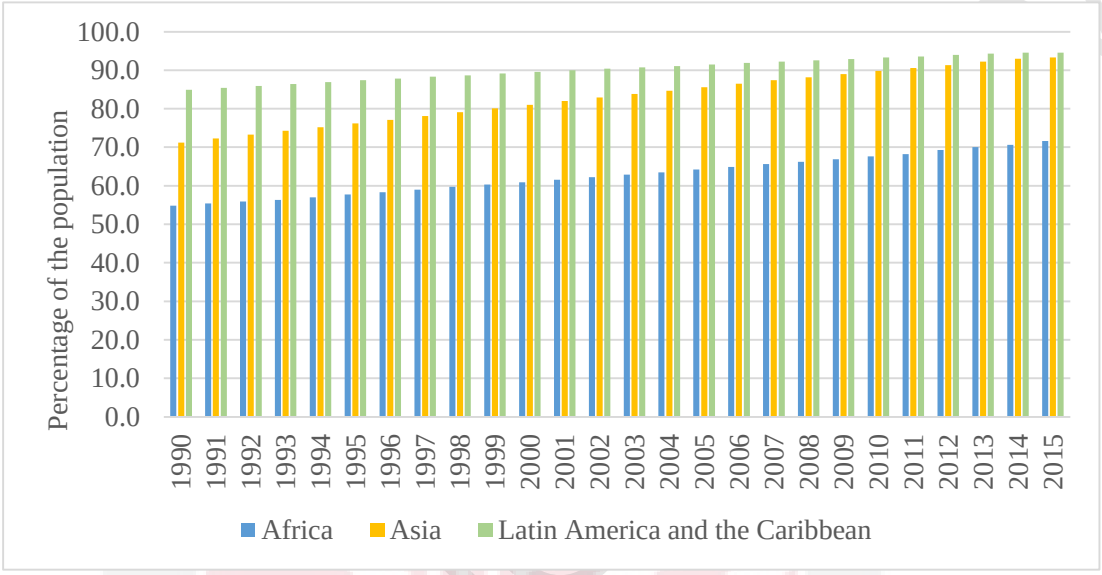

Figure 1.3 : Clean Water
(Sourced: FAO database.)

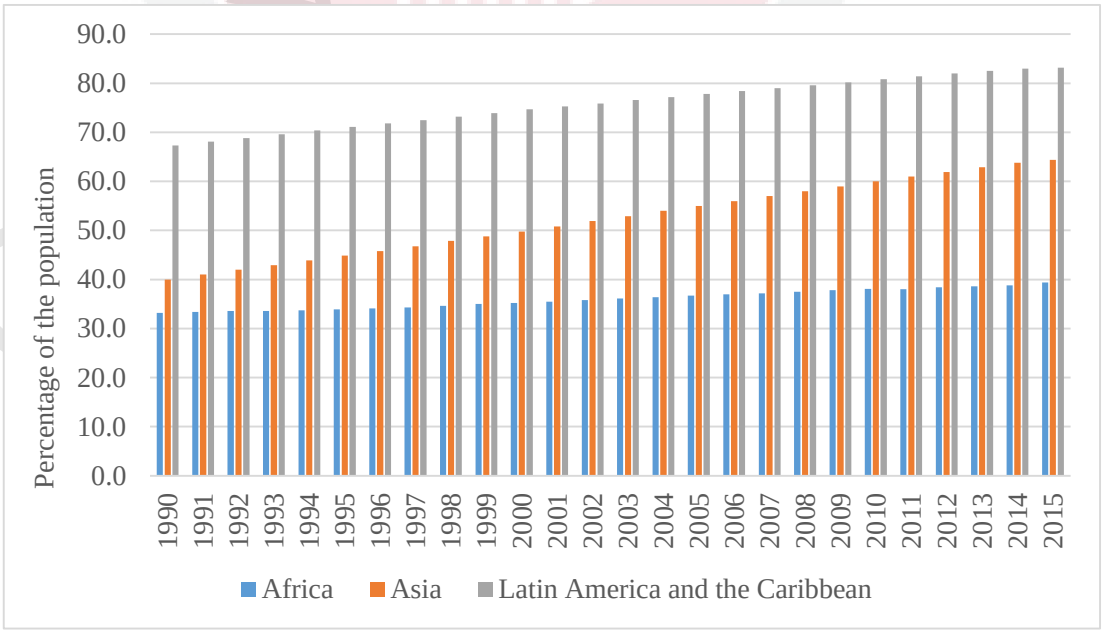

Figure 1.4 : Improved Sanitation
(Sourced: FAO database.)

On the state of the ICT in the continent, substantial progress has been recorded in the recent period. However, with the poor access to electricity across the region as earlier noted, the trade and other economic growth benefits of the ICT may not have been fully maximised. In the year 2000, only around 15 million people were estimated to have been connected on the phone in the entire of Africa; but, with tremendous progress in recent years, estimates in 2013 have shown at least not less than 760 million people across the region are connected on mobile phone (AFDB, 2014). But then again, that has not been the case on the issue of internet usage across the continent. Despite its importance in modern trade and technology application in other sectors of the economy, yet its progress in Africa is far low when compared with that in the regions of Asia or Latin America (see figure 1.5). It is not surprising therefore that, the ICT was found to only contributes 1.1 per cent of the continent`s GDP, against 5-6 per cent in other regions in the world.

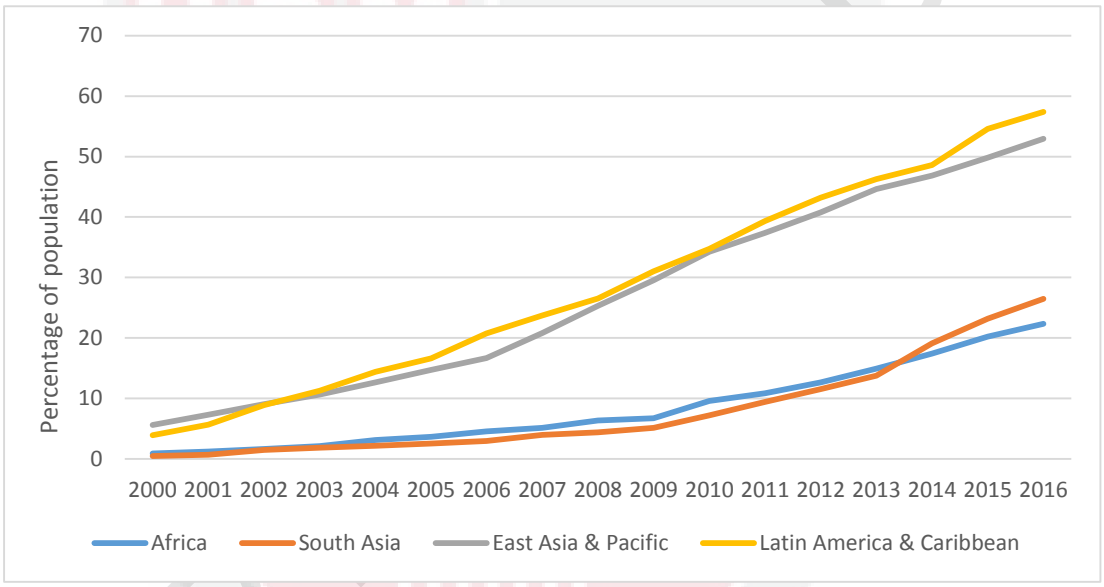

Figure 1.5 : People using internet
(Sourced: Based on WDI database.)

Further examining within the African continent, a substantial disparity is found to exist as to the level of infrastructure (both hard and soft) development between countries from the five sub-regions in the continent (AFDB/AIDI, 2016). For instance, using the Africa infrastructure development index (AIDI), the level of infrastructure development across the African sub-regions is assessed. Comprising of four major infrastructure indicators- Transport, Electricity, ICT, Water and Sanitation, the AIDI was constructed by the African Development Bank to serve as a tool for evaluating the level of infrastructure development in the African countries. In line with figure 1.6, countries from the North African sub-region have been rannnked ahead of their counterparts from the other sub-regions, then followed by the Southern African sub-region, West African sub-region, central African sub-region and then lastly, the East African sub-region. Specifically, the North and South sub-regions on average

outperformed the other regions by their higher performances in the areas of ICT development, transport and improved sanitary services (AfDB, 2013).

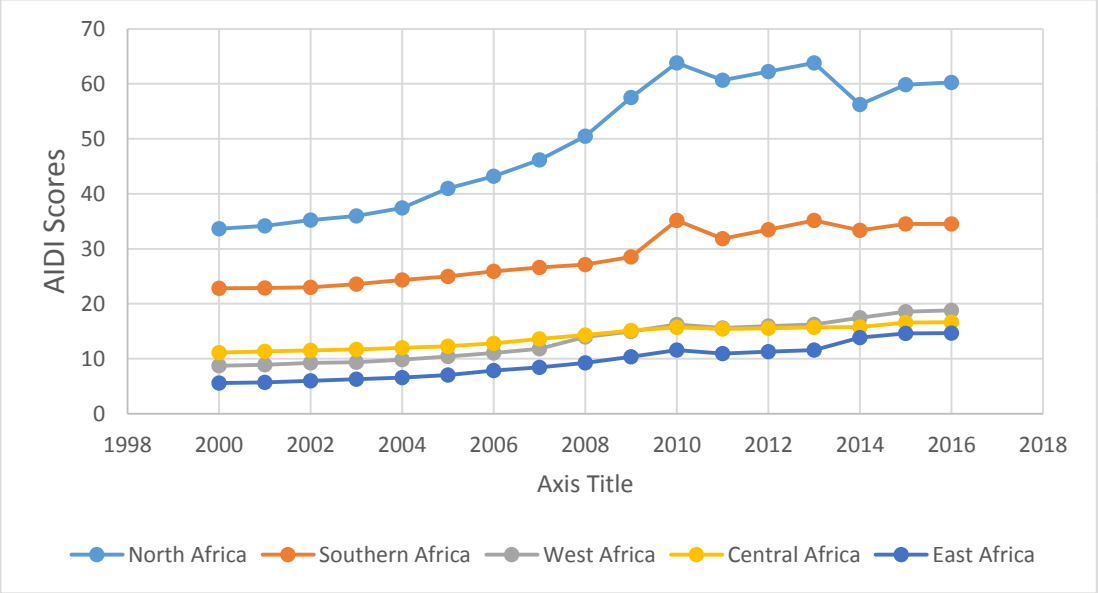

Figure 1.6 : Infrastructure Development for the sub-regions in Africa
(Source: Based on AIDI.)

On the other hand, while the West African sub-region was lagging behind central Africa in late 2009, a slight improvement in the paved road density, electricity generation and transformation in the ICT sector placed it ahead of the former in the subsequent years. Moderate, or even low performance regarding access to clean water, paved road density and ICT development have been among the factors that stacked the Central and East African sub-regions` infrastructure development (AfDB, 2016). Nevertheless, improvement (albeit meagre) have as well been seen in the bottom two sub-regions; particularly in the recent ranking of 2013-2016. On a general note, assessing the African countries based on the AIDI showed that, almost all of the countries ranked at the bottom ten are notably characterised with low performance in ICT, transport and power (AFDB/AIDI, 2016).

1.1.4 Trade Facilitation and Trade in Africa

In addition to its rapid urbanisation, Africa has been with the fastest growing population, exceeding 1 billion since 2011 (AFDB, 2014b). Having increasingly attracted more investors into the region than decades in the past, Africa is emerging as a frontier market with its export amounting to 637 billion in 2012 (WDI, 2018). However, regardless of the liberalisation of most of the African markets, poor soft trade facilitation measures that added to the physical infrastructure deficits in the region may have been the reason for the low business operations and the under-performance in trade recorded in the continent (AFDB, 2014b; AFDB, 2013). As a

result, even with the many trading initiatives in place for decades, still, markets remained poorly connected in the region. While, concerning the inter-regional trade as a percentage of total for the continent, it was for instance put at just 16 per cent in 2014, as against 56, 61, and 69 per cent for America, Asia, and Europe, respectively (AFDB, 2016). In line, figure 1.7 shows that Africa continued to perform below its counterparts regarding global total merchandise exports.

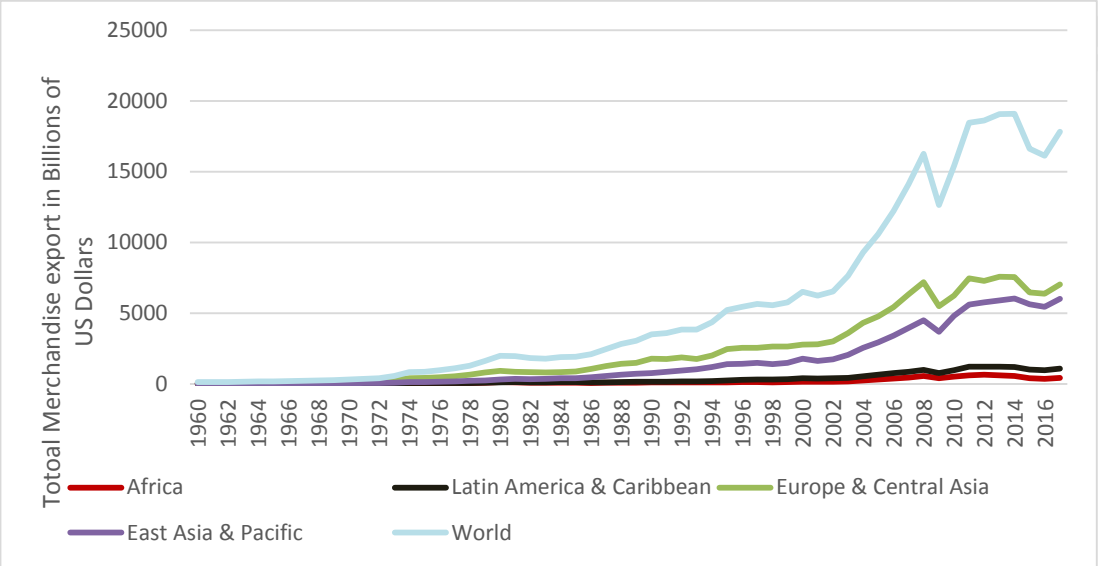

Figure 1.7 : Total Merchandise Exports
(Source: Based on World Bank WDI.)

Furthermore, possibly, due to the volatile commodity prices of recent years, the dollar value for the region`s export continue lagging that of other developing regions, if not even falling. Though the dollar value for the export of Africa reached about 637 billion dollars in 2012, as at 2017, it dropped down to around 414 billion. Consequently, empirical literature have corroborated with the arguments in policy debates that cited poor trade facilitation as one of the factors resulting in the low trade performance of the African region. Similarly, that may not be unconnected with why the cost of doing business in the region is the highest, and that the price of export from Africa are still the highest in the global market (Atkin & Donaldson 2014; AFDB, 2014). Therefore, the role of trade facilitation in smoothing and expanding trade has been highlighted in both the theory and empirical literature (Agbelie, 2014); and that could be paramount, particularly to the African countries as it can help reduce the uncommon high cost of doing business in the region and foster trade expansion across the continent.

Of course, some progress has been recorded recently, especially on the aspect of physical security and regulatory environment on the borders, but there is still the need for more improvements in order for Africa to attain efficiency in making export/import. In terms of transport sector, despite the relevance of road infrastructure to the smooth flow of trading activities (Volpe Martincus and Blyde 2013; Cosar and

Demir 2016), significant portion of the roads in Africa are unpaved- only less than half of the total roads in the continent are paved (AFDB/OECD/UNDP, 2018). Similar to the role of transport infrastructure in trade, number of empirical studies have documented proofs on the impact of ICT usage on trade flow (Ahmad et al., 2011). But that has not been the case with Africa; lack of modern ICT facilities in most of the ports across the continent has continued to cause delays and increase the cost of documentation as obtained.

It worth noting, however, that the factors limiting trade expansion in the developing African region lie beyond just the physical infrastructure deficit. As highlighted in table 1.1; virtually, by all measures of the soft trade facilitation indicators, the region is considered at the backward. Africa has the highest number of documentation needed in doing business, which has therefore added to the time and cost involved in the process. And as argued by Djankov et al. (2010), the cost levied exporting/importing a 20-foot container, and the time and number of documents needed per shipment to export/import matters much that they influence trade cost and volume. In the same vein, rating Africa based on the Enabling Trade Index (ETI) of the World Economic Forum, most of the countries in the bottom of the list is from the African region (World Economic Forum, 2017). Since its introduction in 2008, the index (ETI) has formed part of the widely used toolbox by policymakers in their effort to track progress in improving trade facilitation measures. Constituting four major sub-Indexes: the market access sub-index, the border administrative sub-index, the transport and communications infrastructure sub-index, the business environment sub-index, the ETI is used to rate a country/region vis-à-vis the rest of the member countries.

It could hence be argued that the differences in trade performance seen across and within regions may not only be explained by the differences in the access and quality of physical infrastructure across the regions/countries of the world, but also by how improved are the soft trade facilitation measures (World Bank and AFDB, 2013). For that reason, indeed the poor trade facilitation could be more harmful particularly to the landlocked African countries (World Bank & AFDB, 2013), who because of being located in a geographically disadvantage location, their ability to access global market implies relying on the institutional as well as infrastructure quality in their exit, or transit countries (AFDB, 2015). Thus, the obsolete "on the border" clearance procedures and the deficit in the physical infrastructure in the continent remained one of the major problems to trade across the developing African countries.

1.1.5 Infrastructure and Food security

Hunger and deficit in the food supply are still among the major challenges to good health and wellbeing among the world population, with children affected the most (United Nations System Standing Committee on Nutrition, 2010). That is why, even the high prevalence of underweight and stunting among children is linked to the incidence food deficit and hunger, particularly in the developing countries (World Health Organization, 1994). Therefore, in order to achieve global prosperity, the United Nations committee on nutrition has emphasised for the need to ensure

sufficient nutrition for all, specifically by giving importance to small children, women and the most vulnerable. The central argument for combating hunger and poor nutrition has however gone beyond just its human right fundamentality; the further associated macroeconomic consequences of the problem are unbearable (FAO, 2014).

Even though a recent periodic stocktaking concerning hunger and undernourishment have been quite revealing considering its figures of the early 1990s, but upon the overall progress made, hunger remained a daily challenge for almost 821 million people globally (FAO, 2018). This calls for a more holistic and coordinated approach that will require the commitment of stakeholders at all levels. Examining the trend across regions, sub-regions and countries have shown a significant global variation as to the progress made in reducing undernourishment among people (FAO, IFAD & WFP, 2014). More specifically, the recent global progress gained in combating undernourishment, say to its 12.9 per cent in 2014-2016 is linked greatly to the progress achieved in the populous countries of China and India, while leaving a much work to be done in other countries and sub-regions across the developing world (FAO, 2015). In accordance, the continent of Africa has remained with the high number of people affected by hunger (FAO/OECD/UNDP2018); where approximately, one in every four in sub-Saharan Africa is said to be undernourished.

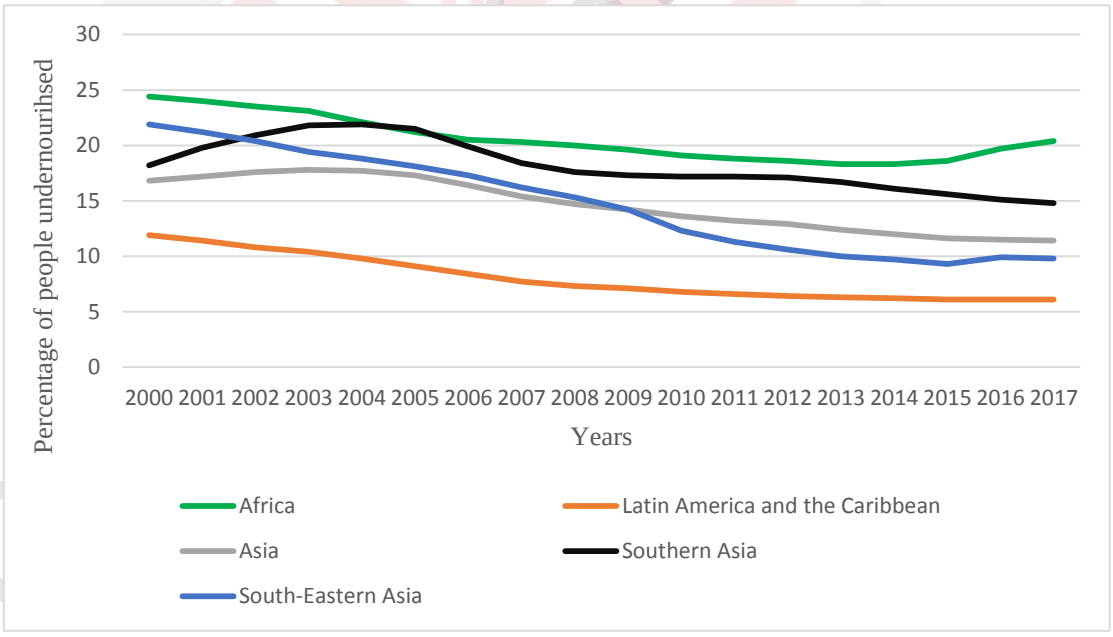

Figure 1.8 : Prevalence of undernourishment across regions
(Source: FAO 2018.)

It would be observed in figure 1.8 that on average, Africa is so far with the highest prevalence of undernourishment when compared to its other-world counterparts. Though the underlying causes of undernourishment could be so complicated and reinforcing- ranging from poor health services as in poor child and maternal care, to

poor economic and political environments (ACC/SCN, 1997), but for the developing African region, a more pronounced factor believed to have worsened the situation has been food insecurity (FAO/IFAD/WFP, 2014). While the genesis to the concern on food insecurity can be linked to the 1948 universal declaration that acknowledged the right to food as an essential component of an adequate standard of living for people (UNDP, 2014), but the surge of interest particularly in Africa on the problem began with the continent`s famine of 1984-85 (Maxwell & Smith, 1992).

Given that, one of the significant supporting measures for ensuring food security suggested for the region of Africa, and in accordance with other developing regions was a transformation in agriculture (Crush et al., 2011). The reason being its key role in increasing food availability and income, thereby improving both food and nutritional security (ACC/SCN, 2010). On the contrary, despite embarking on the green revolution program by most of the African countries, the continent was reported to annually imports food items of about $25 (AFDB, 2015). Based on figure 1.9, regardless of the vast arable land available on the continent, Africa substantially lags other developing regions in terms of cereal production, which may perhaps be due to its subsistence nature of agriculture and the use of obsolete farming implements.

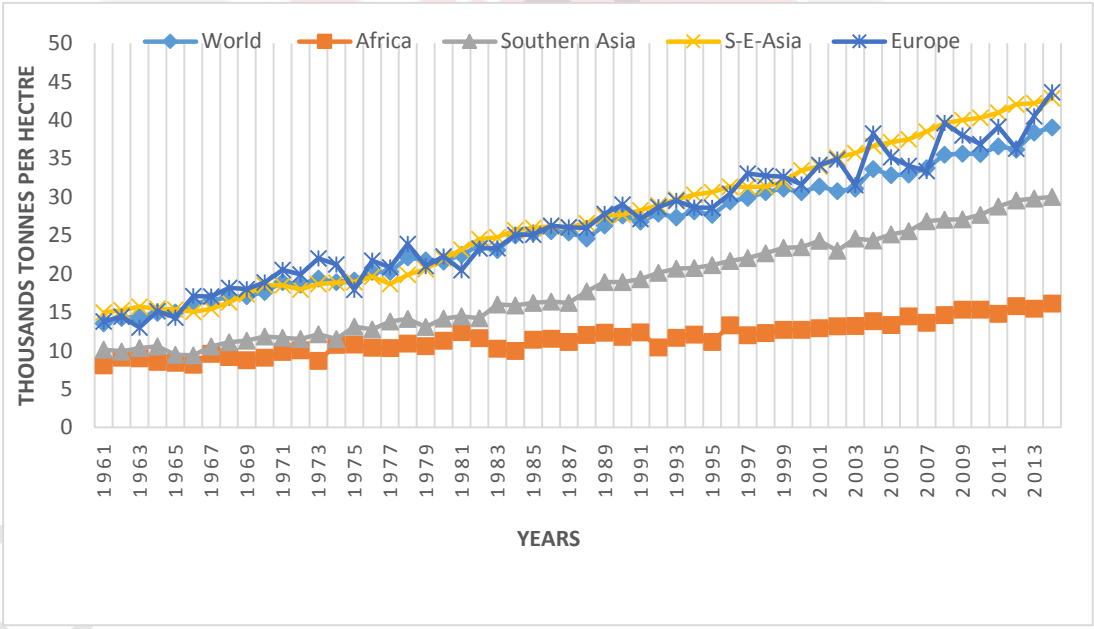

Figure 1.9 : Annual Cereal Yields by Region
(Source: FAO, 2017.)

However, it worth noting that only ensuring enough food is produced doesn`t solve the food insecurity problem; this argument is in line with the assertion that the main problem to food security is not only lack of food sufficiency but also the other non-food elements relevant in achieving food security (Tacoli et al., 2013). Connectivity between farms or places where the food is available and those in need of the food is entirely necessary that a good transportation system is vital to physical food access

and distribution. So also, relevant to that respect is the safety in the food eaten- clean water and improved sanitation, which implies ensuring proper management of the food by households. Analogous to our argument is the assertion that linked achieving food security not only to a single element, instead what they called a "system which begins from the farm to plate" (Tacoli et al., 2013). This is also being noted in the broad definition of food security given by FAO, where the relevance of numerous non-food elements to achieving food security is highlighted.

Therefore, this brings the discussion to what is meant by food security, and how ensuring a food secured community is not possible without attaining some non-food elements. The term food security was used in the past to refer to a scenario entailing food supply in relation to its demand at the national, regional or global level by taking into account sufficiency or otherwise in the food intake (Maxwell, 1996). In recent times, a much broader and generally applied definition for food security is given at the food security summit of 1996. It is said to be achieved when all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (FAO, 2006). In view of this broader definition, emphasis on food security has currently gone beyond how much is produced, and in what geographical location, but other factors such as the food accessibility- in both its economic and physical sense and food utilisation are regarded as significant.

Thus, implicit in the food security definition are the four dimensions of food security- food availability, accessibility, utilisation and stability. The dimension of food availability is about how much of the needed food calories have been produced or supplied; whereas, accessibility is from the two lenses of economic and physical access to food. However, with the remarkable achievement recorded in connecting people beyond national borders in this era of globalisation, less would be worried about the need for every nation/community to necessarily produce for their consumption. Food shortages in distant places could be handled through cross border transfer of food and trading. But, that may not necessarily be the case in some developing countries, particularly those in Africa whose poor state of road connection is found to hinder many activities in both rural and urban centres (AFDB, 2015).

On other side of the coin, given both food availability and accessibility deal with the demand side of food security, one may assert that individual preferences reflecting variations in socio-cultural inclination of societies could limit on "what foods" are consistent with the prevailing taste and values of communities (Barrett & Lentz, 2010), thereby limiting food availability to some extents. Conversely, the effect of socio-cultural background here is more of food availability; therefore, physical access in its broader sense is at the centre to determine the range of food choices open to the individual(s) given their level of incomes and the prevailing market prices.

Whereas, food utilisation being the third food security dimension is about what use is made with the total food calories available (Barrett, 2010). Food utilisation as such is about the food quality and safety, which by implication is contingent on the peoples`

access to an improved sanitary, and clean water for domestic usage. In accordance, figure 1.10 illustrates the relationship between infrastructure (sanitation) and the indicator for food insecurity. Based on the plotted graph, an increase in the percentage of people with access to improved sanitary facilities reduces the risk of prevalence of undernourishment among the population.

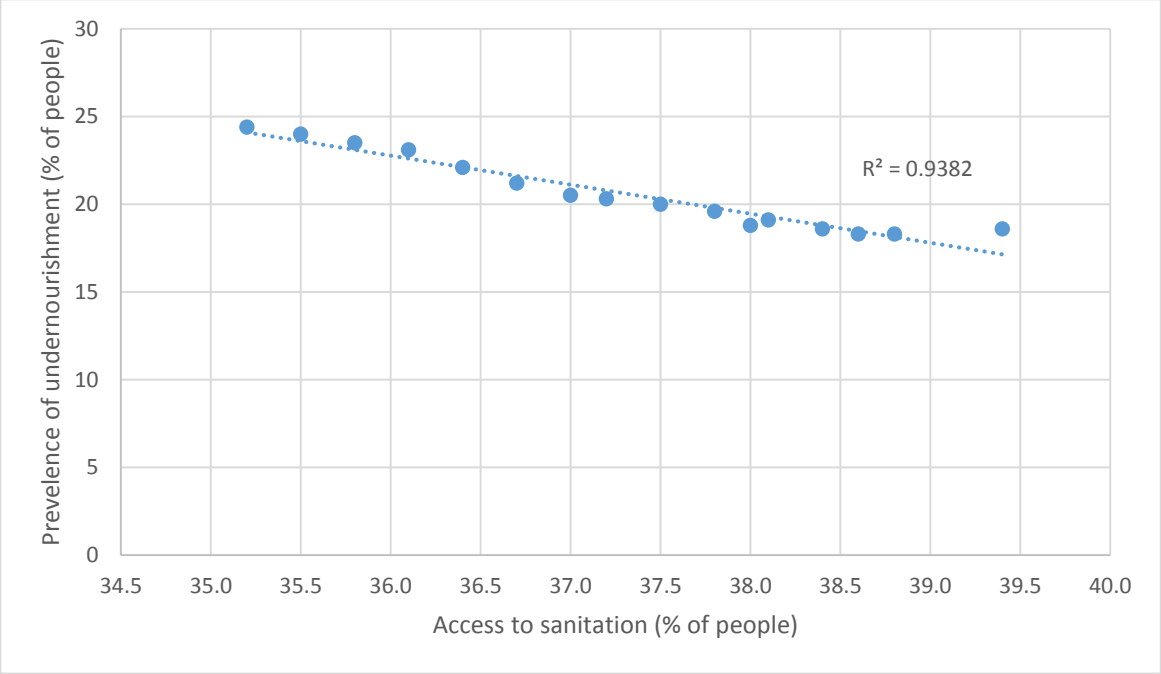

Figure 1.10 : Plot Graph on Infrastructure and prevalence of Undernourishment. (Source: Based on FAO Database.)

Moreover, ensuring stability in realising the three earlier discussed food security dimensions is necessary that without which food security is failed to be achieved (Tacoli et al., 2013). In conjunction with the assertions of FAO as in the definition of food security, people can only be regarded as food secured by being food secured on a periodic basis. This shows the relevance of the other non-food dimensions of the food security where shock in any may temper with the ability of the microorganism to release to the body the needed nutrients, or the ease with which food could be accessed from other geographical locations. However, ensuring food security requires concurrent attainment in all of the four dimensions listed, but only little is known empirically about how interdependence between them could worsen or abate food insecurity, particularly across developing regions (Cafiero, 2012).

Therefore, very significant to the food security policy measures of the African countries would be widening the focus to include measures aimed at ensuring easy food access irrespective of geographical locations. Furthermore, for the fact that still, some food insecurity indicators coexist with food abundance, the importance of the other non-food components of food security cannot be overemphasised. For instance, for a proper functioning of the microorganism in the body, there is a need for a good

healthcare delivery (Boratyńska & Huseynov, 2016). So, with access to clean water and improved sanitation having a direct effect on human health condition (Agenor, 2010), the deficit in their supply could mean poor health condition among people; and this may at large harm the effort exerted to solving the problem of undernourishment, and hence food insecurity.

1.1.6 Infrastructure, health, education and economic growth

Beginning with the new millennium, the continent of Africa has undergone a tremendous positive change from its decades of difficulty and growth stagnation (AfDB/OECD/UNDP, 2015). The average growth rate for Africa`s real GDP between 2001-2014 was put above 5 per cent; and 3.4 per cent in the year 2015 (AfDB/OECD/UNDP, 2016). However, following the global commodity price swings that began in mid 2014, economic growth was thwarted in the continent- particularly that Africa`s main export is primary commodities (AfDB/OECD/UNDP, 2017). So, the global commodity price shock hit hardest the giant economies of the region, such as Nigeria, and that resulted into a significant setback to the economic growth of Africa. This hence added to the shocks caused by the Arab spring and drought incidences reported in some parts of the continent. Subsequently, the pace of the growth slowed to 2.2 per cent in 2016. Nonetheless, having the prices of oil and metal improved around the end of 2016-2017, the real output growth for the region was estimated around 3.5 per cent in 2017, and 3.4 in 2018 (see figure 1.11).

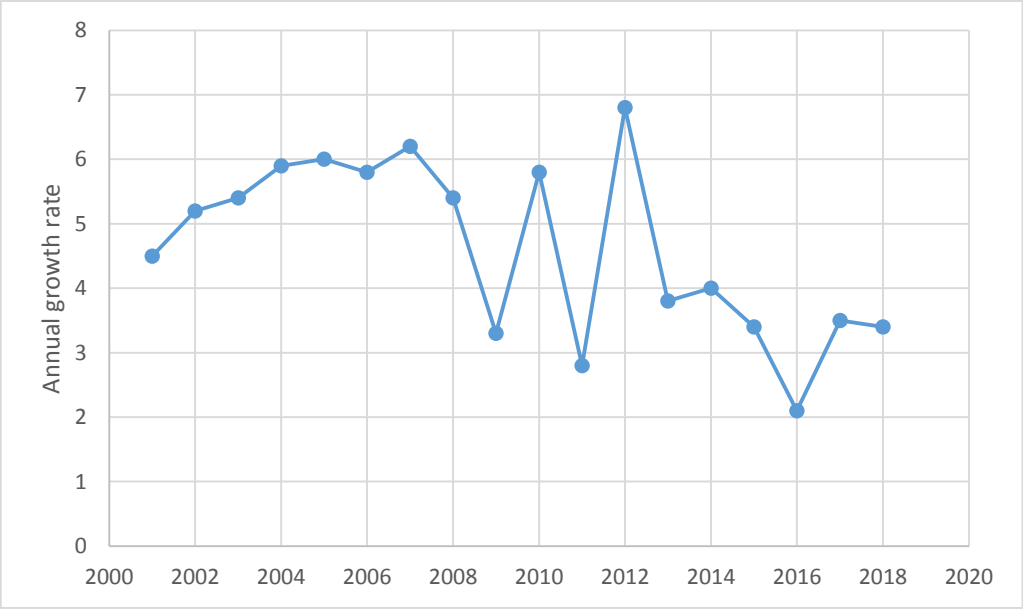

Figure 1.11 : Real GDP growth
(Source: IMF Database.)

There is however a significant variation as to the pace in which the sub-regions and countries in the African region grow (AfDB/OECD/UNDP, 2017); and that may arise from differences in the primary source of earnings for the countries and their political and social stabilities (AFDB, 2015). In that essence, almost for straight three years now (2016-2018), East African sub-region has remained the fastest growing economy in Africa, where its estimated average growth rose up from 4.9 and 5.6 in 2016 and 2017 to 5.8 per cent in 2018. In addition to the significant FDI inflow into the subregion, growth has mainly come to the East African countries from services, private consumption, construction and infrastructural investment (AfDB/OECD/UNDP, 2016; 2018). The second fastest growing subregion has been North Africa- signifying a recovery from the growth slowdown caused to the Northern African countries by the 2011 Arabs upspring and fall in oil prices (AfDB/OECD/UNDP, 2016). In line, the returns of Libya`s oil production and the steady growth recorded in Egypt around 201-2017 have been linked to the recent improvement in the subregion`s real growth rate.

The recent great performance recorded in the South African subregion`s growth placed it as the third fastest in economic growth in Africa (AfDB/OECD/UNDP, 2018). Even though the rate is lower than the African average, but it nearly doubled from the figures of 0.9 per cent in 2016 to 1.6 in 2017. Also, partly due to improvements in the sectors of mining, agriculture and services, projections have shown more signs of future growth in 2018 and 2019 in the region. On the West African region, the global oil price dwindling and the rise in the activities of Niger Delta Militants that halted oil production in Nigeria has dramatically affected the region`s largest economy. Nonetheless, with an increase in output in both oil and agricultural production, economic growth in Nigeria and hence, west Africa is projected to bounce. Lastly, the region of Central Africa has remained the least regarding economic growth amongst its counterparts, and that has been attributed to the underperformance in the oil reach countries of Republic of Congo and Equatorial Guinea. Oil price has though been favourable during the end of 2016-2017, yet that falls less of the adverse effects of the significant fall in the output of the two countries (AfDB/OECD/UNDP, 2018).

On the other side of the coin, perhaps because Africa`s economic growth is virtually from a lower starting point, coupled with relatively a shorter period of the above-average economic growth, the recent rapid progress achieved in the region has been less inclusive (Bank & AFDB, 2013). More precisely, living standards in most of the countries in Africa continued to deteriorate, with a re-current food crisis making the news headlines. Employment generation and thus poverty reduction have not followed the economic progress achieved; instead, the number of the poor population is found on the rise (AfDB/OECD/UNDP, 2018). Unlike in other regions, despite the economic stride achieved in recent years by Africa, much is left to be done in order to achieve a structural transformation (Golub & Hayat, 2014).

Therefore, very important to that respect is the need for having a quality human labour, especially given its role in promoting productivity. A great stride has been made regarding human capital development, whereby, starting from the 1990s, about sixty

million more children in sub-Saharan Africa alone have been enrolled into primary schools; with the enrolment rate in secondary schools more than doubled as well- from 20.8 to 46.3 million (AFDB, 2014b). However, in terms of adult literacy, the enrolment rate for tertiary institutions as of 2014 was only 16 per cent, plus about 80 million adults without formal education (AFDB, 2014b). In fact, by any indicator of education outcomes, Africa is lagging behind. That could be seen in figure 1.12, where the estimated average mean years of schooling in Africa is around 5.5 years, which is far below that of either South Asia (8 years for male) or Latin America (8 years). But, the recent call made by the African Development Bank to the respective nations in Africa to put effort in building human capital has shown the region`s readiness to ends its adversities (AfDB/OECD/UNDP, 2018; P: 56).

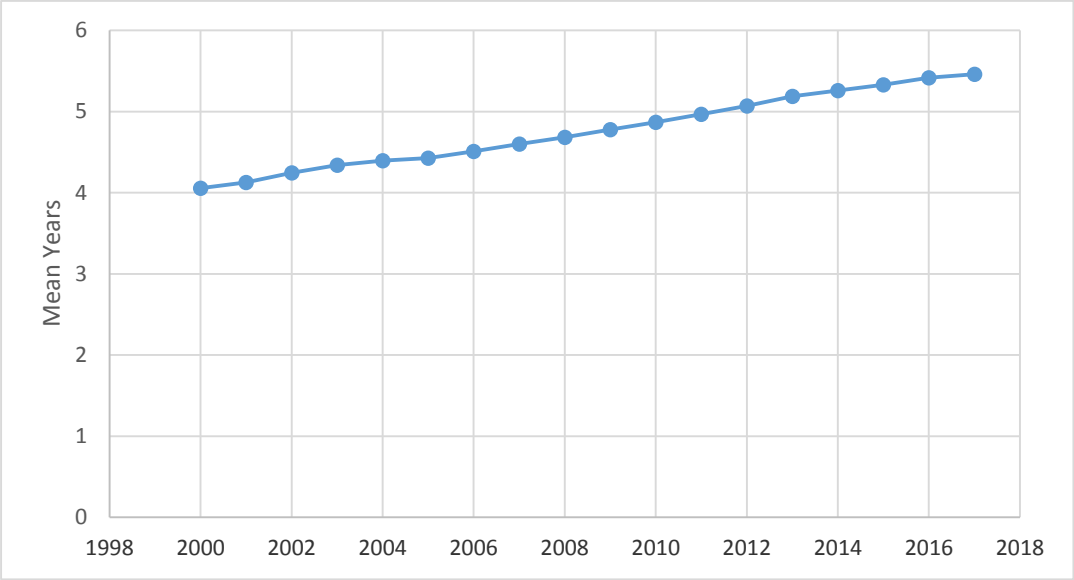

Figure 1.12 : Mean Years of Schooling
(Source: based on UNDP`s data.)

On the state of healthcare in the region, statistics have found a significant improvement to have been achieved over the years, following the period of numerous challenges such as widespread epidemic diseases particularly during the 1980s, malnutrition and food shortages in many countries (AFDB, 2014a). But in the present, partly driven by the improved economic conditions in the continent, life expectancy had tremendously risen from its 37 years in the 1950s to about 64 in 2017; though with variations across the continent, depending on the economic prospects of the countries. In view of that, Africa undeniably made greater headway in improving general healthcare across the continent; however, still, a comparable analysis among its counterparts placed it as the region with the lowest life expectancy (figure 1.13) and highest mortality ratios. Similarly, Africa has the lowest hospital beds to 10, 000 people ratio, and percentage of women using modern family planning schemes (AFDB, 2014b). It could not be surprising, therefore, that Africa continued leading concerning both maternal and under-five mortality rates.

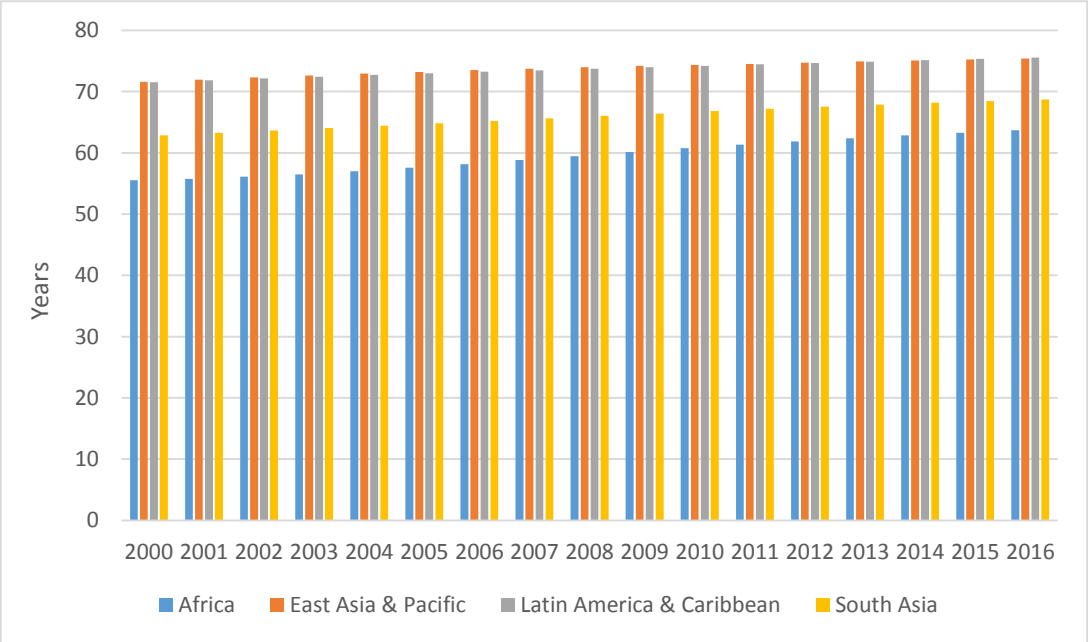

Figure 1.13 : Life Expectancy
(Source: Based on data from UNDP, Food & Nutrition.)

Therefore, giving the multidimensional effects of poor health and education, an all-encompassing policy approach that could improve the social wellbeing of the people and foster growth in the African region is essential. However, from among the numerous remedial policy agenda on the list of the policymakers in the region, virtually infrastructure development has been regarded a top priority (Agenor, 2010; AfDB/OECD/UNDP, 2018). That has been in line with the empirical studies linking infrastructure to economic growth. It began with the early work of Aschauer (1989); and also some recent studies such as, Fedderke and Z., (2009); Farhadi, (2015) among others. Going by the findings in Fedderke and Z., the impact of infrastructure on growth was not only positive but economically meaningful. Also, Farhadi, (2015) showed that infrastructure investment in the OECD countries influences growth through improving labour productivity. Impliedly, labour productivity is increased by the growth in infrastructure stocks.

However, while empirical literature on the positive influence of infrastructure on economic growth is far from being unanimous (Ayogu, 2007), recently, studies have begun to examine other indirect channels through which infrastructure could affect growth; prominent among which are health and education outcomes (Agénor & Moreno, 2006). Hence, given evidence from microeconomic studies (see Brenneman & Kerf, 2002), it is now argued that, under the right conditions, infrastructure also promotes health outcomes and school enrolment, which in turn promote growth (Agénor & Moreno, 2006). Regarding the health sector, proofs based on studies show access to basic infrastructure as very necessary in ensuring healthcare delivery. For instance, the great fall in the infant and maternal deaths witnessed in recent decades in Malaysia and Sri Lanka were not only linked to additional investment in the

healthcare sector, instead, also the access to better roads that made it easier to reach to the rural healthcare centres (World Bank, 2005b).

In the same coin, in a survey conducted in 2005 across African countries, poor road connection was found to have been listed as the main factor that hinders womens` access to health care centres (African Union, 2005). It was also found that providing a quality road connection to have increased access to healthcare centres in rural Morocco in the 1990s (Agénor & Moreno, 2006). On the other side of the argument, because of the lack of reliable power in the African continent, and coupled with the health consequences of using local fuel, about 85 per cent of the people in Africa were estimated to rely on local fuel for heating (Agenor and Moreno, 2006). In line with that, a survey conducted found that, for the Kenyan national government to curtails the problem of respiratory infections in children by 21 to 44 per cent, a shift from using wood fuels to charcoal as a source of heating was required in the country.

It is therefore evidently clear based on empirical facts that, while improvement in infrastructure facilities such as, clean water and sanitation, access to power and good road connections impact on health and education outcomes positively; in return, both the health and education outcomes are empirically found to facilitate economic growth in the long run (Golub et al., 2014). In a similar assertion, a 2005 report by the United Nations has mentioned the presence of malaria diseases to impede economic growth in Africa by about 1.3 per cent point every year. Impliedly, low life expectancy would affect growth through a decrease in the number of human capital and savings. Therefore, by ensuring access to a stable power, clean water and sanitation, the existing economic doom in the African region may be turned around.

Moreover, the long-run growth impact of infrastructure is also achieved through its impacts on educational outcomes. By building more roads, for instance, governments may not only reduce production costs for the private sector and stimulate investment, it would also improve school attendance rate, and hence literacy level. Through easing access to schools and other learning centres, their knowledge would improve, which therefore enhance long-term growth because they have become more productive (Golub et al., 2014). It could hence be argued that given the cost burden associated with building infrastructure services, people living in remote areas might be left with limited access to improved learning facilities.

In that regards, not only does increase in the access to clean water and sanitation lower the incidence of waterborne diseases; it was also shown to improve attendance and enrolment rates in schools, thereby increasing the literacy level. Like wise, better road connection was obtained to reduce school dropout. This corroborates with the arguments in the work of Agenor & Neanidis, (2011) that link girls enrolment to roads connection. It is hence in the right course to say that the availability of basic infrastructure such as safe drinking water and roads would influence teachers` decision to stay and work in rural or suburban communities. Good road connection would also be beneficial for commuting learning equipment to the rural areas. In line, providing clean water and improved sanitation around schools in Georgia was found to have

raised attendance rate and decreased the health risk rate for school-age children (Lokshin & Yemtsov, 2005).

Regardless of the role of power in growth and development, the majority of countries in Africa are faced with acute power shortage. Going by the statistics in the previous section (table 1.1), only less than 50 per cent of the population in Africa do have access to electricity; while based on the estimates by the United Nations, it was only one in every five of the people that have access to electricity in Africa (United Nations, 2005b). Because of that, it could be said that schools in the African continent may hardly benefit from the advantages of technological advances associated with the use of a computer (Lokshin & Yemtsov, 2005). The lack of power access may hence leave educationist with the only option of employing obsolete methods of teaching/learning that lack the application of ICT. Importantly thereof, unless measures are taken towards providing or, maintaining the few decayed infrastructures in Africa, schools in the region may hardly produce the required human capital with skills needed to aid in developing the region even when the other essential components of achieving economic growth are in place.

1.2 Problem statement

Motivated by the essential policy debates in international economics, growth and development economics, this research entails exploring the impact of infrastructure on trade, food security and economic growth in African countries. The global merchandise trade has returned to its growth from the two years of slumber experienced during 2015-2016 (UNCTAD, 2018). That is similar for the African region; however, trade growth in most of the African countries has been weaker than other regions (AfDB, OECD, UNDP, 2017). The average growth rate for the export of the continent was put to 3.5% after the global economic turmoil of 2007-08, alongside the world growth of 5.1%. This necessitates Africa to targets not only on improving the region`s competitiveness in the global trade arena, but also deepens integration amongst the various countries in the region- notably that the intra-African trade is found less susceptible to global shocks than trade between the continent and the rest of the world (AfDB, OECD, UNDP, 2016).

However, one of the problems to stand the way of actualising the targets of boosting the international and intra-African trade for the region is its poor trade facilitation. The poor state of infrastructure in the African countries has been a great challenge to its trading activities; and also a primary limiting factor to communities' integration in the continent. As such, the role of trade facilitation in fostering trade has been documented in empirical literature (Ahmad et al., 2011). Nonetheless, not more than fewer studies are conducted on Africa- with some studies employing a single or few trade facilitation indicators and examine its effect on trade (Djankov et al., 2010); or cover a small number of the African countries (Portugal-Perez and Wilson 2012). Given that, this study will be among the few (such as Tomasz & Kirkpatrick, 2007) to have employed some infrastructure indicators (hard & soft) and examine its effect on trade in the panel

of African countries. This is relevant, especially at a time when Africa seeks to boost trade and deepens integration amongst its countries.

Secondly, the problem of food insecurity has remained a major global problem of top priority to the international community; and that has also been a trending academic research area (Conceicao et al., 2016). Even though some progress has been recorded in improving food security over the years, recent statistics have shown a global rise in the number of undernourished people, with developing countries from Africa affected the most (FAO, 2018). The global number of undernourished people has risen from 795 million in 2015 to 821 million in 2017. So, given its significant effect on sustainable human development and economic growth, United Nations member countries have made a commitment that targets zero hunger and malnutrition by 2030- SDG2 (United Nations, 2015). To make the SDG2 pledge a success, an improved understanding of the significant determinants of food security and how they may vary across countries/regions is considered relevant.

Given that, empirical studies have examined the factors that affect food availability, economic access to food, stability in the food supply and food access (Burchi & De Muro, 2016; Devereux, 2016). However, despite the relevance of clean water and improved sanitation in food utilisation and road connection on physical food access (Drèze and Sen 1989; Sen, 1981), only a few (microeconomic) studies have empirically measured the impact of these infrastructure facilities on food security. In what they summarise as the relationship between people and food, Drèze and Sen (1989) provide clues as to what use (food utilisation) each person should make with the bundle of food available to them. Similarly, the debates on the importance of physical food access made its way into the food security definition after Amartya Sen's assertion that 'Starvation is a matter of some people not having enough food to eat and not a matter of there being not enough food to eat' (Sen, 1981; p. 434). Building on that, the current study would add to the empirical debate on the infrastructure-food security nexus through analysing the impact of infrastructure such as road, sanitation and water on food security in African countries.

Thirdly, statistics have shown Africa to in recent decades achieve a great mile in economic growth, where the average growth for the region between the years of 2000 to 2015 was estimated at around 5 per cent (AFDB, 2016). One of the factors responsible for that has been improvements in the infrastructure developments in the continent (Calderon, 2008). This is in line with empirical proofs that link infrastructure to economic growth, positively (Farhadi 2015; Fedderke and Z, 2009). However, while the empirical debate on this assertion is far from being unanimous (Ayogu, 2007), studies have begun to explore other indirect channels through which infrastructure could impact on growth- prominent among which are health and education outcomes (Agénor & Moreno, 2006). In line with some documented microeconomic proofs, infrastructure has been shown to promote health and education outcomes, and through both channels helping to promote growth in the long run.

Obviously, ensuring that people get access to good health and quality education is part of the preconditions for inclusive economic growth. However, other than investments in the health or education sectors, making certain that people get good healthcare and quality education requires the provision of other vital factors, such as good infrastructure (Agenor & Moreno, 2006). For instance, in two separate studies, lack of adequate road connection in some parts of the African continent was found related to girls` school enrolment and, women`s access to healthcare (Levy, 2004; African Union, 2005). Thus, the main argument remains that, through the provision of road networks, clean water and improved sanitation, power and an improved ICT, the general health condition of the people will improve as will do their literacy level. Consequent up on that, a long run economic growth in the economy will be achieved. So, given the theoretical and microeconomic arguments (see Agénor & Moreno, 2006; Brenneman and Kerf, 2002) linking infrastructure to economic growth in the long run, the current study seeks to examine the effects of infrastructure on economic growth through its influence on health and education outcomes.

1.3 Objectives of the study

1.3.1 General Objectives

The general purpose of this research is to offer an empirical examination of the role of infrastructure in boosting trade, food security and economic growth in African countries.

1.3.2 Specific Objectives

1. To investigate the impact of infrastructure on trade in Africa.
2. To determine the impact of infrastructure on food security in Africa.
3. To examine the impact of infrastructure on economic growth in Africa.

1.4 Significance of the Study

The role of trade facilitation (hard & soft) in fostering within and cross-border trade cannot be overemphasized (Ahmad et al., 2011; Agbelie, 2014); and that could be paramount, particularly to the African region that is aiming to reduce the uncommon high cost of doing business and deepens integration amongst its countries. Quite a number of studies have been conducted that specifically illustrated a link between trade facilitation measures and trade performance of nations. Nonetheless, not more than fewer studies are conducted on Africa- with some studies employing a single or few trade facilitation indicators and examine its effect on trade (Limão & Venables, 2001; Djankov et al., 2010), or cover few African countries (Clarke, 2005; Portugal-Perez and Wilson 2012). The current study would thus be among the few (such as, Tomasz & Kirkpatrick, 2007; Spence et al., 2011; Freund & Rocha, 2010) that employed some indicators for both hard and soft infrastructure and examine their

effect on the trade of the African countries. The study would hence add to the empirical debate on the infrastructure-trade nexus in the African continent, especially at a time when the region seeks to harness more from its trade potentials.

Despite the progress achieved in improving the food insecurity situation in the African region, the continent still has the highest prevalence of hunger and malnutrition in the world (FAO, 2018). The traditionally recommended solution to the food security crisis in the early years was more of the need to improve agricultural sector, which aimed to massively increase food production, particularly by small rural farmers (Toenniessen et al., 2008; Clover, 2003). However, for the fact that recent empirical proofs showed some food insecurity indicators coexist with abundant food availability (Crush et al., 2012), concerns have currently been directed to the impact of other non-food services on the food insecurity. Therefore, in connection to the early theoretical discussions that illustrate the relevance of physical food access and food utilisation to food insecurity, the current research intends to examine the food insecurity problem from a different perspective. The effect of infrastructure facilities such as, clean water, improved sanitation and road on food insecurity in African countries is assessed. In that regard, in addition to the empirical importance of the study, policymakers across the African countries could find it useful in decisions making.

With the direct impact of infrastructure on economic growth being characterised by mixed findings (Mohmand et al., 2016), the current research has been based on the theoretical arguments of Agenor and Neanidis, (2006), among others, which showed other new channels through which infrastructure could affect economic growth. The study empirically illustrated an indirect effect of infrastructure on economic growth, by interacting the employed infrastructure variables with health and education outcomes (life expectancy and mean years of schooling). Thus, the study could be useful for policy making, mainly that it revealed some complementarity between policies meant for building more education or healthcare units and the provision of easy access to the nearest existing ones.

1.5 Scope of the Study

The study examined the impact of infrastructure on trade, food security and economic growth in African countries. In achieving the first objective of the study, trade is proxied by the total export in the sample African countries. Whereas, to measure trade facilitation, hard and soft infrastructures such as road, number of documents per shipment to export/import, cost levied on a 20-foot container and the time to comply with all the procedures to export/import have been employed. Moreover, because the first objective of the research is based on the gravity theory of trade, some variables considered vital in the gravity model have also been employed. They include GDP and population for the bilateral countries and the distance between them. Other time-invariant variables considered is language, remoteness, border, colony, common colony.

For the second objective of the research, the impact of infrastructure facilities (roads, improved sanitation and clean water) on achieving food security in the African countries is assessed. However, in order to proxy the dependent variable, two indicators for food insecurity are used- the prevalence of undernourishment and depth of food deficit. Going by the arguments in the literature, physical food access is presumed to be enhanced through better roads connection; and availability or accessibility to improved sanitation and clean water aids proper food utilisation. Therefore, in the second objective, the impacts of the mentioned infrastructures on food security are measured through their effect on food physical access and food utilisation.

Lastly, the third objective of this research determined the direct and indirect influence of infrastructure on economic growth in African countries. The infrastructure indicators used in this objective are the composite infrastructure indexes of power, roads, water and sanitation, and ICT as provided in the Africa Development Bank database. Furthermore, to investigate the indirect effect, all the four infrastructure variables have been interacted with the two indicators for health and education outcomes (life expectancy and mean years of schooling).

1.6 Organisation of the Chapters

This work is organised as follows: chapter one focuses on the introduction, where the background of the study that entails giving insight on the state of trade, food security and economic growth across the African continent is presented. A detailed outlook on the state of infrastructure and how it is being related to the three macroeconomic issues in the research objectives are as well given. This is then followed by the presentation of the statement of the research problem, objectives, significance, scope and organisation of the research. In chapter two, a comprehensive discussion is given on the theoretical frameworks, and review of previous studies conducted on the impact of infrastructure on trade performance, food security and economic growth, particularly on the African region. Last in chapter two is the literature gap as obtained based on the reviewed literature.

Chapter three offered models specifications, econometrics procedures, nature, type and sources of the data used in the study. In chapter four, the results from the various estimated models and the findings are discussed and interpreted. The last chapter (chapter five) contained the summary, conclusion, policy recommendations and limitations of the study. Then finally, the list of bibliography, references, appendices, list of tables and figures were presented.

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