Agricultural Transformation and Development in Sub-Saharan Africa: Experiences and Policy Implications from the Asian Green Revolution

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Abstract

This review paper employs population and structuralism theories to analyse agricultural transformation in Sub-Saharan Africa, taking a broader continental approach. It also draws lessons from the Asian green revolution of the 1960s. The review finds that the population in Sub-Saharan Africa is increasing, leading to a corresponding rise in food demand. However, agricultural transformation has been limited due to several challenges including low government spending on agricultural interventions and research; inadequate extension service delivery; poor land use governance; insufficient agro-processing and value addition; limited investment; and climate change. Moreover, the Asian Green Revolution demonstrates that even densely populated regions can achieve agricultural transformation through increased productivity. The review concludes that agricultural transformation cannot occur without increased agricultural productivity accompanying structural economic changes. It emphasizes that agricultural transformation and structural economic transformation must progress concurrently. The review offers policy recommendations, stressing the need for strong political will and governments' commitment to drive agricultural transformation in Sub-Saharan Africa..

Keywords: Agricultural Transformation; Population; Development; Sub-Saharan Africa

Introduction

A fundamental relationship between population, food, agriculture and economic growth is well established in the literature. Europe, Asia and Latin America have benefited from this relationship thereby transforming agriculture for inclusive development. In this paper, agricultural transformation is defined as a process in which individual diversified, subsistence, labour intensive and low productivity farms shift to specialised, capital intensive, high productivity and commercialised farming (Staarts, 1998). This is a necessary condition for structural transformation defined, in this paper, as a process in which the economy and employment are generated by more productive sectors like industrial sector than subsistence agriculture (Mpango, 2013; Barrett *et al.,* 2017; Sen, 2019). Asia is highly populated and the Asian green revolution is one of the practical and educative illustrations of agricultural transformation and structural transformation (Johnson *et al.,* 2003; Diao *et al.*, 2008). However, the general picture is different in Sub-Saharan Africa[1] (SSA) where population is actually growing but agricultural productivity growth, necessary for structural changes, is low and has stagnated for many decades (Rashid *et al.,* 2013). This implies that agricultural transformation has either not yet taken place or is hardly taking place in the region.

This piece of work analyses population and structuralism theories and their relevance in SSA. Such theories are appropriate when explaining the nexus between agriculture, population, food and development as exemplified by the Asian green revolution. The agricultural sector is not performing well in SSA despite an increasing food demand attributed to an increasing population growth rate. The factors, which

[1] *Sub-Saharan Africa sub-continent comprises 49 out of 54 African nation states. The area is situated South of the Sahara Desert including East Africa, Central Africa, Southern Africa and West Africa.*

explain this conandrum are many and complex including poor land-use governance (Bob, 2010); low spending in agriculture (Africa Development Bank (2015); limited credit provision (Chivandire, 2019); poor extension service provision (Oladele, (2011), and low spending in research and development (Ncube, 2019; Stads and Beintema, 2020). Others are low usage of agricultural inputs like fertilisers, improved varieties and herbicides; failure to practise irrigated agriculture; poor agro-industrialisation to improve value addition; lack of or poor domestic and international markets; and climatic factors (African Development Bank, 2015). Asia encountered similar challenges in the 1960s and resolved them through the Asian Green Revolution. Addressing such challenges through appropriate policies would perhaps take SSA a step further towards speeding up agricultural transformation.

Agricultural transformation is a necessary and sufficient condition for development through structural changes within sectors of the economy predominantly agricultural and industrial sectors. This suggests defining development in broader terms. Nonetheless, the world including SSA has been trapped in a situation of inability to re-define development holistically, but rather defining it in economic terms such that inclusive development becomes challenging (Shao, 2004). The outcome has been a mismatch between the economy at a macro level and quality of life. For example, impoverishment or poverty, as universally recognised, is rampant in rural and urban areas while economic growth is impressive in some SSA countries like Tanzania. Inequalities also exist by gender, showing higher poverty among female-headed households than their counterparts (Niboye and Kabote, 2012; URT, 2019). The purpose of this review is to analyse agricultural transformation in SSA. The review is preceeded by theoretical underpinning and thereafter guided by two objectives: (i) Analyse agricultural transformation in SSA compared to Asia (ii) Discuss and propose policy options drawn from the Asian green revolution that are likely to accelerate agricultural transformation in SSA. Understanding agricultural transformation is critical than just economic growth because transformation takes a broader and holistic view that takes on board economic and social conditions.

Malthusian theory of population: agriculture, population and food nexus

This section explores the relationship between agriculture, population and food using population theories departing from Malthus theory of population. The Malthusian theory of population was coined by the classical economist, Thomas Malthus, whose ideas were widespread in the 18th century. The theory remains relevant as a point of departure to analysing agriculture, food and population relationship particularly in SSA where agricultural productivity growth has stagnated for many decades compared to Europe and East Asia. The Malthusian theory theorises that human population grows exponentially compared to food production that grows arithmetically. Secondly, the rapid population growth rate exceeding the earth's carrying capacity and the natural resource base would lead to serious environmental degradation and food shortage. Such arguments were inspired by hunger and high population growth rate during the pre-industrial revolution and pre-agricultural transformation eras in Europe. Neo-Malthusians, however, emerged in the 1970s bolstering the theory while inspired by hunger, economic and oil crises in Africa (Rees, 1990). Although the Malthusian arguments may seemingly hold water, especially in the context of poor science and technology elsewhere, the theory has been proved fallacy and so received strong criticism in the literature. For example, Smith (2015) shows that technological advancement has sustainably been able to intensify agriculture, and by extension, increasing agricultural productivity in Europe and East Asia to meet an ever increasing food demand thereby proving the theory incorrect. Nonetheless, Malthusians sparked a fruitful debate among scholars of different disciplines resulting into a strand of anti-Malthusians, which is fundamental for development.

The Malthus theory of population growth is opposed by scholars like Ester Boserup and Julian Simon whose arguments are pertinent, particularly when considered in the post

industrial revolution and post agricultural transformation epoch in Europe in the 20th century (Boserup, 1981; 1996). Ester Boserup and others bring in the debate the role of science, innovation and technology, particularly on improving agricultural productivity to produce enough food for the ever increasing population. This factor was ignored by the Malthusian theory. The anti-Malthusians succinctly argue that the rapid population growth rate is not a problem. They further argue that although a growing population increases demand for food, it also triggers agricultural productivity through application of science, innovations and technologies like irrigated agriculture, better cropping systems, and adoption of industrial and organic fertilisers, herbicides and pesticides. Environmental pollution and land degradation, which can emanate from adoption of industrial agricultural inputs, can also be taken care of by science and technology, and innovations. To that effect, food production per capita increases to upkeep an increasing population thus opposing the ideas of the classical Malthusians (Boserup, 1981; Niboye and Kabote, 2012). This has been empirically tested in the literature and confirmed that it holds water in the countries like China and India (Darity, 1980; Uridal, 2005; Fischer-Kowalski *et al.,* 2014).

Anti-Malthusian ideas are relevant and applicable in SSA because they bring in a solution for sustainable food supply in a context of high population growth rate. In SSA, population growth rate is higher than it was in Europe in the 19th century (Rooyen, 1997), because of high fertility rate, and that with improved health facilities, the population is likely to skyrocket in future, deriving further an increasing food demand. The ideas are seemingly more relevant in a context where there is low agricultural productivity growth rate in SSA while food demand is on the increase. The population structure comprising more dependants (World Population Data Sheet, 2020), makes the anti-Malthusians more relevant in the region. However, from this review, classical Malthusian ideas conditionally hold water in a situation when science, innovation and technology are limited in agriculture to improve productivity. Understanding these theories informs the analysis of agricultural transformation in SSA with regard to the relationship between food, agriculture and human population. The next section analyses structuralism theories and their relevance in bringing agricultural transformation in SSA.

Structuralism theories: Relevancy for agricultural transformation in Sub-Saharan Africa

This section explores how structuralism theories can inform policies for agricultural transformation in SSA. The post World War II period marked commencement of theorising international development. Different theories emerged to explain development and underdevelopment in developing countries including SSA. Therefore, the discourse on structuralism theories ushered between 1960s and 1970s, concentrating on a mechanism for transforming an economic structure from depending on a traditional subsistence agriculture, to depending on a productive modern, urbanised or industrial sector (Willis, 2005; Chingonikaya and Nawanda, 2011). To that effect, in the 1960s, William A. Lewis, a development economist, coined a sector surplus labour model commonly known as the Lewis Model to explain structural transformation of development in developing countries. This is a two-sector model that theorises structural relationship between two sectors of a closed economy. The first one is agriculture, also referred to as rural, traditional or subsistence sector. The second sector is modern, urbanised or industrial sector.

Lewis postulates existence of unlimited labour force in the agricultural sector. This labour is not productive, implying marginal or zero productivity. On the other hand, the modern or industrial sector is theorised to expand at the expense of the rural sector, providing at least 30% higher wages than the wages offered by the agricultural sector (Chingonikaya and Nawanda, 2011). According to Lewis, such a circumstance kindles labour movement from the agricultural sector to the productive modern sector and that they would be absorbed in the industrial and service sectors. The motivation behind this theorisation is increased income

saving, profit maximization and re-investment of the income accruing out of the modern sector. Therefore, the modern sector is theorised to grow into heavy and high tech-industries (Agbenyo, 2020). In line with the structuralism theories, literature including Sen (2019) underscores three pre-conditions necessary for structural transformation, including declining employment in agriculture; hump-shaped share of employment in the modern sector, and increasing share of employment in service.

Based on the Lewis's ideas, as a country moves from an early level to a high level of development, the role of agriculture decreases in terms of its share to the Gross Domestic Product (GDP) and employment. At that particular point, the economic output and employment are generated by other sectors, including the industrial sector (Mpango, 2013). In addition, whenever agricultural productivity growth is low, industrialisation process is also limited (Barrett *et al.,* 2017). Developed countries enjoyed a long-term agricultural productivity growth rate concurrently with modernisation of the rural non-farm economy to become industrialised, implying that the Lewis model fits well in the developed countries context.

This pre-condition is not only necessary for agricultural transformation but also for structural transformation of the economy which is defined in the literature as: 'the process by which low income societies, in which agriculture absorbs most labour and generates most economic output, become high income societies characterised by a relatively smaller but more productive agricultural sector' (Barrett *et al.,* 2017). Others define it as a 'process in which an increasing proportion of economic output and employment are generated by sectors other than agriculture' (Mpango, 2013).

Another strand of structuralism theories is the structural change and patterns of development theory coined by the American development economist, Hollis Chenery and others in 1975 (Chenery *et al.,* 1975). As postulated by Chenery *et al.* (1975) and empirically tested by Syrquin and Chenery (1989), and Vu (2017) in Asia, the theory of patterns of development coincides with the Lewis model in the sense that structural changes of development require common patterns like shift from agricultural sector to the industrial sector, and urbanisation. In addition, Chenery and others accentuates increased income savings, investment in human capital and technological development. These are necessary but not sufficient conditions for structural transformation, which, in addition, obliges transformation of production and changes in composition of consumer demand, and international trade. The theory concludes by identifying two gaps in developing countries including SSA: savings gap and foreign investment gap. It further postulates that, while domestic investment is critical for filling the saving gap, foreign aid addresses the foreign investment gap. Generally, domestic investment requires human capital development, resource endowment and institutions, typically government policies and political will; while foreign investment essentially stresses on access to capital, technology and international trade. When applied correctly, the theory has brought positive impact in the Global North and and East Asia (Behrman, 1982; Sen, 2019) where agricultural transformation is apparent.

Authors like Harris and Todaro (1970), who view agriculture as a means for other sectors' development, supports structuralism by postulating an inversely proportional relationship between labour force and agricultural productivity. This implies that as agricultural productivity increases, its share in employment decreases and vice versa. Such writers underline importance of science and technology to increasing agricultural productivity, and by extension, increasing importance of research and development in agriculture, which in turn generates new knowledge for agricultural transformation. Lucas (2004) endorses this relationship in Britain and USA. In addition, Asia is the pragmatic confirmation through the green revolution, though she has integrated government policies to discourage rural-urban labour force movement in countries like China (Zhao, 1999). This seems to be contradiction to the structuralism theories but perhaps China has not been able to daunt structural changes because it is the most populated country in the world; both in rural and urban areas.

On one hand, extending structuralists' ideas

including Harris and Todaro (1970), implies that urbanisation[2], elicited by rural-urban migration, is an opportunity for agricultural transformation because it is likely to stimulate growth of the middle class in urban areas, small towns and peri-urban areas particularly if the labour force is skilled. This perhaps can upsurge demand for processed food materials, and so stimulating agricultural transformation as theorised by Chenery and others (Chenery *et al.,* 1975). In that line of thinking, it vindicates that urbanisation is an opportunity not only for the rural sector but also for the private sector through investment on agro-processing, transportation and food markets. In case the migrating labour force is unskilled, the picture is likely to be the opposite.

On the other hand, writers including Byerlee (1974) and Sakho-Jimbira and Hathie (2020) contend that rural-urban labour movement declines per capita agricultural productivity, particularly in SSA, through reduction of labour force. This translates into poor agricultural sector performance, and by implication increases income gap between rural and urban areas with urban areas hypothesised to have relatively higher income possibly generated through better employment. This in turn fuels urbanisation and so sustaining the vicious circle of poverty in the rural areas.

Structuralism theories are seemingly relevant for agricultural transformation, structural transformation and development in SSA. However, they have to be adopted with caution to aptly fit SSA context. First, the theorisation of labour movement from the rural sector to the urban sector, motivated by capital accumulation, may not necessarily hold water in a context when the industrial sector, like it is in SSA, is dominated by foreign investment. In this case, the income generated from the industrial sector may not be re-invested in the host countries where it would be required to stimulate industrial growth that in turn would perpetuate the labour movement, but the income is rather sent back to the countries of origin in terms of capital flight[3] (MacCarthy *et al.,* 2022). In addition, the labour force from subsistence agriculture is essentially less skilled or unskilled and therefore becomes mainly absorbed in the informal sector (Wuyt and Kilama, 2016), in some countries like Tanzania, while the skilled labour becomes absorbed in the service sector. To that effect, unless policies are formulated to rectify the situation, labour movement may not necessarily contribute to agricultural transformation including industrial growth in SSA.

Second, the theorisation of surplus labour force in the subsistence sector and unlimited employment in the modern sector is increasingly becoming fallacy in the region because unemployment is currently proliferating in urban areas in SSA (Simon, 2019). Third, Lewis, for example, theorises continuous labour supply up to the point of diminishing returns in the industrial sector. This does not necessarily hold water in SSA perhaps because most of the labour force ends up in the informal sector and service sector where wages are unpredictable and extremely low respectively. In addition, the bargaining power for wages in the private sector, including multinational corporations, does not almost exist.

With the foregoing analysis, it is logical to argue that structuralism theories are relevant and applicable in SSA; however, an efficacy adoption of the theories needs a political will and governments'commitment. This involves formulating a policy that concentrates on investment and capital accumulation principles for a win-win situation to offset capital flight. In addition, efforts should focus on human capital development to improve labour productivity, labour wage improvement, building an enabling environment in favour of domestic investment, and informal sector formalisation.

Re-defining the concept of development

[2] *In this paper, I adopt definition of urbanisation as correctly put by McGranahan and Satterthwaite (2014: p4) who define the concept as movement of a population from rural to urban settlements measured by the urban population share, with the urbanisation rate being the rate at which that share is increasing. Scholars raise two contrasting views about the importance of urbanisation in agriculture transformation.*

[3] *Capital flight is defined as all capital that flees to abroad regardless of the motive. This has negative consequences on economic growth, macroeconomic stability and and people's welfare (MacCarthy et al., 2022).*

The concept of development is defined differently by different authors based on different perspectives. As such, development in the Global North does not have the same meaning to the Global South. To that effect, the concept needs re-defining for contemporary policy-making in SSA. A quest to bring development to the Global South commenced right after the World War II in 1945. Since then, the concept of development has become widespread in the international development agenda. However, the concept has remained a buzzword, open for different interpretations. An attempt to define it revolves around social, economic, environment, political and cultural aspects. For example, Todaro and Smith (2012) and Agbenyo (2020), succinctly define the concept as a multidimensional process of change in social structures, attitudes and institutions that involves economic growth, reduction of inequality and poverty. This is a broader definition, which considers development holistically. Other scholars have been caught in a narrow way of defining development focusing on economic growth by equating development with modernity, described as a process of industrialisation, urbanisation, and increased use of technology in all sectors of the economy (Shao, 2004; Willis, 2005). Economic growth is measured using Gross Domestic Product (GDP), which considers the value of all goods and services produced within a particular country (Willis, 2005) leaving out non-economic indicators of quality of life.

Governments in the Global North and Global South have also been trapped in the narrow economic conception of development. With that the WB classifies countries in the world using levels of economic development and therefore come up with four groups of countries: low-income countries, lower-middle-income countries, upper-middle-income countries and high-income countries (Fantom and Serajuddin, 2016). This is purely an economic-based measure, which does not view development holistically. For instance, in 2020, the WB categorised Tanzania as a lower-middle-income country. However, the basic needs poverty is lingering on, in the country at 26.4%, and the food poverty stands at 8.0% (NBS, 2019). Thus, defining development in economic terms does not only narrow the concept and its measurement but also narrows interventions required for development. This has resulted into a mismatch, or a paradox as economists aptly put it, between macro level economic development and quality of life in SSA countries including Tanzania (Kabote, 2022).

To make development sustainable, environmentalists have factored in, environmental factors in the equation of development, which were initially ignored and so causing environmental problems (Kabote and Mangi, 2018). Sustainable development strikes a balance in the development process between social, economic and environmental aspects. Although there is no conclusive definition of sustainable development, the most cited definition considers it as 'development that meets the needs of the present without compromising the ability of the future generations to meet their own needs' (UN, 1987). In 1990, an attempt to re-define development with a human centred perspective came up with a concept—human development—that combines economic and non-economic indicators. The major indicators include long and health life (life expectancy at birth), knowledge (education) and decent standard of living (Gross Domestic Product[4]) (Willis, 2005). Based on this conception, the United Nations Development Programme (UNDP) classifies countries in the world into low, middle and high human development.

Generally, a conclusive definition of development hardly exist and this piece of work did not anticipate to establish a common definition. Yet, exsiting definitions coincide on the fact that development is multidimensional concept focusing on structural changes in social, economic, environment, political and cultural aspects. Development should be sustainable,

[4] *Gross Domestic Product (GDP) measures the value of all goods and services produced within a particular country. It does not matter whether the individuals or companies profiting from this production are national or foreign. It is different from the Gross National Product (GNP), which measures the value of all goods and services claimed by residents of a particular country regardless of where the production took place. It is, therefore, GDP plus the income accruing from abroad (such as repatriation of profits) minus the income claimed by people overseas (Willis, 2005).*

human centered and inclusive[5] (Sachs, 2004). In addition, it is non-static and not uniform across societies. All in all, development is a complex and dynamic process. Therefore, it should not be defined in the same way across the board. Importantly, it has to be viewed holistically to avoid a mismatch at macro and micro levels, thus augmenting realisation of structural transformation. The next section analyses population and agricultural transformation nexus in SSA.

Population and agricultural transformation in SSA

In SSA, population is higher than it is in Europe, Northern America, Northern Africa and Western Asia. Figure 1 shows that a significant share of the world projected increase in population by 2050 will come from SSA. Further projections show that population growth in SSA will continue and by 2050 will be the highest globally (UN, 2022). This is likely to continue throughout the 21st century.

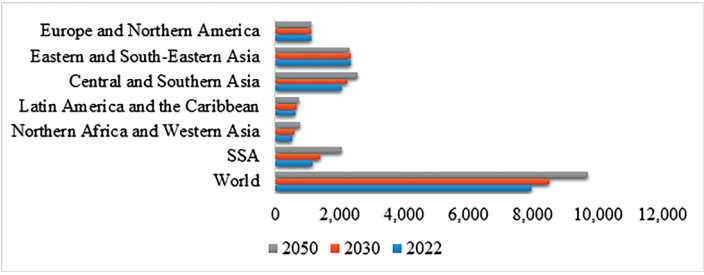

Figure 1: Comparing population size between SSA and other regions in millions
Source of data: United Nations (2022)

Sub-Saharan Africa has highest fertility rate (Fig. 2) in the world. Figure 3 shows that life expectancy at birth illuminates an increasing trend in all regions in the world attributed to declining mortality levels. For example, it increased by 10.5 years from 49.2 in the 1990, and it is projected to stand at 66.7 years by 2050 (UN, 2022). However, life expectancy in SSA remains lower than that at the world level, which is 71 years, projected to stand at 77.2 by 2050 (UN, 2022). Unlike life expectancy at birth, fertility rate in SSA is higher than all regions in the world, justifying a potentially increasing population growth rate in the region (Fig. 2). This absolutely translates into an increasing food demand, which can either be met through food imports or through increasing agricultural productivity growth in the region.

Although food demand is categorically skyrocketing as population increases in SSA, the agricultural sector experiences low productivity concurrently with low growth rate standing at 2.4% lower than an average of 4.0% in all developing countries (Pemechele *et al.*, 2021). Agricultural ontribution to GDP ranges between 20 and 23% (African Development Bank, 2015; Stads and Beintema, 2020). The share of employment in agriculture ranges between 50 and 60% upholding that the labour force is mainly locked in agriculture. In addition, service remains a dominant sector compared to industrial sector (Totouom *et al.,* 2019; Enongene, 2023). In coutries like Ethiopia, Kenya, Mozambique and Tanzania, trends in manufacturing are remarkable but there is low productivity. This portrays a picture of inadequate agricultural transformation, which is explained by multiple institutional challenges affecting entire agricultural value chain. Such challenges include poor land use governance that lead to escalation of different land use disputes and conflicts occurring at micro and meso sclaes (Bob, 2010; John and Kabote, 2017). Unlike micro-level land conflicts, which are widespread between villages or between farmers themselves, and or, with agro-pastoralists (John and Kabote, 2017); meso-level land conflicts occur between ethnic groups like what is happening in the Democratic Republic of Congo (Vlassenroot and Huggins, 2004). In addition, the region is now witnessing an increasing trend in medium-

[5] *Inclusive development is defined differently but it generally refres to a much broader process than growth (Sachs, 2004)*

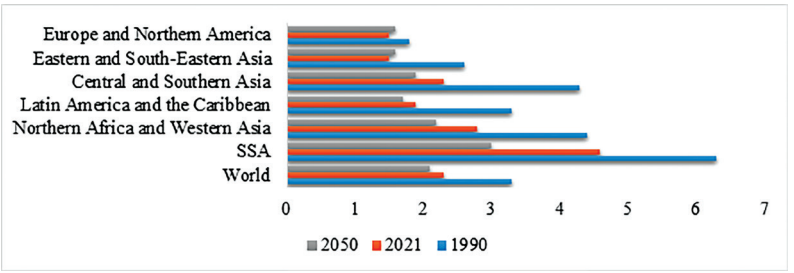

Figure 2: Comparing fertility rate between SSA and other regions
Source of data: United Nations (2022)

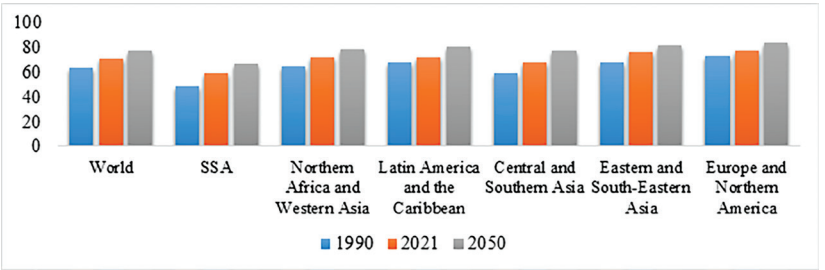

Figure 3: Comparing life expectancy at birth between SSA and other region
Source of data: **United Nations (2022)**

scale farmers holding land between 5 and 100 ha; and large-scale farmers holding 100 ha and above fuelled by the land rush (Jayne *et al.,* 2019). This is apparently not only partly creating an appropriate environment for agricultural transformation but also causing a serious land insecurity among smallholder farmers.

Literature shows low spending on agriculture, which stands at 6%, and about 33% of this comes from development partners (African Development Bank, 2015), implying low governments' commitment to transform agriculture. In 2003, the Maputo declaration on Agriculture and Food Security set a target of 10% spending in agriculture per annum in order to improve agricultural productivity growth to a turne of 6% per annum (IFM, 2012; African Development Bank, 2015).

However, two decades later, only Malawi met the target (Pemechele *et al.,* 2021), suggesting failure or low governments' commitment. Other challenges include poor extension service delivery attributed to a poor policy-legal framework to guide extension service delivery; and existence of contradictory extension models (Oladele, 2011). There is also limited credit provision to smallholder farmers attributed to the perception that agriculture is a risky enterprise (Chivandire, 2019). Research for development in agriculture are limited because of low governments' financing (Ncube, 2019; Stads and Beintema, 2020). Funding for research is predominantly tied up with development patners. However, there is contradictions between donors' priorities and governments' research priorities in the region (Ncube, 2019). The United Republic of Tanzania (URT) (2013) adds climate change and dependence on rain-fed agriculture, poor rural roads and inadequate use of agricultural inputs among the challenges that need to be addressed for agricultural transformation. There is also limited value addition and poor market for raw and processed agricultural products.

The arable land in SSA has poor soil fertility due to soil erosion, leaching, and land degradation (Niboye and Kabote, 2012; Sunbet and Simbanegavi, 2017). However, the use of fertilisers is tremendously low compared with other regions in the world (Dimkpa *et al.,* 2023). Similarly, the use of other inputs like improved varieties and mechanisation is also not impressive (Kaki *et al.,* 2020; Thomas, 2020), and majority of smallholder farmers do not afford costs for expensive fertilisers and other inputs (Niboye and Kabote, 2012),

justifying importance of input subsidisation. The knowledge gap also exist among smallholder farmers between usage of fertilisers and fertility of the soil; suggesting an importance of awareness education. Furthermore, irrigated agriculture ranges between 4 and 6% of cultivated land (Wiggins and Lankford, 2019). This is exceedingly low to off-set the impact of climate change in agriculture.

Combining the challenges together have stagnated agricultural sector performance, such that agriculture remains subsistence causing Africa's dependence on food imports standing at about USD 50 billion and projected to raise up to USD 150 billion by 2030 per annum (Sunbet and Simbanegavi, 2017). This implies that, as the population increases, food imports also increase and it is increasingly redirecting resources away from development interventions. Nonetheless, different countries are affected differently justifying presence of variations between countries with some few better of outliers like South Africa. Therefore, SSA needs to resolve the puzzle affecting agricultural sector performance in order to transform agriculture to become commercialised, capital and skill intensive. The next section dwells on the experience from the Asian green revolution with regard to agricultural transformation.

Experience from the Asian green revolution

Studies including that of Johnson et al. (2003) and Hazell (2009) defines the Asian green revolution as a process of significantly increasing food grains productivity to resolve food and economic crises and poverty challenges. By extension, the phenomenon is about structural transformation realised through agricultural transformation. The US and Latin America adopted it, and later on the green revolution was implemented in Asian between the 1960s and 1990s (Rashid *et al.,* 2013). Asia adopted the green revolution at the time when the agricultural sector was dominated by over 90% smallholder farmers holding less than two hectares of land (Jayne *et al.,* 2019), implying that it is possible to transform agriculture in SSA, which is also dominated by smallholder farmers. This context justifies why this work chose the Asian green revolution as an experience that can inform transformation in SSA. The main goal of the green revolution was to comprehensively improve agricultural productivity, which in turn improved and sustained development and, more specifically, economic growth. The case in point includes countries like China, India, Philippines, Malaysia, Vietnam, Japan, Taiwan, South Korea, Thailand, and Indonesia.

The key features of the Asian green revolution is adoption of high yield varieties, fertilisers, pesticides and irrigation technology; and uses of modern plant breeding and improved agronomy. In addition to research and development, which are key for science and technology, the Asian green revolution embarked on a broad-based transformation in land tenure security and increased government spending on agriculture. Education was key in addition to smallholder farmers' active participation in the process (Hazell, 2009; Niboye and Kabote, 2012). These are necessary pre-conditions for agricultural transformation implying that it is not only the question of science and technology in addition to Information and Communication Technology that is needed to transform agriculture but also supportive policy environment and substantial government policy interventions. More than half of the world's population is found in Asia. However, Asia managed to feed the population through agricultural transformation with favourable policies, structure and institutional arrangement and so producing own food and, by implication, controlling food imports (Niboye and Kabote, 2012).

Scholars including Hazell (2009) show statistics on outcomes of the green revolution in Asia, which include expansion in the area under irrigation and increasing usage of fertilisers from 23.9 kg/ha in 1970 to 102.0 kg/ha by 1995. The use of high yielding varieties increased from 40% in 1980 to 80% by 2000, while spending on agriculture increased from 15.4% in 1972 to 30.8% by 1985 per annum confirming that spending doubled during that particular period. Subsequently, the Green Revolution brought a significant impact. The Asian countries shifted from being food importers to food exporters. Overall, the average in cereal productivity growth particularly wheat, rice, and maize stood at 3.57% per annum between 1967 and

1982. The effort also moved many people out of poverty and contributed to sustained economic growth. For example, in 20 years since 1975, poverty decreased by 28% even though the population grew by 60% over that specific period. The physical environment was also saved through agricultural intensification (Hazell, 2009). This implies that agricultural transformation has occurred in Asia, which is translated into structural transformation accompanied with poverty reduction and economic growth. However, some disparities across countries in terms of low growth and widespread poverty persist in some countries (Hazell, 2009), especially in South Asia.

Literature demonstrates that agricultural transformation has happened in the East Asian countries[6] and it is linked to structural transformation. Contrary, in the South Asian countries[7], the results of the green revolution are mixed in the sense that the speed of structural transformation varies and to some extent does not concur with the structuralism theories particularly on decreasing share of employment in Agriculture. For example, in 2010, the share of employment in agriculture stood at 51% in South Asia including India (Sen, 2018). The share of agriculture in GDP has declined concomitantly with sharp rising of the share of service in GDP (Jha and Afrin, 2021). This is in line with partterns of structural transformation as theorised by structuralists like W.A Lewis, Chenery, Harris and Todaro. However, manufacturing sector is contrary to structuralists in the sense that its share to GDP has stagnated (Jha and Afrin, 2021). This implies that structural transformation theories have worked well in the East Asian countries like China, Japan and South Korea compared to South Asia. The constraints in South Asia include government failures explained by restrictive labour laws; policy that constrain growth of high productive sectors and policy constraints on land acquisition for agricultural and industrial use. There are also coordination problems in investment, credit market imperfection and human capital formation (Sen, 2018).

Based on the experience from the Asian green revolution, the idea that agriculture plays key role in structural transformation for development in SSA is not debatable. Theoretically and empirically, it is widely agreed that in a context where labour intensive agriculture has been transformed, its share in the economy and employment decreases, such that they become largely contributed by sectors like capital intensive manufacturing industries, and service accompanied by a rapid urbanisation (Hazell, 2007; Mpango, 2013; African Development Bank, 2015; Barrett *et al.,* 2017; Sen, 2019).

Therefore, SSA should learn from the Asian green revolution. For example, the high population in SSA is an opportunity for internal market but only if agro-industries are in place for agro-processing and value addition. Currently, agro-processing industries particularly for perishable goods, which are key for income generation in the rural sector are limited. In addition, a shift from labour intensive to capital intensive agriculture is necessary to transform the sector. This goes with market-oriented production and use of more advanced agricultural technologies informed by research and development; and appropriate government policies. Generally, agriculture is not adequately transformed in SSA because of poor productivity and weak nexus with other sectors particularly industrial sector. To that effect, SSA should not expect miracles in improving agricultural sector performance without agricultural transformation synchronised with structural transformation of the economy. The next section focuses on agricultural transformation in Tanzania.

Agricultural Transformation in Tanzania

Tanzania is an agrarian country dominated by smallholder farmers, and it is one of the countries in SSA with high population growth rate. This trend is likely to continue for a long time. Like other countries in the region, Tanzania is dominated by a young population with high dependence ratio. Agriculture provides a significant share in employment in the country, standing at 66.9% (URT, 2011; Kahyarara, 2019; Loiboo *et al.,* 2021). Nonetheless, agricultural growth rate has stagnated for a long period

[6] *This includes China, South and North Korea, Japan and Taiwan.*

[7] *This includes India, Sri Lanka, Pakistan, Nepal and Bangladesh.*

while showing a decreasing trend in the period of seven years since 2014. Its growth is less than 6% per annum lower than the growth in industry and construction and service (Fig. 4).

Available data on aggregated crop productivity are limited. However, similar to the region level, the overall picture shows poor agricultural productivity, and has basically stagnated over a long period of time (Niboye and Kabote, 2012). Individual crops and dairy sub-sector also show low productivity growth (Table 4). This justifies inadequate agricultural sector performance in the country. It can also be interpreted that agriculture has remained subsistence and labour intensive instead of becoming capital intensive, as postulated by structuralists. Another possible interpretation is that labour is gradually released from agriculture to the industrial sector. The factors that explain poor agricultural productivity in Tanzania are many, and such factors echo the challenges at the region level. One of these is low usage of agricultural inputs like fertiliser, which is explained by poor awareness and skills of using it among smallholder farmers. In addition, fertiliser is sometimes not easily accessible, and in some cases price is unaffordable.

Table 4: Crop productivity in Tanzania

Crop	Actual productivity	Productivity potential
Maize	3.9	6.0-7.5
Paddy	2.0-3.8	6.0-8.0
Cotton	0.4	2.0

Source: United Republic of Tanzania (2013)

Statistics show that the usage of fertiliser in the country ranges from 9 to 13.68 kg/ha lower than the African Union target of 50kg/ha (TNBC, 2009; AGRA, 2020). Such amount is by far lower than the global average that stands at 135 kg/ha (AGRA, 2020), and it is also lower than that at a region level (Niboye and Kabote, 2012). Experience from the Asian green revolution suggests that the usage of agricultural inputs like fertiliser should be increased to transform agriculture. In India for

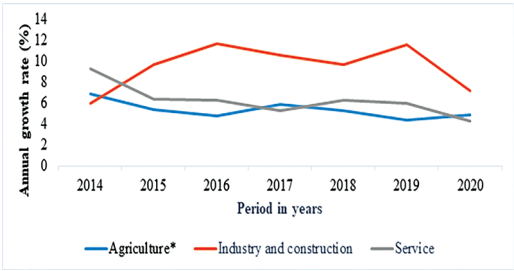

Figure 4: Annual growth rate at 2015 prices
Source of data: United Republic of Tanzania (2021)
**Agriculture includes crops, livestock, forest, fishing and agricultural support services*

example, fertiliser usage stands at 161.58 kg/ha (AGRA, 2020), higher than the global average.

Other constraints include high dependence on rain-fed agriculture and limited usage of improved seed varieties and low usage of pesticides. There is also a question of low government spending in agriculture. For example, in a period of five years between 2016 and 2020, the agricultural budget degreased from 5.3 to 1.3% of the total annual budget (Policy Forum, 2020). The year 2022 however, saw an increase up to 2.93% (URT, 2022). This is still low when compared to Maputo declaration. The Tanzania's priorities include expansion of arable land under irrigated agriculture, subsidisation of inputs including fertiliser, development of livestock and fisheries sub-sectors; and the current youth block farming programme. Evidence shows that increasing use of agricultural inputs like fertiliser, improved seed varieties, use of irrigated agriculture and government spending on agriculture increases performance of the sector (TNBC, 2009). For example, the yield ranges from 2 to 3 times higher in irrigated agriculture than in rain-fed agriculture. The Asian green revolution is a practical example (Pemechele *et al.,* 2021). In Tanzania, statistics show that the agricultural irrigated land has decreased from 4.2% published by the United Republic of Tanzania in 2013 (2013) to 1.3% in 2028 (Marijan, 2023), which is categorically too low when compared to the available arable land suitable for irrigated agriculture in the country.

According to structuralists, inclusive development comes with changes in structures of the economy (Wuyts and Kilama, 2016). In Tanzania, the share of employment in

agriculture shows a gradual decreasing trend from nearly 92% out of 12.3 million people in 1961 (Agwanda and Amani, 2014) to 66.9% in 2018 (URT, 2011; Kahyarara, 2019; Loiboo *et al.,* 2021).

Analytically, the share of agriculture to the economy remained above 25% per annum since 2014 (Fig. 5). The share from the industry was initially lower than that of the agricultural sector. However, the industry surpassed agriculture in 2019. In addition, the service's contribution to the economy is significantly higher than agriculture and industry but it is showing a decreasing trend. This shows an early stage of agricultural transformation in the country, and structural transformation more generally. Structuralists argue that in order to bring a significant impact to development, the agriculture's share needs to keep on decreasing as opposed to the industrial sector share in Tanzania. For example, Mpango (2013) argues that Tanzania's structural transformation requires a sharp decreasing share of employment in agriculture, dropping to at least 41.2% by 2025. This is definitely possible if agricultural productivity growth is increased through adoption of best agronomic practices, research and development, and increased government spending concurrently with creating an enabling policy and legal environment for industrial expansion in terms of size and number of industries. Agro-processing industries are key for value addition while the quality of the products should be competitive in the world market.

Urbanisation

Rura-urban migration that explains urbanisation surged in Tanzania in six decades following the attainment of independence in 1961. While the population growth rate has not significantly changed since the first population census in the country in 1967, urbanisation has significantly increased (Fig. 6). The pull factors include perception of better employment opportunities and quality standard of living in urban areas. There are also costs for living in urban areas including congestion and overcrowding, lack of resources to provide basic services, health hazards and more crime than in rural areas.

A study conducted by Cockx *et al.* (2019) shows that majority of urban dwellers have higher income and education levels than rural residents in Tanzania. This dictates composition of food consumed. For example, the food consumed in urban areas has a larger share of dairy, meat, fish, fruits, vegetables and legumes than that in rural areas. Similarly, urban dwellers consume more processed and imported food from supermarkets compared to rural dwellers. Meals consumed outside home are also increasingly becoming important in urban Tanzania. This implies changing diet as people become urbanised. It also implies that increasing urbanization rate in Tanzania is inseparable to an increasing food demand in urban areas. Nevertheless, in SSA including Tanzania, urbanisation hardly drives the economy as opposed to Asia (Wenban-Smith (2015), mainly because agriculture is inadequately transformed in addition to a slow rate of structural transformation.

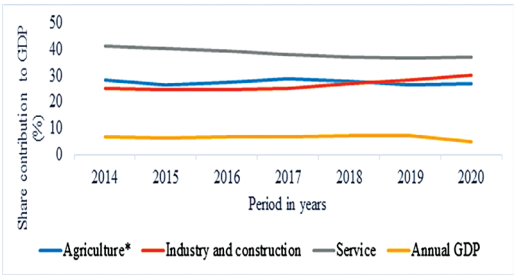

Figure 5: Share contribution to GDP at current price

Source of data: United Republic of Tanzania (2021)

**Agriculture includes crops, livestock, forest, fishing and agriculture support services*

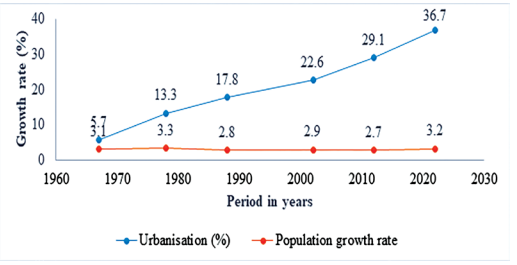

Figure 6: Population and urbanisation growth rates in Tanzania: 1967-2022

Source of data: Wenban-Smith (2015) and United Republic of Tanzania (2022)

Although urbanisation is potentially increasing food demand, especially processed food in urban areas, poverty is persistent in urban Tanzania. For example, while non-income indicators in urban Tanzania including better housing, access to clean water supply, electricity and use of flush toilet facilities have improved (Cockx *et al.,* 2019), a recent Household Budget Survey shows that food poverty gradually decreased in a period of 10 years from 2007, and by 2017-2018 it stood at 8.0%, while basic needs poverty stood at 26.4% over the same period of time (URT, 2019). This implies that income and food poverty are becoming impediments of urbanisation, and so interpreted as urbanisation with slow pace of structural transformation. If this trend continues, it could aggravate poverty challenges in urban Tanzania.

Conclusion and policy recommendations

This review concludes that agricultural transformation and agricultural productivity should move together with structural changes in the economy. However, in SSA agricultural transformation has hardly happened causing stagnation of agricultural productivity growth while food demand is increasing concomitantly with population growth. If this trend continues unabated, SSA is likely to remain into a food insecurity trap for a very long period.

With that conclusion, the review recommends policy issues to address the conundrum. Efforts should focus on agricultural transformation encompassing a struggle to increasing agricultural productivity; agro-processing and value addition, human capital development, marketing and structural changes of the economy. Specifically, the review recommends six policy issues in which research, innovation, information and communication technology should be cross-cutting.

First, improving land use governance and land security. A policy strategy should focus on improving land use governance to curtail land use disputes and conflicts, and heighten land acquisition to improve land security between smallholder, medium and large-scale farmers, domestic and foreign investors. This, among other things, is key to resolving land conflicts while creating an enabling policy-legal environment for agricultural transformation.

Second, increasing political will and governments' commitment for agricultural transformation. A policy strategy should focus on improving extension service delivery in order to impart appropriate skills in agronomic practices and usage of inputs, which are currently limited. The policy should also focus on putting in place a framework for credit provision to smallholder farmers concurrently with increasing government financing through annual budget allocation of at least 10% as recommended by the African Union. Increasing spending in agriculture is likely to address a number of issues deterring agricultural transformation in SSA including those linked to research financing; agricultural input subsidisation; climate smart and irrigated agriculture; and rural roads infrastructure.

Third, increasing agro-processing and value addition. Urbanisation is on the increase and it is likely to reverse the current situation dominated by an agrarianism that is characterised by subsistence agriculture. The middle class in urban areas is growing while creating domestic market for the raw food materials and agricultural processed food. Therefore, a policy strategy focusing on agro-processing and value addition is necessary to push structural changes forward.

Fourth, increasing human capital development and informal sector formalisation. The high population in SSA is an opportunity for agricultural transformation. Therefore, a policy strategy focusing on improving human capital development relevant for high technological development in the industrial sector is unavoidable to enable rural-urban migrants become absorbed in the industrial sector where labour wages are relatively higher than they are in the subsistence sector. Informal sector integration into the economy and, or formalisation is also pertnent to create an economically appropriate living environment in urban areas. Further studies are needed to deepen understanding on how to integrate the informal sector into the economy.

Fifth, create a better envrironment for investment and capital accumulation in SSA. This is necessary for the industrial sector growth

at the expense of labour force from subsistence agriculture. To that effect, a policy strategy to attract investment and enable foreign investors to re-invest the capital accumulated in SSA is necessary. The same applies for domestic investors.

Sixth, increase governments' role in agricultural marketing. Sub-Saharan Africa suffers poor marketing system or lack of market for agricultural produce. This is exacerbated by neo-liberal policies that emphasise on the market forces. This has consistently been a challenge to the smallholder farmers in the region and so paralysing the agricultural sector growth and transformation. Experience from the Asian green revolution shows that countries in Asia are implementing neo-liberal policies but with government regulations whenever necessary. Therefore, a policy strategy focusing on regulating market forces is unavoidable. Further studies are needed to deepen understanding on how governments can effectively regulate market forces.

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Annual growth rate at 2015 prices

Period	Agriculture*	Industry and construction	Service
2014	6.9	6.0	9.3
2015	5.4	9.7	6.4
2016	4.8	11.7	6.3
2017	5.9	10.6	5.3
2018	5.3	9.7	6.3
2019	4.4	11.6	6.0
2020	4.9	7.2	4.3

Source: United Republic of Tanzania (2021)

Comparing population size between SSA and other regions

Region	2022	2030	2050
World	7,942	8,512	9,687
SSA	1,152	1,401	2,094
Northern Africa and Western Asia	549	617	771
Latin America and the Caribbean	658	695	749
Central and Southern Asia	2,075	2,248	2,575
Eastern and South-Eastern Asia	2,342	2,372	2,317
Europe and Northern America	1,120	1,129	1,125

Source: United Nations (2022)

Share contribution to GDP at basic current price

Period	Agriculture*	Industry and construction	Service	Annual GDP
2014	28.5	25.1	41.3	6.7
2015	26.7	24.5	40.4	6.2
2016	27.4	24.9	39.4	6.9
2017	28.8	25.0	38.0	6.8
2018	27.9	27.0	37.2	7.0
2019	26.6	28.6	36.8	7.0
2020	26.9	30.3	37.2	4.8

Source: United Republic of Tanzania (2021)

Population and urbanisation growth rates in Tanzania: 1967-2022

Period	Urbanisation (%)	Population growth rate
1967	5.7	3.1
1978	13.3	3.3
1988	17.8	2.8
2002	22.6	2.9
2012	29.1	2.7
2022	36.7	3.2

Source: Wenban-Smith (2015) and United Republic of Tanzania (2022)

Comparing fertility rates between SSA and other regions

Region	1990	2021	2050
World	3.3	2.3	2.1
SSA	6.3	4.6	3.0
Northern Africa and Western Asia	4.4	2.8	2.2
Latin America and the Caribbean	3.3	1.9	1.7
Central and Southern Asia	4.3	2.3	1.9
Eastern and South-Eastern Asia	2.6	1.5	1.6
Europe and Northern America	1.8	1.5	1.6

Source: United Nations (2022)

Comparing life expectancy between SSA and other regions

Region	1990	2021	2050
World	64	71	77.2
SSA	49.2	59.7	66.7
Northern Africa and Western Asia	64.3	72.1	78.3
Latin America and the Caribbean	67.7	72.2	80.6
Central and Southern Asia	58.9	67.7	77.1
Eastern and South-Eastern Asia	68.1	76.5	81.7
Europe and Northern America	73.6	77.7	83.8

Source: United Nations (2022)