African Food Security Status and Challenges of Climate Change

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Abstract

Food security is assured when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a more productive and healthy life. Food insecurity in Africa has been increasing over the years despite the existing measures to ensure sustainable agriculture and food security in line with the Sustainable Development Goals (SDGs). Climate change, disease, and pest infestation, conflict and wars as well as poverty are noted to be responsible for the prevailing food insecurity. Some of the gaps in the literature include modalities for successful transformation of African agriculture, research on agricultural development, and various ways of rejuvenating African agriculture to deal with climate change. This study is an attempt to respond to the following questions: How effective are the indices used in measuring food security? What is the status of agricultural development in Africa? What should be done to successfully transform and invigorate small-scale farming in the continent? This is a review article using secondary data from various literature sources (journals, books, book chapters, and reports, among others). The human-ecological system theory, the sustainable livelihoods approach and the pulley of agricultural innovation were to develop small-scale farm food security approach, where the small-scale farmer becomes the centre of food security

innovations and development for sustainable food and nutrition security. The discussions underscore the importance of paying more attention to the environment and climate change within small-scale farms, giving more support to women farmers and identifying centres of agronomic practices for better innovation and transformation. There is also inadequate literature on sources of undernutrition, negligence of indigenous crops, inadequate investment in agriculture and less prioritization of small-scale farmers. The study concluded that special effort needs to be made towards food security in Africa through policy reforms and a review of agronomic practices to enable the continent adapt to the adverse impacts of weather and climate extremes.

Keywords: Food security, Climate change, Agronomic practices, Agricultural development, Indigenous crops, Africa

Introduction

Food security is an important research and policy goal in Africa (Ike, Jacob & Keling, 2015). It is assured when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a more productive and healthy life (Coates, Swindalu & Bilinsky, 2007). In the year 2020, Africa had 256 million hungry people and less likelihood of meeting the Sustainable Development Goals (SDG) targets for 2030 (European Union, 2020) Climate change, disease and pest infestation, conflict and wars, and poverty among others, are a challenge (Ehui, 2020; Fawole, Ilbasmis & Ozkan, 2015).

Despite many attempts to deal with food insecurity over the years, the prevalence of undernutrition has continued to escalate in sub-Saharan Africa, particularly East Africa (Sasson, 2012). A number of countries also did not meet the Millennium Development Goals (MDG) targets as was expected (FAO & UNECA, 2020; Oluoko-Odingo, 2018). Many suggestions have been made to improve food security through improvement in productivity (Crush & Ceasar, 2017; Chikaire & Nnadi, 2011). It is believed that future agriculture within sub-Saharan Africa should be based on systems of agroecological production and agroforestry, crop diversification, use of organic inputs, new methods of

farming — drip irrigation, vegetables and fruit production, community-focus agriculture, recognition of agricultural wealth, as well as improving agricultural infrastructure such as markets, roads, storage, conservation, and job creation (Sasson, 2012; Omiti, Chacha & Andama, 2002).

The prevalence of food insecurity in Africa could be linked to the agricultural development path whereby indigenous crops have been replaced by less drought-tolerant and exotic ones, making them more vulnerable to weather and climate extremes (Staatz & Eicher, 1990: Austin, 2009; Papaioannou &Haas, 2017; Sauer, 1952). Research has shown that some of the traditional crops indigenous to Africa, such as sorghum, would offer the best solutions to food security (Mwadalu & Mwangi, 2013).

A number of gaps have been identified in the literature. These include, for instance, modalities for successfully transforming African agriculture to overcome food security challenges, research on agricultural development over the years to benchmark present efforts towards food security as well as different ways of rejuvenating African small-scale farming for sustainable food security. The ecological and human Systems model, the sustainable livelihood frameworks model, the farming systems approach and the pulley of agricultural innovation have been applied in the development of the small-scale farm food security approach as a step for improving food security in Africa. The focus on small-scale farms for food security was mentioned by the New Partnership for Africa's Development (NEPAD) and Sasson (Moyo, 2007; Sasson, 2012).

This is a review paper using secondary data from various library resources to find lasting solutions to African agriculture. Some of the methodologies used in food security measurements have been reviewed from various existing data sets. Discussions revolve around setbacks from negligence of indigenous crops to ensure better resilience to extreme weather and climate in Africa in relation to emerging food security challenges, low investment in African agriculture and escalating food insecurity, as well as ways of improving food security using the proposed small-scale farm food security approach.

Perspectives on African Food Security and Agricultural Development

Food security in Africa

Food security is attained when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a more productive and healthy life (Coates, Swindalu & Bilinsky, 2007). In Africa, agriculture accounts for 60 percent of employment, 20 percent of the exports, and 15 percent of the GDP. African governments identify food security as an important policy goal together with research (Oluoko-Odingo, 2018). Food security is a multidimensional phenomenon and in most cases appears difficult to measure (Ike, Jacobs & Kelly, 2015). Currently, three indicators have become common in food security measurements: Household Food Insecurity Access Scale (HFIAS), Dietary Diversity Score (DDS), and Coping Strategies Index (CSI), which require harmonizing in a multidimensional way.

According to Ehui (2020), in 2018, there were 239 million undernourished people in Africa. In East Africa, inter-communal violence and armed conflicts are perpetuating instability and tension, particularly in South Sudan, leading to many refugee camps in Uganda. Locust invasions and disease outbreaks have led to 8.5 billion in crop and livestock losses in the Horn of Africa, with severely reduced harvests and reduced food in the market, leading to hunger and food insecurity. Refugees, internally displaced persons (IDPs), and people living in areas of conflict and fragility (Sahel) are the most at risk. COVID-19 prevention procedures have contributed to inadequate food accessibility and increased post-harvest losses, making Africa a major food importer (more than 40 tonnes of cereals in 2018), with high vulnerability.

In the year 2020, Africa had 256 million hungry people and less likelihood of meeting the Sustainable Development Goals (SDG) targets for 2030 (European Union, 2020). The key cause of food insecurity is inadequate production (Sasson, 2012). Recurrent drought is a problem for the Horn of Africa as it causes water insecurity and high food prices.

Pastoralists are forced to search for pasture in distant areas, leaving their families behind. Sasson (2012) suggests possible solutions to food insecurity as use of higher yielding crop varieties and sustainable agriculture, social and economic measures, political will, participation of

international donors through commitment to funds, elimination of unfair trade and competition, and prohibition of dumping of cheap agricultural products from overseas.

Food security affects human health and welfare and economic and political stability, as countries without food security continue to experience conflict (Fawole, Ilbasmis & Ozkan, 2015). West African countries achieved the MDGs of halving the number of undernourished people by 2015, and the availability of food in sub-Saharan Africa (SSA) increased by 12 percent in 2 decades (FAO, 2015). West Africa reduced hunger from 24.2 percent in 1990-92 to 9.6 percent in 2014. Prevalence of hunger in the region declined by 30 percent between 1990-92 and 2015. The United Nations Food and Agriculture Organization (FAO) and the United Nations Economic Commission for Africa (UNECA) (FAO & UNECA, 2020) recorded 256 million hungry Africans in 2020. North Africa had 17 million, while SSA had 239 million, mainly attributable to climatic shocks, conflict, and economic downturns. The share of undernourished people in Africa and their distribution in 2020 for the 256 million hungry people was 144.6 million in Eastern Africa/Horn of Africa, 68.6 million in Middle Africa, 39.2 million in West Africa and 3.8 million in Southern Africa, , (assuming that the 2015 trend remained the same).

Measurement of food security

The Household Food Insecurity Access Scale (HFIAS) is based on the idea that the experience of food insecurity (access) causes predictable reactions and responses that can be captured and quantified through a survey summarized in a scale.

- Feeling of uncertainty or anxiety over food (situation, resource or supply)
- Perceptions that food is of insufficient quantity (for adults and children)
- Perceptions that food is of insufficient quality (including aspects of dietary diversity, nutritional inadequacy, preference)
- Reported reductions of food intake (for adults and children)
- Feeling of shame for resorting to societally unacceptable means to obtain food resources

The HFIAS had been applied to evaluate the impact of programmes and it is recommended that it be used in combination with other methods like the anthropometrics. The prevalence of undernutrition (PoU) indicator was replaced by the Food Insecurity Experience Scale (FIES). The scale showed that food insecurity in Africa is not improving as there were 256 million hungry people in 2020; North Africa had 17 million, while SSA had 239 million (FAO & UNECA, 2020).

The PoU is an estimate of the proportion of the population whose habitual food consumption over the course of the year is insufficient to provide the dietary energy intake levels that are required to maintain a normal, active and healthy life. Globally, PoU was 10.8 percent in 2017 and 2019. The number of undernourished people in the world was 812 million in 2017, 797 million in 2016, and 822 million in 2020. In Africa, it was 232 million in 2017, 239 million in 2018 and 256 million in 2020. In Africa, PoU was 18.2 percent in 2014 and 24.5 percent in 2020. The figures indicate the existence of conflicting data regarding food security in the continent.

The Food Insecurity Experience Scale (FIES) refers to limited access to food at the level of the individual or the household due to lack of money or other resources. The indicator measures the proportion of the population that faces moderate or severe constraints to their ability to obtain sufficient food over the course of the year. According to the Integrated Phase Classification (IPC), the problem of Africa can be attributed to conflict, extreme climate, and economic shocks. In 2018, 33 million of its people required humanitarian assistance due to conflicts, 23 million needed assistance due to climatic shocks and 10 million due to economic shocks.

Countries with conflict included the Democratic Republic of Congo, South Sudan, Lake Chad basin, Somalia and Central African Republic. Countries experiencing climatic shocks included Ethiopia, Malawi, Kenya, Mozambique, Madagascar, Zambia and Uganda, while economic shocks were experienced by Sudan, Zimbabwe and Burundi (FAO & UNECA, 2020).

Sustainable Development Goals 1 & 2 on food security and its indices are as follows:

- **SDG 1:** End poverty in all its forms — this goal touches on food security, employment, early warning and disaster risk reduction, cities, economic growth and biodiversity conservation.
- **SDG 2:** End hunger, achieve food security and adequate nutrition for all, and promote sustainable agriculture — this goal touches on health, food production and productivity, agricultural practices and biodiversity, food emergencies, peaceful and inclusive societies, rule of law and capable institutions, food price volatility, among others.
- **Other areas**: include reducing food waste and post-harvest losses, technology and gender, sustainable use of agricultural biodiversity, effectiveness of humanitarian food emergencies and addressing food price volatility .

  SDG target 2.2: By 2030, end all forms of malnutrition, including achieving by 2025, the internally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and other older persons.

  SDG indicator 2.2.1— prevalence of stunting in children under five years of age is measured by height-for-age z scores.

  SDG indicator 2.2.2 — Prevalence of wasting and overweight in children under five years of age is measured by low-weight-for-height (FAO & UNECA, 2020).

The unparalleled food shortages and famine in the Sahel, affecting millions of people and contributing to conflicts in Sudan and Somalia, point towards wars over resources in future. Despite the efforts by relief agencies to anticipate potential famine and responding accordingly, food insecurity in the Sahel has been constantly worsening with little hope of improvement. The citizens blame food insecurity on climate, epitomized in the form of droughts. The region is inhabited by about 50 million people and increasing population, over-farming as well as over-grazing also contribute to increased desertification in the area, partly blamed on sedentary lifestyles rather than nomadic pastoralism (Lifland, 2012).

Besides, the conflict in the Darfur region has had devastating effects on the natural environment as refugees deplete the existing natural resources. It has also been debated whether the growth of biofuels (sugarcane, palm oil and jatropha) for transport is responsible for

worsening the food security problem or represents an impetus for agricultural revolution as was witnessed in Asia during the green revolution (Lifland, 2012). In Asia, the agricultural revolution was to put food on the table for everyone. In the case of Africa, the 'African agricultural revolution' has not yielded good results.

The people of East Africa and their economies are among those most dependent on agriculture in the whole world (Matondi & Harnevik, 2012). For instance, agriculture contributes 44 percent, 46 percent, 32 percent and 28 percent of the GDP in Ethiopia, Tanzania, Uganda and Kenya respectively. In many of these countries productivity has declined in the past 4 and a half decades with soil degradation indicated as a major culprit. It has been proposed that solutions lie in the correct use of fertilizers, seeds and suitable land management, where land degradation could be addressed by decentralization of natural resource management, scaling up of applied research and adoption of scientific global initiatives.

If productivity has declined, then it means food insecurity has worsened and therefore, solutions lie in finding alternative methods of enhancing food access for the majority who need it. Biofuels would not fill this gap. Food remitting as a livelihood strategy, mostly linking urban areas with rural environments, rural-urban linkages and cross-border transactions have been adopted and could enhance food security between regions and countries in Africa to deal with the impacts of climate change: food insecurity and poverty, water insecurity, health issues and other effects on infrastructural services (Intergovernmental Panel on Climate Change (IPCC), 2015; Crush and Caesar, 2017). Human-induced climate change will impact human settlements and associated land uses — residential areas, commercial space and infrastructure (harbours, streets and industrial plants), due to sea level rise. A number of islands would be submerged, soil fertility would be compromised, with increasing global water scarcity. Ecosystem malfunction would arise from intrusion of salt water into riverine ecological systems and agricultural lands, decline in food and water security would lead to famine, while enhanced evapotranspiration and unreliable rainfall would advance desertification, thus compromising agriculture and human settlements (Roschmann, 2013).

Some of the SSA countries that have not achieved the MDGs and World Food Security (WFS) targets include Cape Verde, Sierra Leone,

Lesotho, Kenya, Rwanda, Zimbabwe, Chad, Congo, Botswana, Burkina Faso, Guinea and Guinea Bissau. In the countries that have increased food availability poverty rates have decreased (Oluoko-Odingo, 2018).

In order to deal with food insecurity in Africa, NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) focused on four mutually reinforcing pillars: the need for expansion of the area under suitable land management and reliable water control systems; improvement of rural infrastructure and trade-related capacities and market access; increasing food supply and reducing hunger by accessing improved technology to enable small farmers play a greater role in increasing food availability close to where it is most needed; and agricultural research, technological dissemination and adoption and sustained long-term productivity growth (Moyo, 2007).

Even though women in SSA contribute a great deal to food production (Oniang'o, 2005; Oluoko-Odingo, 2020a), they face a number of challenges including: weak legal rights as formal titles are provided to men, limited access to common property resources (public irrigation systems, use of water, and decision-making), lack of equipment and appropriate technology, limited contact with agricultural extension, limited access to credit (collateral or socio-cultural barriers), and inadequate education. Obeng-Odoom (2011) attributes food insecurity among small-scale farmers to population pressure, poverty, land degradation and climate change.

Other efforts made to reduce hunger and food insecurity in Africa include: intensification of staple food production, integrating people and the environment, expanding the role of the markets, diversifying out of the major cereals, reforming economic wide policies as well as improving food quality and human nutrition in the past few decades (Chikaire & Nnadi, 2011). The authors noted that in 2011, in spite of all these efforts, the number of hungry people surpassed 1 billion, thus creating another reason for more concern. The food security is attributable to population growth, demographic changes, high and volatile food prices, land and water constraints, under-developed agricultural sector, and climate change. Achieving sustainable food security in Africa requires improved smallholder productivity and market access, keeping trade open, promoting productive social safety nets, integrating climate change

strategies, while also harmonizing food security and sustainability policies.

Sasson (2012) suggests that the agricultural future of sub-Saharan Africa (SSA) should be based on systems of agroecological production and agroforestry, use of crop diversity to prevent pests and diseases, use of organic fertilizers instead of chemical fertilizers, with the new method of farming involving drip irrigation, vegetable crops, fruit trees and community sharing of fruits. Other strategies include political will to properly budget for agriculture, changing the mindset to recognize the wealth presented by agriculture while also improving agricultural infrastructure — markets, roads, storage, and conservation — to increase production, improve food security and create jobs. Suitable tariff protection will eliminate cheap products and encourage poultry instead of frozen chicken. Some of the upsets include: the increasing reliance on genetically modified organisms (GMOs) and chemical inputs for African agriculture. In Congo Brazzaville, oil contributes 90 percent of the revenues and agriculture is neglected. In the DRC, the government pays salaries for people to import food, yet the country receives sufficient rainfall.

Biotechnology programmes for crop improvement are ongoing in Kenya and Zimbabwe to address resistance to maize stem borer and drought. In Europe and Japan there are separate production systems for genetically modified crops (GMOs) like maize and soy bean (Omiti, Chacha & Andama, 2002). According to Omiti et al. (2002), there shall be a dichotomy in the market and consumption — GMO free /organic products and GM indifferent market and consumption.

Food security and agricultural development

In the 1950s and 1960s, development was equated with structural transformation of the economy, while the roles of agriculture in the national product and of the labour force declined. Resources were transferred from traditional agriculture to industry (the presumed engine for growth). There was development dichotomy consisting of capitalist exchange sector (industry, mining and plantation agriculture) and non-indigenous non-capitalist sector made of subsistence farmers. The capitalist sector had reproducible capital, hired labour and sold output profits, while the subsistence farming sector was self- employed and

neither hired labour nor had reproducible capital (Staatz & Eicher, 1990). Staatz and Eicher (1990) also noted that food shortages could choke off growth in the non-farm sector by making its labour supply less than infinitely elastic by failing to invest in agriculture and even manufacturing would not succeed. The authors demonstrate the gap in the structural transformation of agriculture in African economies. Agriculture still lacks the resources to launch it into a more productive food enterprise in terms of labour and finances.

In pre-colonial agriculture, about 1000 AD to 1800 AD, Africans engaged in hunting and gathering, agriculture, mining and simple manufacturing. The environment was hostile and labour was scarce. West Africa was practicing agriculture (growing oil palms, yams and plantains — labour-saving crops), and mining in the tropical forest and transporting some gold (to Europe), copper and salt. In the Savannah, farmers grew grains such as millet (in the drier regions of West Africa) and sorghum (in southern Africa). In the Great Lakes Region of Central Africa, there was cultivation of yams and sorghum and later bananas. In the Highland areas (within Tanzania, Central Kenya and Ethiopia) farmers applied intensive forms of farming by employing terracing, manuring, mulching and sometimes irrigation. There was the use of ox-ploughs in the Ethiopian highlands and surplus was produced under their centralized system (Green, n.d). The concentration on export products and crops undermined efforts to attain lasting food security in the continent. It meant that food security did not obtain the much needed attention to improve livelihoods and eliminate poverty in the continent.

Post-colonial agriculture witnessed West Africa export agriculture concentrating on groundnuts, peanuts and palm oil. The peanut was produced in the western Sudan (Senegal, Gambia and Guinea Bissau). Palm oil was farmed in the forest of the Guinean coast (Sierra Leone, Southeastern Nigeria and Cameroon). There was preference for wild rubber (1880s to 1900s) in Ghana. Later, there was development of cocoa in French Sudan (Mali), while northern Cote d'Ivoire grew cotton (Austin, 2009).

Papaioannou & Haas (2017) noted that the expansion of cocoa production in Ghana and Nigeria was driven by African rural capitalists. The expansion of commercial groundnut production in the Gambia and Northern Nigeria as well as introduction of tobacco and cotton in

Uganda, Tanzania and Malawi were conditional on the productive choices of millions of rural households. The cotton, tobacco and groundnuts originated from Latin America.

While examining food security and agricultural origins and dispersal to Africa through the works of Sauer (1952), sorghum originated from the Sudan and millet, sorghum and rice from central Africa. Wheat, barley, flax, sorghum, pea, beans and coffee originated from Ethiopia and Eritrea, among other regions. According to Mwadalu & Mwangi (2013) sorghum has the potential to end severe food insecurity in arid and semi-arid lands (ASALS) due to its tolerance to drought and ability to thrive under a wide range of soils. Yet the government policy has promoted research on maize despite its high risk and poor adaptation to low rainfall conditions. The crops owing their origin to Africa have therefore not been given priority in terms of food security, thus contributing to perpetual vulnerability to adverse weather and climatic conditions.

Summary of literature and gaps

Food security is both an important policy and research goal in Africa (Oluoko-Odingo, 2018; Ike, Jacobs & Keling, 2015). The continent experiences conflicts and wars, disease and pest invasions, extremes of weather and climate, use of biofuels, small-scale farm population, poverty, land degradation, high and volatile food prices, land and water constraints, leading to greater vulnerability to increased food insecurity and the high number of undernourished people in Africa (Ehui, 2020; Fawole, Ilbasmis & Ozkan, 2015; Sasson, 2012). The food security situation would be worsened by climate change which will widen the food security depression (Roschmann, 2013). East Africa has emerged as one of the most food insecure regions of the world where productivity has declined due to soil degradation.

Besides the Anthropometric, Income and Welfare approaches, other methods such as Household Food Insecurity Access Scale, Prevalence of Undernutrition, and Food Insecurity Experience Scale have been used to measure food security (FAO & UNECA, 2020).

The proposed solutions lie in the correct use of fertilizers, seeds and sustainable land management, scaling up of applied research, and adoption of scientific global initiatives. Others are alternative methods of food production, food remitting and linking urban and rural areas in

terms of development, expansion of areas under agriculture, reliable water control systems, improvement of rural infrastructure and trade relations, market access, focusing on small-scale farm development and agricultural research, technology and dissemination.

Intensifying of staple food production, recognizing the role of the environment, expanding rural markets, crop diversification, policy, improving food quality and nutrition, productive social safety nets, integrating climate change adaptive strategies and harmonizing food security and sustainability policies are also some of the solutions (Crush & Ceasar, 2017; Chikaire & Nnadi, 2011; Moyo, 2007). The role of women was underlined (Oniang'o, 2005).

Many countries in sub-Saharan Africa had not attained the MDGs or WFS targets by 2015 (Oluoko-Odingo, 2018). The future should be based on systems of agroecological production and agroforestry, crop diversification, use of organic fertilizers, irrigation, vegetable and fruit production, political will to increase the budget for agriculture, recognizing wealth in agriculture and improving agricultural infrastructure, job creation, suitable tariff protection, elimination of cheap products and development of poultry sector (Sasson, 2012). This is in line with the Sustainable Livelihood framework and the Pulley of Agricultural Innovation model discussed later in the Theoretical Framework model. Some of the issues that could compromise the future include reliance on GMOs and chemical inputs, as well as reliance on oil and neglect of agriculture among oil producing countries of Africa (Omiti, Chacha & Andama, 2002).

Agricultural transformation in Africa has remained a challenge over the years (Staatz & Eicher, 1990). Pre-colonial Africa concentrated on growth of indigenous crops which changed with colonization (Green, n.d; Austin, 2009). Colonial agriculture emphasized cash crop production at the expense of food security crops, thus derailing the farming path. Secondly, industrial crops were not indigenous to the continent but were imported from other areas, thus undermining the local and indigenous crops (Papaioannou & Haas, 2017; Sauer 1952). The indigenous crops have the potential to survive harsh weather conditions (Mwadalu & Mwangi, 2013). It therefore means that the adopted farming systems are inappropriate since they do not prioritize indigenous crops, and thus compromise the ability of the farming systems approach to address the

food security problem. Secondly, the failure of the human system component of the Ecological and Human System Approach could not lead to the expected output in agriculture, thus emphasizing the need to re-align the human system for enhanced food security in Africa. There are also too many variables to measure either qualitatively or quantitatively and the failure to implement government policy sabotages the entire system.

Some of the gaps identified in the literature include: information gaps in the measurement of food security and transformation of African agriculture to overcome food security challenges, inadequate research regarding agricultural development from the pre-colonial, colonial and post-colonial periods in Africa and geopolitical dynamics to benchmark the present efforts towards food security. Further, there is a need for information on modalities for transforming small-scale farming to ensure food security within their population. As a result, the literature obtained has been used to shape this paper and propose the small-scale farm-centred food security approach, where all innovations should take place as discussed in the Theoretical and Conceptual Framework Model.

Theoretical Framework and Conceptual Framework Model

The small-scale farm food security theory proposed in this research is benchmarked on four theories: the Ecological and Human systems theory (Binder et al., 2013), the Farm systems theory (Auricht & Dixon, 2014), the Sustainable Livelihood framework (FAO, 2019; Oluoko-Odingo 2020a; Oluoko-Odingo & Ayiemba, 2020) and the Pulley of Agricultural Innovation (Oluoko-Odingo, 2020b). The theories support each other and are used to develop the conceptual framework model.

The ecological and human systems work together to influence farming through their influence on the biophysical and human environments of the individual farms. Some of the biophysical factors include climate — temperature, humidity, rainfall/water and soil, while the human factors include population and labour — education, health and experience, capital, technology and infrastructure, information and communication systems, markets, and governance among others. These factors can improve farm production and yields if the appropriate and ecologically-friendly technology is used, thus impacting positively on the household farm. On the farming systems approach, it is believed that the

household farm is a firm/enterprise with inputs and outputs. The biophysical and socio-economic environment interacts with the farm firm to produce increased production, yields and income. In the theory, the farmer is rational and makes accurate decisions that lead to the outcomes. Years spent in farming and improvement through innovation enables the farmer to gain experience that is important for the enterprise and envisaged higher yields. Mixed farming systems popular in the continent are concentrated and spread out within human settlement areas and are characterized with low productivity. The sustainable livelihoods approach is related to the livelihood assets (human, physical, social, financial, and natural capital) added to the appropriate livelihood strategies, while governance enables households/farmers to increase their productivity and overcome many vulnerabilities shocks. The pulley of agricultural innovation emphasizes that there is constant sharing of information between the ecological and human systems within the rural, peri-urban and urban areas and vice versa, which contribute to sustainable livelihoods and food security as an integral part of this process. These are illustrated in the conceptual framework in Figure 1. The conceptual framework model attempts a simplification of rather complicated models for easy application, particularly, where key variables are needed for quantitative analysis.

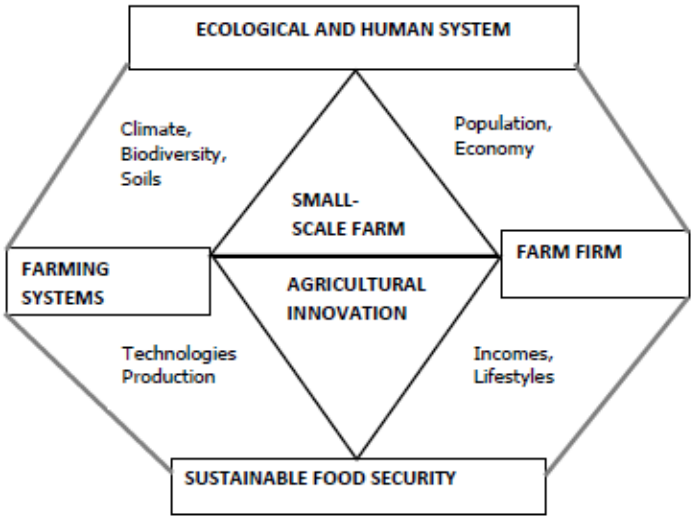

Figure 1: Small-scale Farm Food Security Approach

Source: Oluoko-Odingo, 2022.

The small-farm food security approach proposes that small-scale farms be the focus for agricultural innovations. The farming practiced should embrace the correct farming system and should function as a complete system with inputs and outputs. The farming system should adapt appropriate technology and a production system that are aligned to the natural environment — climate, biodiversity and soils. With the small-scale farm, it is important to address issues of farm size which contribute to the bigger area of small-scale farmer populations and the entire population in general. The small-scale farmer is part of the national farmers and is integrated into the national economy with structures in place for decentralized governance. It is assumed that the farmer is rational and would make the best decisions to improve incomes and increase the wealth-base, which manages consumption/lifestyles to maintain wealth, thus resulting in sustainable food security. These are shown in Figure 1. The development of small-scale farms was mentioned by NEPAD (Moyo, 2007) but it has not received the attention it deserves. The small-scale farm-centred approach is also in line with suggestions on the future solutions to food security (Sasson, 2012). The small-scale farm is the unit at which climate change adaptation and mitigation efforts should begin.

Materials and Methods

This is a desktop review article and is the result of secondary data obtained from the various library resources on issues relating to food security. The benefits of using secondary data are well known (Kothari & Gaug, 2014). The sources used include journal articles, books, internet sources and reports, among others. The main focus is on food security from pre-colonial to post-colonial agriculture in Africa to trace the steps taken towards food security, the use of indigenous crops and the relevance to agricultural development in the continent, the solutions employed in dealing with food insecurity and the search for a more applicable model to address food security challenges amidst threats from climate change. Figure 2 shows the search strategy matrix.

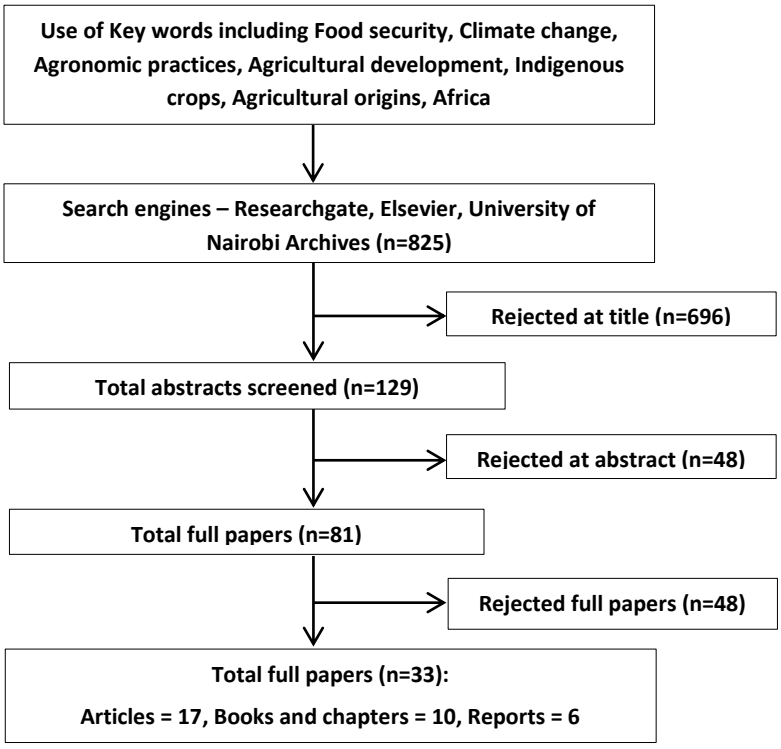

Figure 2: Search Matrix Strategy

Some of the retrieved data were existing different scales of measurement (Bluman, 2004). For instance, categorical data was used to refer to countries in Africa as Western Africa, Eastern Africa, Middle Africa and Southern Africa. The data in ordinal and interval levels of measurement were relevant in enumerating the food insecure people in Africa and to determine the current and proposed future solutions to food insecurity, while prevalence of undernutrition information was on ratio scales. These sets of data were those applied in determining percentages, used to create pie and bar charts.

Results and Discussions

Food security in Africa

Though an important policy and research goal, food security challenges still exist. These include extremes of weather and climate which are either directly or indirectly linked to water security, land

degradation and poverty. Despite global efforts through the MDGs and SDGs, food insecurity has continued to escalate in sub-Saharan Africa, particularly in East Africa, thus calling for a change in approach to addressing the issue in the region. The main question is why does the continent continue to suffer from mass undernutrition? Some of the current solutions to food insecurity are as shown in Table 1.

Table 1: Current Solutions to Food Insecurity in Africa

S/No.	Solution	Percentage
1	Correct use of inputs (fertilizers and seeds)	8
2	Sustainable land and water resources management	12
3	Change in agronomic practices (Alternative methods of food production, expansion of areas under cultivation, improving food quality and nutrition)	20
4	Food remitting and rural-urban linkages	4
5	Infrastructure (markets, roads, and social safety nets)	16
6	Focus on small-scale farms	4
7	Focus on environment and climate change	8
8	Policy reforms	12
9	Role of women	4
10	Research, technology and dissemination	12
TOTAL		100

Source: Results from data sets retrieved during literature review.

The change in agronomic practices (20 percent) is the most common/preferred solution to food insecurity in Africa, followed by infrastructure (16 percent). In third position are sustainable land and water resources management, policy reforms, and research, technology and dissemination, with a score of 12 percent each. Correct use of inputs, and focus on environment and climate change scored 8 percent each. Food remitting, focus on small-scale farms and role of women were the least preferred solutions.

Two important aspects on the list (focus on environment and climate change and focus on small-scale farms) are given low priority, yet

even with adequate infrastructure, if the two issues are not dealt with, it will be impossible to attain food security. Secondly, as the majority of small-scale farmers are women, undermining their contribution compromises the entire process. Thirdly, it is not clear where the change in agronomic practices should take place, whether in large farms or small-scale farms, thus prompting a vital area of research. Even though there are proposals for future food security, sub-Saharan Africa has not even realized the MDGs and SDGs. This demands urgent attention if the war against food insecurity is to be won.

The change in agronomic practices (systems of agroecological production and agroforestry, crop diversification, irrigation and production of vegetable and fruits) (34%) and policy reforms (increasing the budget for agriculture, recognizing the wealth in farming, improving infrastructure and job creation) (36%) scored the highest. The results indicate that from pre-colonial times to the present, food security in Africa has not given enough attention to agronomic practices and policy reforms; wrong steps could be taken, inadequate provisions made in practices or policies, inaccurate measurements taken or lack of commitment/funding. All these factors require investigation.

Measurements of food security

The share of undernourished people in Africa and their distribution in 2020 are shown in Figure 3.

Figure 3 shows that Eastern Africa had the greatest challenge regarding food security in 2020, followed by Middle Africa. However, there are discrepancies in data regarding food security in Africa, thus requiring more precise methods of food security measurement.

For instance, the use of HFIAS may need modification to suit African conditions where food insecurity is rampant and affects most households, including the middle income, due to low incomes within households. For instance, the following limitations can be pointed out on the use of HFIAS to measure food insecurity:

i) Food insecurity is a shameful condition and people may hide their status and therefore the survey may give false perceptions.

ii) Food insecurity is a political tool that is used, depending on prevailing circumstances, on the electorate to the benefit of the interested parties.

iii) Due to low salaries in Africa, the majority of households worry about food and therefore the scale may have limited application in Africa and other developing regions as almost all responses would be in the affirmative.

iv) There are professional beggars in some African countries who will always play the victim, hoping to reap some benefits.

v) Moral health is low in some communities and therefore, some responses could be misleading.

vi) The use of quality does not arise in the diets of the poor as the priority is to eliminate hunger.

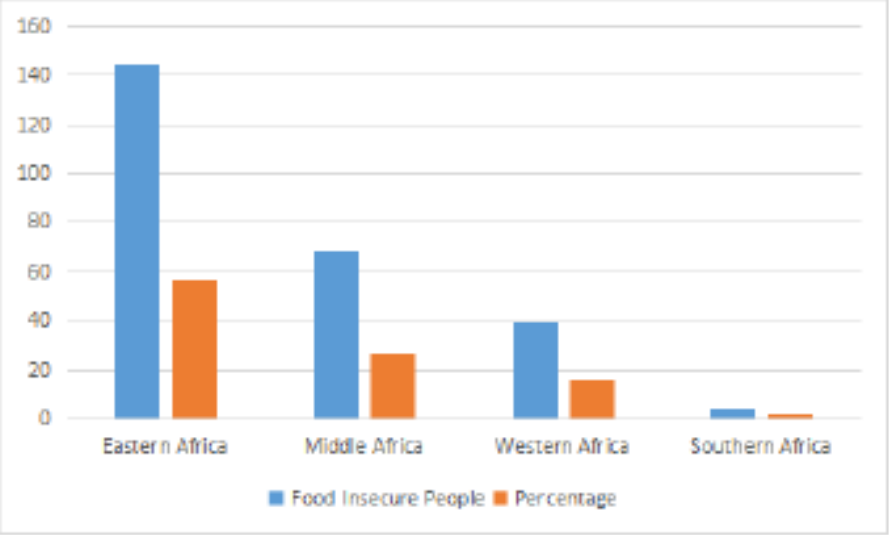

Figure 3: Undernourished in Africa (millions) in 2020 by Region

Source: Retrieved data from FAO & UNECA, 2020.

Figure 4 shows the prevalence of undernutrition (PoU) (the number of undernourished) in Africa by sub-region and year. The figure shows a worsening of food insecurity in Africa over the years. However, the indices (FIES and PoU) are silent on the sources of increases — whether due to increasing new borns who are undernourished or to more

people getting into the food insecurity trap or both, and the progress that was made in the respective periods. Thus it is important to evaluate the efforts made over the years to tackle food insecurity in Africa globally and regionally.

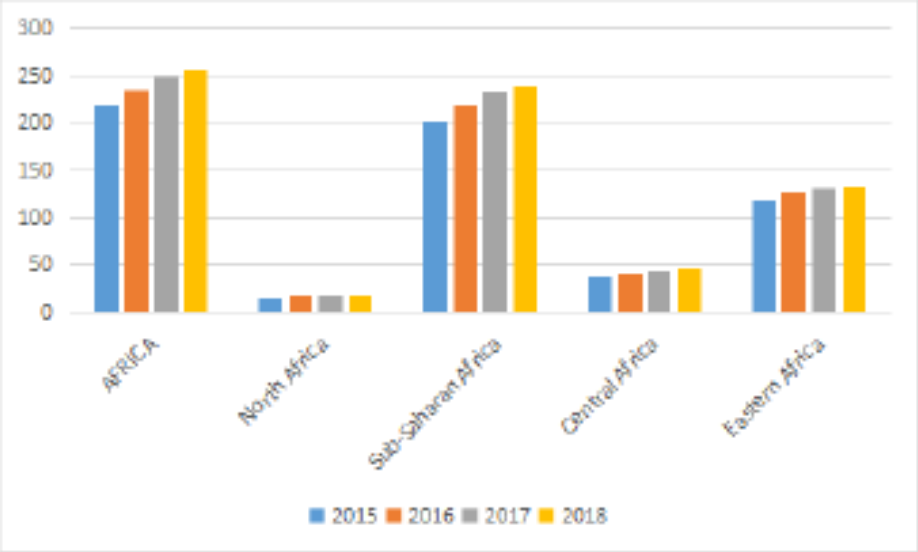

Figure 4: Undernourished in Africa by Region and Year
Source: Retrieved data from FAO and UNECA 2020.

Food Security and Agricultural Development

African crop research and diversification

The crops in favour of African agriculture are sorghum, millet, rice, wheat, pea, beans, coffee (East Africa), yams, bananas, oil palm and plantains (West and Central Africa). These crops could provide a healthy diet and are more resilient to dwindling climatic conditions as established and adapt to the harsh climates of Africa. The crops could provide answers to the changing climate and insights to the breeder's diary.

Sadly, today, maize has taken precedence over all these crops. The maize crop has consumed a large volume of research resources and yet is very vulnerable to the uncertain climatic conditions. Maize originated from Mexico and although the ecological conditions in Africa may be close to those of Mexico, the crop is not indigenous to the continent, and

thus requires more work and resources to adapt to the African conditions. Sorghum is one of the crops that originated in Africa and has great potential for food security. The crop was replaced with maize, thus launching the continent on the path of poverty and food insecurity.

Pre-colonial agriculture

The Swynnerton Plan of 1954 in Kenya allowed Africans to grow cash crops. By this time, the African mind had been conditioned to believe that cash crops were the best and could lead them to lavish lifestyles. Africans thus abandoned food production and concentrated on cash crop production, which slowly became the subject of taxes, price fluctuations, and changing goal posts or discrimination. This affected food security and livelihoods. The use of chemical inputs among illiterate farmers degraded the soil and negatively impacted the natural environment; the impacts haunt livelihoods till today. By bringing in foreign crops, for instance maize and sweetened teas, to indigenous populations used to millet and sorghum, the palate became tuned to the new diet and the climate-resilient, environmentally-friendly local crops were no longer preferable. Most of the industrial crops could also be grown with minimum monitoring and therefore favoured remote-control agriculture which allowed farmers to live miles away and employ local labour with occasional visits.

The elite viewed their own food as inferior and preferred imported and processed products — food, clothing and other household items, and therefore were oblivious to the growing poverty and food insecurity in their respective countries. The big question is: why were industries not established equitably within regions to spur growth but instead were concentrated in urban areas? Today we are occupied with solving urban problems: food security, poverty, settlement, social services, all of which are products of a derailed process.

Labour was transferred to export crops from indigenous farming, leading to loses in skills and experience already acquired due to new techniques of farming. Oluoko-Odingo (2011) noted that the experience of the farmer contributed over 50 percent of the production. Cultivation of industrial crops also meant that the diet of the people had to change to what was offered to them, thus allowing non-indigenous crops to take precedence over more climate-friendly crops. It also meant that

sustainable land resources management skills and techniques were replaced by chemical inputs that degraded the soil, making it unreceptive to simple local techniques. The mind of the cultivator was tuned to farming for export and not for food security, thus under-valuing crops for food, yet poor communities could not afford to import food, leading to the culture of begging, indignity and poverty, among others.

Post-colonial agriculture

Agricultural development and transformation in Africa over the years, as indicated by Staatz & Eicher (1990) and other researchers, is characterized by a disconnect between the development path and food security strategies. For instance, cash crops were introduced among traditional farmers who produced unprocessed agricultural products with inadequate labour. The capitalists had the labour force for the plantations and extensions on smallholder farms, leading to more profits; the food production industry was therefore neglected. Secondly, agriculture was denied investment, leading to a major cause of food insecurity in Africa. Even today, some African governments are not keen on allocating funds to agriculture but still hold on to the theories of the 1950s for their citizens. How much time does Africa need to embrace sustainability in food security for the continent?

The small-scale farm food security approach

The development of small-scale farm food security (SFF) approach was conceptualized by a number of researchers (Moyo, 2007; Sasson, 2012; Oluoko-Odingo et al. 2018). In the SFF approach, it is important to enable eco-friendly farming techniques in terms of inputs, technology and practices, for instance, integrating agro-biodiversity and agroforestry together with capacity building, while also recognizing the importance of farm size and social support systems for conflict resolution.

It is essential for governments to provide social security to small-scale farmers to ensure a minimum wage together with crop insurance to cushion them against extreme weather events.

Within the small-scale farms, traditional crops that were indigenous to the respective areas should be promoted and targeted for technological improvements. The small-scale farm should be run as enterprises with profits to supply both household requirements and

additional income for the family. Proper governance systems should be available to connect small-scale farmers at both local and national levels to ensure that there is dissemination of information and trickling down of positive effects. More serious efforts should be made to embed climate change adaptation and mitigation strategies within the small-scale farms to ensure sustainable livelihoods.

Conclusions

This paper set out to examine the effectiveness of food security indices, the status of agricultural development in Africa and ways of transforming and rejuvenating small-scale agriculture in Africa. The literature focused on the status of food security, methods of measuring food security (the anthropometric, income and welfare approaches, HFIAS, Prevalence of undernutrition and FIES) and agricultural development in the continent. The study indicates that food security will continue to worsen with climate change, with East Africa being the most vulnerable.

The proposed solutions to food security crises include correct use of inputs, sustainable land and water resources management, change in agronomic practices (alternative methods of food production, expansion of areas under cultivation, improving food quality and nutrition), food remitting and rural-urban linkages, infrastructure development, focus on small-scale farms, environmental and climate change issues, policy reforms, the role of women, and lastly, research, technology and dissemination.

Some of the setbacks for food security development include prioritization of maize over other indigenous food crops like sorghum and millet, among others; putting emphasis on cash crops at the expense of food crops; less support given to agriculture; and failure to focus on changes in agronomic practices. The methods used in measuring food security also require review to ensure accuracy.

In order to develop small-scale farms for sustainable food security, eco-friendly farming techniques should be prioritized (in terms of inputs, technologies and practices). Social security and crop insurance, while also running the small-scale farms as enterprises to support household incomes and provide surplus are important. Proper governance systems should be available to link famers to both local and

national extension services for information dissemination and trickling down of positive effects. Lastly, climate change adaptation and mitigation strategies should be integrated into small-scale farms to ensure sustainable livelihoods.

As part of recommendations, the continent needs education and awareness creation on how to fight food insecurity more effectively in the face of the challenges of climate change. The leaders require an induction forum to help them sharpen their skills and to understand the meaning of service, socialization (to understand the benefits of service), nurturing values in the society and moral health (by using history to inform the future) as these are essential in the path towards sustainable food security. It is important to shed the coat of blame on colonization and wear a new one of freedom with responsibility, and risks for the future while also charting the way forward for agricultural development. The paper concludes that special efforts should be made towards food security in Africa, starting with policy reforms to address the gaps and a re-examination of the agronomic practices of the continent to enable the citizens survive the eminent adverse impacts of climate change.

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