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SLEJ
Sri Lanka

"The Peer-Reviewed International Academic Journal of the Sri Lanka Economic Association"

ISSN: 1391-5894 2024, Vol. 21, Special Issue, 67-76

Climate Change and Food Production Challenges in Africa: A Review

M. K. Alabi[1]

Climate change has increasingly become an issue of concern to both human and animal sustenance across the various continents. While all sectors of the economy are not spared of the adverse effects of climate change, the agricultural sector is the worst hit due to its susceptible nature to heat, rainfall, drought and flooding. The Intergovernmental Panel on Climate Change stated in its report that climate change is negatively affecting crops, livestock and fishery. It is interesting to note that while Africa's level of carbon emission is low compared to the rest of the world, the impact of climate change seems to be felt more in Africa than in other regions. Drought has led to loss of livestock and farmer's harvest, and this has deprived millions of Africans. This ugly trend is partly due to the lack of resources and technical expertise needed to respond to the devastating effects of climate change. It has led to emigration for so many. This paper examined climate change and the challenges of food production in Africa. Some of the challenges of food production and food security in Africa include loss of food crops (pre and postharvest), farming systems are unproductive, soils with low fertility, shortage of farm inputs, inadequate microcredit to support small-scale farmers, value addition is low, poor storage facilities, poor food preservation techniques, poor pricing policies, and climate change and environmental degradation. African governments need to do more in terms of creating awareness among farmers on the various adaptation measures to deal with climate change. Government, in collaboration with the private sector, should subsidize agriculture and agricultural input to farmers. Early weather detection systems should be embraced and deployed. Doing this will help to mitigate the devastating effect of climate change on crops, livestock and fishery.

Keywords: *Climate Change, Food Production Challenges, Hunger, Africa*

[1] Department of Economics, University of Ilorin, Nigeria. Email: alabi.mk@unilorin.edu.ng

1. Introduction

The world is experiencing climate change. The Intergovernmental Panel on Climate Change (IPCC) stated in its sixth assessment report that climate change is negatively affecting crops, livestock and fishery. It is predicted that in the future, as rainfall becomes unpredictable and temperatures rise, the situation will get worse. While all sectors of the economy are not spared of the adverse effects of climate change, the agricultural sector is the worst hit due to its susceptible nature to heat, rainfall, drought and flooding. Mirzabaev et al. (2023) suggest that climate change will affect food production across various regions of the world in different ways and the extent will differ. Various countries will respond differently to climate change either due to their ability or resources or both (Mbow et al., 2019). At the same time, global food production also contributes to climate change as it accounts for about 30 per cent of total greenhouse gas emissions (World Bank, 2023).

Studies like (Pickson & Boateng, 2022; Thornton et al., 2011) have shown that climate change has caused a reduction in food security in developing countries. Africa is not spared as climate change is also having adverse effects on food security in the continent (Yobom, 2020; Owusu et al., 2021). According to the sixth assessment report of the IPCC (2023), approximately 3.3 - 3.6 billion people live in contexts that are highly vulnerable to climate change. Human and ecosystem vulnerability are interdependent. Regions and people with considerable development constraints have high vulnerability to climatic hazards. Increasing weather and climate extreme events have exposed millions of people to acute food insecurity and reduced water security, with the largest adverse impacts observed in many locations in Africa, Asia, Central and South America, Small Islands and the Arctic, and globally for Indigenous Peoples, small-scale food producers and low-income households. Between 2010 and 2020, human mortality from floods, droughts and storms was 15 times higher in highly vulnerable regions, compared to regions with very low vulnerability (IPCC, 2023).

Climate change has caused substantial damages, and increasingly irreversible losses, in terrestrial, freshwater, cryospheric, and coastal and open ocean ecosystems. Hundreds of local losses of species have been driven by increases in the magnitude of heat extremes with mass mortality events recorded on land and in the ocean (IPCC, 2023). Climate change has also reduced food security and affected water security, hindering efforts to meet Sustainable Development Goals. Ocean warming and ocean acidification have adversely affected food production from fisheries and shellfish aquaculture in some oceanic regions. Roughly half of the world's population currently experiences severe water scarcity for at least part of the year due to a combination of climatic and non-climatic drivers.

The occurrence of climate-related food-borne and water-borne diseases and the incidence of vector-borne diseases have increased. In assessed regions, some mental health challenges are associated with increasing temperatures, trauma from extreme events, and loss of livelihoods and culture. Climate and weather extremes are increasingly driving displacement in Africa, Asia, North America, and Central and South America, with small island states in the Caribbean and South Pacific being disproportionately affected relative to their small population size (IPCC, 2023).

With more studies on the impact of climate change on agriculture, it becomes imperative to assess their findings to understand what they have in common and the observed trend. The knowledge gained from this study will help policymakers better understand climate change and equip them with the

knowledge needed to mitigate the adverse effect of climate change especially as it affects agriculture. This study looks at the impact of climate change and the challenges of food production in Africa.

2. The current situation of agriculture and food production in Africa

Agriculture is the mainstay of Africa's livelihood as it supports more than 55 per cent of the labor force. Anything that adversely affects agriculture affects the continent. Healthy, sustainable and inclusive food systems are critical to achieving the world's development goals. Agricultural development is one of the most powerful tools to end extreme poverty, boost shared prosperity and feed a projected 10 billion people by 2050 (World Bank, 2023). Growth in the agriculture sector is 2 – 4 times more effective in raising incomes among the poorest compared to other sectors.

Between 2020 - 2022, Sierra Leone recorded the agricultural sector's highest contribution to the Gross Domestic Product (GDP) in Africa at almost 60 per cent. Ethiopia and Niger followed, with agriculture, fishery and fishing accounting for about 38 per cent and 36 per cent of the GDP respectively. On the other hand, Libya, Djibouti, Botswana, Equatorial Guinea and South Africa were the African countries with the lowest percentage of the GDP generated by the agricultural sector (AfDB, 2023).

Despite the significant variations across countries, agriculture is a key sector in Africa. In 2022, agriculture contributed 17 per cent to Sub-Saharan Africa's GDP. The sector also strongly supports job creation as it employs 55 per cent of the working population. Sudan and South Africa are the African countries with the largest agricultural areas planted. While Sudan utilized 113 million hectares of land for growing crops, South Africa used 96.3 million hectares. Agricultural production varies significantly across African countries in terms of products and volume. Cereals such as rice, corn and wheat are among the main crops on the continent. The leading cereal producers are Ethiopia, Nigeria, Egypt and South Africa (AfDB, 2023).

Africa's food production levels have been declining when compared with other continents. The decline is due to challenges such as poor market access and supporting institutions; unfavourable topography; a lack of demand for irrigated products; low population densities; low incentives to agricultural intensification; low quality soils and inadequate policy environments; agroecological complexities and heterogeneity of the region (FAO, 2023). This situation will be made worse by climate change.

Hunger around the world is still far above the level it was before COVID-19. About 690 to 783 million people globally experienced hunger in 2022. 122 million more people faced hunger than before the COVID-19 pandemic. Comparing 2021 with 2022, it was observed that the number of hungry people in the world reduced by 3.8 million from 2021 to 2022 (FAO, 2023). This reduction can be attributed to the various recovery policies introduced by the government to get the economy back on track after COVID-19. The Ukraine war, which has triggered an increase in energy and food prices seems to be contributing to cases of hunger. All hands must be on deck as hunger is still on the rise throughout Africa. Achieving the sustainable development goal of Zero Hunger by 2030 is proving to be difficult. Meanwhile, it is estimated that about 600 million people will still be facing hunger by 2030. Had it been that the COVID-19 pandemic never happened and there was no war in Ukraine, the projected

estimate of those who would be facing hunger would be 481 million by 2030; but if there is no war, then the figure would be 577 million people (FAO, 2023).

Behind the statistics are individual children, women and men suffering from severe hunger. Malnourished mothers give birth to malnourished children; thereby passing the hunger from one generation to another (WFP, 2023). Children's physical and cognitive growth is stunted. Farmers are unable to grow enough food to provide for their families and communities. Entire towns are forced to leave their homes in search of food. Three major factors identified to be driving the global food crisis are conflict, climate change and rising costs. In 2021, climate extremes were the main driver of acute hunger in eight African countries and 23 million people were forced into emergency levels of hunger. The worst hit are the households headed by women, the poor families and then those that have no land of their own. Most urban and rural households in Africa rely on food purchases and stand to lose from high food prices. These high prices reduce real income and increase the prevalence of food insecurity and malnutrition among the poor.

3. The climate in Africa

Africa has different climatic zones, and they include equatorial climate, tropical wet and dry climate, tropical monsoon, semi-arid, desert, humid subtropical and subtropical highland climate. Climate change is already adversely affecting the continent, and the evidence is found in the unpredictable rainfall and rising temperature (Omotosho et al., 2023).

There have been cases of extreme weather events across the African continent. In the period 2015 to 2017, Southern Africa witnessed drought and heat stress and this adversely affected livestock production (Archer et al., 2021). Although the region has been working on its weather forecasting system, it can do better. Climate change has made farmers across the continent to seek mitigation and adaptation methods. Some of these measures include conservation of soil and water, irrigation, improved crop variety, livestock diversification, and diversification of income sources. The use of these measures is gradually spreading but a lot still needs to be done in creating awareness and giving farmers the financial support to adopt these measures.

The El Nino Southern Oscillation has caused severe damage in terms of loss of crops and livestock in East Africa between 2015 and 2016. El Nino Southern Oscillation is a climatic change that takes place every two to seven years. Whenever it occurs, it leads to a rise in temperature, drought, heavy rainfall, floods and forest fires. The consequence of this is that many people become undernourished. Between 2015 and 2016, the number of undernourished people in East Africa became 132 million from the previous figure of 121 million and many of these people were from Uganda and Kenya. Similarly, in 2017, unfavourable climatic conditions like drought hit Kenya, Sudan and Uganda; destroying crops and raising the price of food (FAO and ECA, 2018). In June 2018, a meeting was held by the regional East African Climate Change Technical Working Group, the GIZ Global Carbon Markets Programme, and the UNFCCC Regional Collaboration Centre, and various ways of sourcing of funds for mitigating and adopting to climate changes were discussed. Climate finance agreements were reached (Namande, 2018).

One country that has been worst hit by climate change is Ethiopia. It has witnessed drought and floods (Burnett, 2013). Between 1988 and 2006, six major floods hit the nation (Bizuneh, 2013). In the 1980s, the country suffered seven severe droughts. Five out of these droughts created food shortages (World Bank, 2010). Different countries, given their different levels of environmental, political, social and economic development, do exhibit various levels of vulnerability to climate change largely due to their various levels of exposure and adaptation.

Climate change impact is not peculiar to Africa. In 2019, Northern Australia lost about five hundred thousand livestock due to flooding and cold weather. In 2018, Hurricane Michael destroyed over 2 million chickens in Georgia, USA. Hotter and humid conditions have led to losses in farm harvests (Godde et al., 2021). The impact of climate change on top major crops globally (including maize, rice, oil palm and wheat) has been negative in Europe, but mixed in Asia, Northern and Central America (Ray et al., 2019).

Changes in temperature and rainfall affects the quantity and quality of livestock feed and reduces the output of crops (Godde et al., 2021). Warsame et al. (2021) observed that agricultural output in Somalia had suffered due to increase in temperature as this has led to evaporation and reduction in soil moisture. This has ultimately affected the availability of water for irrigation and has caused a reduction in crop output. Meanwhile, major cities like Darus Salam in Tanzania, Addis Ababa in Ethiopia, Nairobi in Kenya and Mogadishu in Somalia and others have been experiencing rising temperatures. For instance, temperatures rose by 1.9^{o}C in Darus Salam, 2.2^{o}C in Addis Ababa, 1.9^{o}C in Nairobi, 1.9^{o}C in Mogadishu and 2.09^{o}C in Khartoum (IGAD Climate Prediction and Applications Centre ICPAC, 2021). The African continent has witnessed natural disasters connected to too much rain or very little rain. Extreme weather events such as flooding, drought and forest fires are bound to happen as long as there are rising temperatures and inadequate rainfall.

4. Climate change and the challenges of food production

A review of the literature reveals that there are various methods of estimating the impact of climate change on agriculture. Fonta et al. (2018) made use of the Ricardian model to study the impact of climate change on cocoa in Nigeria. Their findings revealed that farmers were adversely affected due to rising temperatures and dwindling rainfall. Also, Sadiq et al. (2018) made use of the Ricardian model to study the impact of climate change on Pakistan's agricultural output. Results showed that changes in temperature and rainfall had caused a reduction in net revenue per hectare in farms.

Similarly, Chandio et al. (2020) provided evidence to show that while rainfall and temperature changes have negatively affected agricultural output in China in the long run, carbon dioxide (CO2) has improved output both in the short run and long run. The study made use of the Autoregressive distributed lag model (ARDL).

Attiaoui and Boufateh (2019) assessed the impact of temperature and rainfall on the production of cereals in Tunisia using the panel-pooled mean group estimator (PMG). They found evidence to show that rainfall positively affects cereals while rising temperature negatively affects it. Livestock have not been spared of the adverse effects of climate change. The production and growth of animals, their welfare, behaviour and food intake have all been negatively affected (Gauly & Ammer (2020), Filipe

et al., (2020)). Rising heat waves and cases of drought have lowered livestock productivity and reproduction, reduced water and animal feed, and spread of animal diseases (Mbow et al., 2019).

CO2 can aid the growth of grasses during the rainy season (Mirzabaev et al., 2019) but in arid areas, the reverse is the case (Boone et al., 2018). The fish population has reduced by about 4 per cent due to the impact of climate change (Free et al., 2019). Every 1°C increase in global warming was projected to decrease mean global animal biomass in the oceans by 5 per cent (Lotze et al., 2019), as well as redistributing fish populations away from sub-tropical and tropical seas towards poleward areas (Oremus et al., 2020). Springmann et al. (2016) predict that by 2050, getting nutritious meals that will also be within the reach of the masses will be a challenge. Therefore, there is an urgent need for all stakeholders to rise to this challenge. All hands must be on deck to ensure that appropriate mitigation and adaptation measures to climate change are used.

5. Mitigation and adaptation measures

According to the sixth report of the IPCC (2023), various mitigation and adaptation measures can be used to address the issues. First and foremost, funding for adaptation and mitigation as well as enhancing technology innovation systems needs to be increased while fostering international cooperation. Between US dollar 2.6 trillion and US dollar 2.8 trillion is needed by 2030 to implement the continent's climate action ambitions as expressed in Nationally Determined Contributions (NDCs) submitted by April 2023. Put annually, this comes to between US dollar 234.5 billion and US dollar 250 billion. This highlights the fact that there is a climate finance gap. To close this gap by 2030, private climate finance in Africa would therefore need to increase by about 36 per cent a year (AfDB, 2023). The funds should trickle down to every farmer in the community and rural areas. Monitoring as well as evaluation need to be carried out to make sure that the aims of the funds are being met. Furthermore, adequate training and support should be given to farmers on how to use the technology.

Secondly, greenhouse gas emissions need to be reduced drastically across all sectors of the economy. Rising population, increased use of fossil fuels and deforestation have all contributed to the rise in greenhouse gas emissions. These are areas which can be looked into. Next, sustainable land management should be practiced. Water-efficient irrigation methods such as sprinkler and drip irrigation can help increase resilience and adoption of drought-resistant crop cultivars under diversified cropping systems is an essential adaptive strategy in many dryland areas (Mirzabaev et al., 2019). Other measures are: promote open and equitable food trade, strengthen social protection and empowerment of the vulnerable, support urban and peri-urban agriculture, invest in research and encourage perennial crop cultivation and production. More adaptation strategies are migration, cultivating new plots of land, crop rotation, diversifying sources of income, using fertilizers and manure, changing the dates for planting and the varieties as well, tree planting and conservation of the soil.

6. Conclusion

This study assessed the literature on the impact of climate change on agriculture in Africa, the challenges and the adaptation and mitigation issues. From the literature reviewed, it was observed that prior to the adverse effect of climate change, the African continent was already faced with some challenges. Here are some of the challenges: loss of food crops (pre and postharvest), farming systems are unproductive, shortage of farm inputs, inadequate microcredit to support small-scale farmers, value addition is low, poor storage facilities, poor food preservation techniques and poor pricing policies. In addition to all of these is the challenge of climate change. Drought, flooding, extreme weather, rising temperatures and too much or too little amount of rainfall have taken their toll on food production. The impact varies from country to country. Africa, Western Asia and the Caribbean are still faced with rising cases of hunger. No doubt, achieving the sustainable development goal (SDG) target of Zero Hunger by 2030 poses a daunting challenge. Indeed, it is projected that almost 600 million people will still be facing hunger in 2030 (FAO, 2023).

As part of measures to address these challenges, the various African governments should increase funding for adaptation and mitigation. Innovation technology systems like early weather warning detection systems should be embraced and deployed to the field. Farmers need to be given more orientation on how to adapt to the challenges of unpredictable rainfall, rising temperatures and extreme weather events. The use of irrigation systems should be encouraged also. At the moment, Africa contributes only a small fraction to the total greenhouse gas emission; however, efforts should be put in place to make sure the continent goes green. All agricultural activities including, production, industrialization, and energy consumption should adopt environmentally friendly technologies. If these policy measures are put in place, it is capable of achieving food security and reducing poverty considerably.

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