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CLIMATE CHANGE, FOOD SECURITY AND THE ATTAINMENT OF SUSTAINABLE DEVELOPMENT GOALS IN NIGERIA

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Abstract
This paper examines the impact of climate change on food security and the attainment of sustainable development goals in Nigeria. Climate change has continued to decimate food security plans in Nigeria. Despite the plethora of policies and programmes put in place to stem the tide, its impact on food security, food productivity has continued to shrink. Climate change crisis has been causing severe hunger and deprivation due to shortage of food, as food and commodity prices continue to soar on daily basis. The paper adopts the environmental security theory as theoretical framework, while relevant data were obtained from secondary sources. The paper found out that climate change has huge impact on food security. Increased climate variability, increased frequency and intensity of extreme events hamper the stability of food supply access and utilization. The paper recommends sustainable agricultural practices by advocating that governments at both national and sub-nationals should encourage private investments in the agricultural sector by providing incentives that apply to both primary and secondary food producers, adequate funding of agriculture, transparency and accountability in the allocation and disbursement of resources in agricultural sector, investment in climate resilient or smart agriculture, adequate sensitization of farmers on climate change and provision of extension services and farming inputs, access to credit facilities, adequate provision of modern storage facilities, mechanized farming and empowerment of women and youth to enhance self-sufficiency in food production.
Keywords: Climate change, hunger, food security, sustainable development goals

Introduction

Climate change constitutes one of the challenges to food security. Its impact on food security has been worrisome and alarming. It is a major contributor to the unprecedented hunger which affected many people and livelihoods, thereby contributing to food insecurity in the country. According to the World Food Programme (2023), Nigeria as Africa's biggest economy and most populous country has the world's fifth highest burden of people experiencing food crisis or worse, exceeded only by Yemen, Ethiopia, Afghanistan and the Democratic Republic of the Congo. Nigeria's human development potential remains unfulfilled and its most vulnerable people continue to suffer critical levels of food insecurity and malnutrition driven by persistent conflict, organized violence, recurrent climate shocks and broad exposure to the impact of climate change. As Africa's largest economy, Nigeria's wide range of livelihoods, agricultural practices, and commodities are threatened by climate change. Apparently, rising sea levels increase vulnerability to flooding and water borne disease. Also, drought and rising temperature hinder agricultural production and fishing, reducing food security. Climate change constrained water which increasingly cause adverse impacts on agricultural production through diminishing water supplies, increases in extreme events like floods and severe storms, heat stress, and increased prevalence of pests and diseases. Climate change impacts has continued to provoke conflict, spate of insecurity in many of the rural communities and has made it practically difficult for farmers to engage in agricultural production optimally thus affecting productivity and largely causing market disruptions with attendant food price shocks. Food security situation in Nigeria has been alarming and worrisome, with millions of people estimated to be critically food insecure.

Moreover, food inflation has put more Nigerians on the edge as food inflation for November 2023 surged to 32.84 percent on a year-on-year basis. It was 8.72 percent points higher than the rate (24.13 percent) recorded in November 2022 (Edeh, 2023). The National Bureau of Statistics report (2023) indicates in its analysis on food insecurity that food inflation has soar to 31.5 percent made it now worrisome. The report also showed that approximately nine million children are at risk of suffering from acute malnutrition or waste. Of these, an alarming 2.6 million Children could face severe acute malnutrition and require critical nutrition treatment. There is a whole lot of poverty in the country as a result of food shortage. The National Bureau of statistics estimates the number of poor in Nigeria at 133 million, representing 63 percent of the Nigerian population.

According to United Nations Office for the Coordination of Humanitarian Affairs (2023), many people are food secure in Nigeria, of the 18.6 million people who experience food insecurity today, 3.3 million live in the North-Eastern States of the Bauchi, Adamawa and Yobe region. This number might rise to 26.5 million nationwide by the height of the 2024 lean season (and to 4.4 million in the Bauchi, Adamawa and Yobe States) if immediate action is not taken. Nigeria is one of the countries exceptionally vulnerable and climate change which affect millions of people and make pressing as rapid changes in weather patterns erode the productivity of local water and food systems and generate unintended consequences for sustainable development (African Development Bank, 2022, p.7). Climatic conditions such as floods, droughts and extreme temperature are some of the consequences of climate change. These conditions have led to crop loses and has threatened the livelihood of farmers as well as poses food security challenges overtimes, to some states, especially in developing countries (Ani, Anyika & Mutambara, 2022).

Nigeria ranked among the top five African countries and is also listed among the top 31 countries globally, achieving a score 64.6 percent in the United Nations (2023) Sustainable Development Report. Food insecurity has remains worrisome and alarming. Furthermore, despite the fact that Nigeria passed the Climate Change Act in 2021 to address the impact of climate change and seeks to achieve low greenhouse gas emissions, green and sustainable growth by providing the framework to set a target to reach a net zero between 2050 and 2070 (Climate Action Tracker, n.d.). The impact of climate change on food security has become worrisome and alarming. According to the Global Hunger Index Report (2023), Nigeria ranks 109th out of the 125 countries with sufficient data to calculate 2023 GHI scores, with a score of 28.3. Nigeria also ranked 163rd of 189 countries in the 2020 Human Development Index and 186th for life expectancy, at 52.7 years at birth (United Nations Development Programme, 2020). The United Nations World Food Programme has warned repeatedly that millions of Nigerians are at the risk of hunger as prices of food stuff increases.

Climate change has continued to adversely affect agricultural production and food security. There is need for urgent action to reverse this trend of food insecurity impacted by climate change crisis. It is against this background that this study attempts to interrogate the impacts of climate change on food security and sustainable development goals in Nigeria. Relevant data were drawn from journals, text-books, newspapers and online sources were explored to provide a comprehensive understanding of the topic. The paper is divided into six sections. The first section dwells on introduction. Section two dwells on the conceptual framework and literature review, and theoretical framework. Section three provides an overview of the Nigeria's efforts at combating climate change impacts on food security. The fourth section examines sustainable development goals and food security in Nigeria. The fifth section discusses the impact of climate change on agriculture and food security in Nigeria and the challenges of climate change on food security in Nigeria, while section six provides the conclusion and recommendations.

Conceptual Clarification and Literature Review

Climate Change

Climate change essentially refers to changes in the mean variability properties of the climate, which persists over an extended period of time, typically within decades or longer. It is incontrovertible that climate and food security are related because climate change necessarily affects the climatic conditions responsible for optimum food production. According to Ani et al. (2022), the climatic condition is the long-term summation of the atmospheric elements such as solar, radiation

temperature, relative humidity and precipitation and their variations over a long period. Climatic conditions have led to crop loses and has threatened the livelihood of farmers as well as poses food security challenges overtime. Thus, a favourable climate will have a significant impact on food security and vice versa.

According to the United Nations Nigeria (2022, p.71), developing countries are more vulnerable to the impact of climate change and have been the hardest hit. This is primarily because of their vulnerability to the damaging effects of a climate change driven hazard and coupled with their reduced capacity to cope with these efforts. The report noted that changes to the climate driven by human activity are already resulting in weather and climate extremes in every region across the globe. Some evidence of the changes includes heat waves, heavy rainfall, drought and tropical cyclones. Climate change exposes the environment to numerous challenges thereby affecting the economy, health and agriculture as well as food and human security. The two of the most affected subsectors by flooding induced by climate change crisis is crop production and fishery which account for over 80% of the value of Nigeria's agricultural sector. It is estimated that 108,392 hectares of farmlands are affected by the 2022 flooding. The flooding disaster caused by climate change made it difficult for farmers to invest or maintain investments in farming as the crops get washed away, and their fish do not survive the surge that takes over pounds (Oyedeji, 2022).

Food Security

Food security has expanded in meaning and scope, the definition now covers both the supply (assuring availability at stable prices) and demand (access and affordability) sides, as well as the nutritional (health) aspects and individual food preferences (choice). The issue of vulnerability is now added to the definition of food security to accommodate the fact that the need for food does not mean ability to buy. The World Bank, in its "Poverty and Hunger" report (1986), introduced the difference between chronic food insecurity associated with structural poverty and low incomes, and transitory food insecurity are living experiences in Nigeria, but generally, when people do not have adequate physical, social or economic access to food, they are considered to be food insecure (Federal Ministry of Finance, Budget and National Planning, p.155). Food security therefore reflects the stability of the food supply and availability of and access to food. Food insecurity can be brought about by climatic shocks, natural disasters, economic crises or conflict (Idoko, 2016). Moreover, some of the major factors identified to be contributing to food insecurity in Nigeria include poverty, climate change, conflict and insecurity, increasing population, poor policy implementation, inefficient agricultural practices, post-harvest losses and low budgetary allocation to agriculture, among others (Mojeed, 2023). Other factors responsible for food insecurity in Nigeria include regional instability, climate change and inflation (www.voanews.com). Similarly, Nigeria Economic Summit Group (NESG, 2023) succinctly put the causes of food insecurity in Nigeria including lack of cheap agricultural financing, lack of access to commercial agricultural finance and incentives to promote low-cost local production of food.

FAO (2015) cited in Ake, Owoeye, Ajakaiye, Ayantunji, Apalowo, Popoola and Ayantunde (2023) explains that food security hinges on all requirements needed to assess sufficient and nutritious food for a healthy and functioning life. Adding that, the major aim of food security is to ensure individual access to adequate food always needed and utilization of such food to meet body growth and developments. It also identified four components of food security. These include availability, access, utilization and stability. These components must be simultaneously satisfied to meet its objectives.

Ogundipe, Obi and Ogundipe (2020) submit that the impact of environmental degradation on food security is huge. These include depletion of farmlands and reduction in crop yields. Climate change is a big threat to Nigeria food security affecting both subsistence and commercial farming. Climate change causes an increase of diseases and pests, thereby declining agricultural production. Declining rainfall in some parts of the country is causing increasing desertification. Also, harsh weather condition induced by climate change resulting temperature hampers agricultural yields and promotes crime and conflict. Climate change can disrupt food availability, reduce access to food, and affect food quality. Thus, extreme temperature and precipitation can prevent crops from growing. Extreme events, especially floods and droughts, can hinder crops and reduce yields. Changes in temperature,

atmospheric carbon dioxide and the frequency and intensity of extreme weather could have significant impacts on crop yields (United States Environmental Protection Agency, n.d.).

According to Adams and Razmara (2013), Nigeria has a large informal economy, accounting for more than half of its GDP and over 80 percent of employment. Agriculture represents about one quarter of total GDP, indicating broad exposure to the impact of climate change. High incidence of floods, desertification and deforestation continue to pose serious threats to livelihoods (World Food Programme, 2023). Furthermore, United States Environmental Protection Agency (n.d.) confirming the view of Ajetomobi, Ajakaiye and Gbadegesin (2015), contends that climate change impacted agricultural production results in decreased crop yields. Adding that rising temperatures and carbon dioxide concentrations may increase some crop yields, but the yields of major commodity crops (such as corn, rice, and oats) are expected to be lower than they would in a future without climate change.

Climate-Smart Agriculture

According to the World Bank (2021), climate-smart agriculture is a set of agricultural practices and technologies which simultaneously boost productivity, enhance resilience and reduce greenhouse gas emissions. Climate-smart agriculture is an integrated approach to managing landscapes-cropland, livestock, forests and fisheries that address the interlinked challenges of food security and climate change. Climate-smart agriculture is distinct in many ways. It has an explicit focus on addressing climate change in *agrifood* system, enhance resilience and reduce greenhouse gases emissions of the food system, avoid deforestation due to crop expansion and increase the carbon sequestration of plants and soils. Although, it is built on existing agricultural knowledge, technologies, and sustainability principles (World Bank, 2024).

Theoretical Framework

This work adopts Environmental security theory as its framework. The theory emerged within the broader concept of human security which was introduced by the United Nations Development Programme (UNDP, 1994). Global environmental degradation affects all aspects of our lives and livelihoods. Apparently, environmental degradation hampers food security. The more the environment is degraded due to various human or natural factors, the more the reduction in food production. Environment Security is defined as a state in which an ecosystem is able to support the healthy pursuit of livelihoods by the people living in that system (OECD, 1996). Furthermore, Josef (1994) reinforces the above definition noting that, environmental security is concerned with the protection of natural environment and vital interests of citizens, society, the state from internal and external impacts, adverse processes and trends in development that threaten human health, biodiversity and sustainable functioning of ecosystems, and survival of human kind.

The theory explores the linkages between the environmental conditions and food security, particularly how environmental events such as climate change, water, air, land degradation etc. affects food security (Whyte, 2001). The theory contends that environmental condition is inextricably linked to food security. Therefore, the choice of environmental security theory is apt and relevant for interrogating climate change, food security and the attainment of sustainable development goals in Nigeria. Food security is dependent on environmental factors, and a favourable climate is necessary for sustainable food production and food security. Also, agricultural production and or food security may be influenced by the environment and climate conditions. Furthermore, the environmental security theory explains how environmental concerns such as water, air, pollution, land degradation, deforestation, desertification, drought, flood, erosion, loss of biodiversity, and extreme events impact food security. It also provides insights on how the environment and climate change related risks, including the underlying drivers of risks vulnerabilities could impact food security.

Overview of the Nigeria's Efforts at Combating Climate Change Impacts on Food Security

On the food security roadmap, the Federal Government has initiated numerous policies to boost agricultural productivity in Nigeria. This includes but not limited to the following. The Agriculture Promotion Policy (APP, 2016-2020), Economic Recovery and Growth Plan (EGRP) 2017-2020, the National Livestock Transformation Plan (NLTP) (2019-2028), National Animal Identification System and Traceability System (NAITS) (2022) and the Anchor Borrowers Programme. Also, National

Agricultural Technology and Innovation Policy (NATIP) 2022-2027 was designed, a document that seeks to guide sectoral activities for ensuring food and national security in the country. The Policy is hinged on 10 thematic areas which include strengthening priority crop value chain and climate-smart agriculture, promotion of rural infrastructural development amongst others. Despite these policies, food insecurity still remains a threat. However, lack of political will has undermined the effectiveness of the above mentioned programmes and policies in achieving the desired results of boosting food security in Nigeria.

Furthermore, Nigeria has undertaken efforts at the national level to reduce and eliminate the adverse impact of methane emissions. As part of Government of Nigeria's climate priorities in 2021, the Government of Nigeria updated its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement, which stipulates an unconditional contribution target of reducing greenhouse gas (GHG) emission reduction by 20 per cent below the business as usual (BAU) emissions scenario by 2030, and a conditional target of 47 per cent GHG emission reduction below 2018 emissions levels contingent on international support.

The National Council on Climate Change established in 2021 by the Nigeria Climate Change Act, works to mainstream climate change actions and achieve low greenhouse gas objectives. Others include the Nigeria's Adaptation Plan Framework (2020) which articulates Nigeria's adaptation actions, and facilitates the implementation of priority adaptation activities. The Nigeria Energy Transition Plan outlines Nigeria's commitment to carbon neutrality by 2060 across 5 key sectors. Power, cooking oil and gas, transport and industry (United States Agency for International Development, 2023). These plethora of policy, declarations, document and a new national climate change law has been criticized for lack of effective and comprehensive implementation of key policies and commitments, and absence of clear budgetary provisions for their implementation (Agora Policy Report, 2023).

Sustainable Development Goals and Food Security in Nigeria

Food security is one of Sustainable Development Goals. It is the SDG 2 which aims to "end hunger", achieve food security and improved nutrition and promote sustainable agriculture. The Sustainable Development Goals aim to transform the world. They are call to action to end poverty and inequality, protect the planet and ensure that all people enjoy health, justice and prosperity. Sustainability has been considered a precondition for long-term food security. The environment and especially climate and the optimality of natural resources, are a precondition for the availability of food as well as the preservation of biodiversity (Berry, Dernini, Burlingame, Meybeck & Conforti, 2015). Sustainable agriculture has the potential of satisfying human needs for food, protecting natural resources and ensuring environmental quality. Sustainable agricultural systems offer ecosystem services, such as pollination, biological pest control, regulation of soil and water quality, maintenance of soil structure and fertility, carbon sequestration and mitigation of greenhouse gas emissions, nutrient cycling, hydrological services and biodiversity (Rehman, Farooq, Lee & Siddique, 2022).

Furthermore, through the adoption of sustainable agriculture practices, more food can be produced per acre, more crops can be grown on an area of land, and at the same time, more nutritious produce can be grown, resulting in a greater supply of food (Colson, 2022). Sustainable agriculture practices also promote sustainability and improvement of all systems of production, including organic approaches, and sustainable intensification, so as to preserve biodiversity and ecosystems, minimize environmental degradation and reduce greenhouse gas emissions per unit of product. It also promotes integrated agricultural systems making better use of natural resources, halting deforestation, restoring degraded lands, improving soil quality, and fostering the sustainable management of water resources (Committee on World Food Security, 2016, p.5). Thus, achieving food security in Nigeria requires investing in sustainable agricultural practices, supporting smallholder farmers, strengthening value chains, and improving post-harvest loses and storage systems.

However, Sustainable Development Goals on "end hunger" is far from being achieved as many Nigerians are food insecure as a result of climate change crises and other associated factors. The WFP Report (2023, p.5) noted on access to food (SDG Target 2.1) that despite significant investments by

the Government and its partners, Nigeria is not yet on track to ending hunger by 2030. The percent of the population living under moderate to severe food insecurity increased from 36.5 percent in 2015 to 57.7 percent in 2020. Adding that conflict, climate change and significant humanitarian access challenges have been the key drivers of food insecurity but the socio-economic effects of the coronavirus disease 2019 (COVID-19) pandemic and the global impact of the Ukraine crisis have exacerbated the situation.

Impact of Climate Change on Agriculture and Food Security in Nigeria

According to World Bank on climate smart-smart agriculture, the global agriculture food system emits one third of all emissions. Traditionally, the increase in food production has been linked to agricultural expansion and unsustainable use of land resources. This creates a vicious circle leading to an increase in emission.

Nigeria's agricultural sector has been hurt by several shocks: regular flooding, desertification of crop and grazing land, extremist insurgencies, and conflicts between herdsmen and local farmers (International Trade Administration, 2023). Similarly, FAO (2015) highlighted in a study on climate change and food security that climate change has been found to have an impact on food safety, particularly on incidence and prevalence of food-borne diseases, increase climate vulnerability, increase frequency and intensity of extreme events as well as slowing ongoing changes will affect the stability of food supply, access and utilization.

Ani et al. (2022) conducted a study on the impact of climate change on food and human security. The study found out that climate change has negatively affected food security in Nigeria. The consequence of which has also led to continuous armed confrontations over natural resources thereby undermining human security in the country. However, the study fails to mention how climate-smart agriculture and promotion of coherent and efficient agricultural policies can help to combat the impact of climate change on food security in Nigeria.

Furthermore, Dauda (2023) in a study on climate change and food security in Nigeria submits that climate change negatively affects crop yields contributing to agricultural losses, soil fertility, and droughts. It threatens food security, environmental, health and nutrition. The study highlighted some of the challenges of climate change on food security to include, the alteration of planting and harvesting seasons, decrease in crop yield, increased pest, influence on livestock, flooding of farmlands and high demands for irrigation. The study recommends adequate legislative policies to promote environmentally friendly practices, research in natural and climatological sciences, adoption of agricultural methods or smart food systems and propagating drought-resistant grasses in drought affected areas. However, the study fails to capture in its recommendations adequate climate financing, robust awareness and sensitization of farmers on impact of climate change on food production and adequate funding of agriculture to combat impediments to food security in Nigeria.

Durodola (2019) in a study on the impact of climate change induced extreme events on agriculture and food security with particular reference to Nigeria. The study found out that extreme events such as droughts and floods impact agriculture and food security. The study recommends the need to intensify efforts and researches on climate change to mitigate and adapt to the occurrence of these extreme events. Other measures recommended include practicing climate-smart agriculture, construction and improvement of drainage networks to effectively dispose of flood water in order to reduce the risks of flooding in urban agriculture and drought resistant varieties of crops should be cultivated. However, the study fails to recognise the importance of adequate coherent and coordinated policies and funding of agriculture, adequate security, leveraging on biodiversity technology, advocacy and the sensitization of farmers on the impact of climate change on food security.

Ajetomobi et al. (2015) explore the potential impact of climate change on Nigerian agriculture. The study examines how extreme weather condition has affected the mean and variance of the yield of 18 food crops in Nigeria over a period of 42 years (1971-2012). The framework of analysis consists of a stochastic production suggested by Just and Pope (1978, 1979). The results indicate that the productivity of more than half of the staple crops in Nigeria is threatened by increase in total annual

rainfall and extreme temperature nationally and across states in Nigeria. However, the study fails to accommodate contemporary development in science and technology such as climate-smart agriculture and other modern sustainable practices of farming methods that can be deployed to boost food production.

Agricultural sector is responsible for non-CO2 emissions generated within the farm gate by crops and livestock activities, as well as for CO2 emissions caused by the conversion of natural ecosystems, mostly forest land and natural peat-lands, to agricultural land use (Food and Agriculture Organization, 2020). Climate change poses a threat to Nigerian agriculture- the World Bank recently predicted an up to 30% drop in the country's crop output due to erratic rainfall and higher temperatures (FRN, 2021). Agriculture is one of the major contributors to emissions in the Nigerian economy, followed by Forestry and other Land Use. Also, transport, the industrial sector, waste and the power sector.

Other impacts of climate change on agriculture are flooding, desertification, and drought. According to the United Nations (nd cited in FRN, 2021) Nigeria has the highest rate of deforestation in the world, losing 3.7% of its forestry every year. It is also home to Africa's largest mangrove forest but only six per cent is protected. Its multiple ecological zones have given rise to a wide range of livelihoods, agricultural practices, and commodities, all of which are affected by climate change and shocks (United States Agency for International Development, 2023). Desertification induced by climate change is another driver of food insecurity. It causes loss of biological diversity, contribute to disease burden, alter geo-chemical composition of the soil, contribute to water scarcity, reduced agricultural yield hence, contributed to food insecurity, reduced economic growth among others unfavourable impacts (Olagunju, 2015). The consequences of desertification include loss of biodiversity by worsening the living conditions of many species, food insecurity due to crop failure or reduced yields. Others include the loss of vegetation cover therefore of food for livestock and humans (Desertification, n.d.). The resultant effects of land degradation in Nigeria include unemployment, pockets of conflict for resources (herdsmen crises), food insecurity, desertification, drought, flood and erosion (Land Degradation Neutrality Target Setting Programme, 2018, p.8).

Also, flooding is one of the impediments to food security in Nigeria and also a component of the consequence of the impact of climate change on agriculture and food security. Flooding adversely affects food availability, accessibility national worth and stability. Flooding degrades the environment and destroys crops, farm settlements, livestock and seeding stores. This reduces harvest and affects the next planting season, resulting in a food storage crisis. Flood washes away the top soil which is the richest part of the soil and contains organic matter and other crop nutrients and deposits elsewhere. This eventually leads to a reduction in the soil's fertility and its sustainable use and thereby undermining food security (Eljuwairiya, 2020).

Furthermore, livestock are killed or lose pastures and inundated farmlands are unsuitable for cultivation. Depending on the type of sediment deposited on farmlands during floods, some can't be cultivated for a long time, creating a cycle of food scarcity and hunger. Aquaculture and fish farming are not spared either (Echendu, 2022). The above assertion is consistent with a study by Week and Wizor (2020) which submits that 69.9% of the respondents attested to the fact that growth and development of crops are affected when flood washes away farmlands. It can also be seen that flood increases food insecurity, unavailability of stable food and malnutrition as agreed by 78.3% of the total respondents. Similarly, studies have been conducted on implications of extreme events such as droughts and flooding induced by climate change on agriculture and food security. These effects include changes in crop and livestock yields as well as the economic consequences of these potential yield changes globally (Durodola, 2019). Thus, flooding has had consistent devastating impact on the fragile food security.

Table 2: Summary of Global Agricultural Emissions of Nigeria, 2015-2021

S/N	Year	Contributions of Agriculture to Global Emissions (m tonnes)	Carbon (CO_2) (m tonnes)	Methane (CH_4) (m tonnes)	Nitrous Oxide (N_20) (m tonnes)
1	2015	-	9.81	911.50k tonnes (0.91)	75.92k (0.076)
2	2016	-	9.57	-	-
3	2017	-	9.82	-	-
4	2018	-	10.58	1.73	-
5	2019	-	8.96	1.55	82.75k (0.083)
6	2020	-	9.14	1.54	82.75k (0.083)
	2021	-	-	1.54	82.75k (0.083)
7	2021	4.9%	8.70	3.00	0.09
	Total	2%	66.6	20.3 and 2% of global agricultural	0.63 and 1.6% of global agricultural emission

Source: Compiled from Oladapo (2023).

Table 2 indicates the Global Agricultural Emissions of Nigeria, particularly from carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), from 2015 to 2021. Nigeria contributed 2% of global agricultural emissions during the period. The country's emission included 66.6m tonnes of carbon dioxide (CO2), 20.3m tonnes of methane (CH4), and 0.63m tonnes of Nitrous oxide (N2O). This shows that Nigeria contributed 2% and 1.6% of methane and nitrous oxide respectively to global agricultural emission.

Challenges of Climate Change on Food Security in Nigeria

Climate change conditions such as climatic shocks, natural disasters and conflict have continued to impact food security in Nigeria. Conflicts such as the Boko Haram insurgency, herder-farmer conflicts, and armed banditry attacks are major concerns affecting the livelihoods and food security of households in Nigeria. The Federal Ministry of Finance, Budget and National Planning (2022, p.155) listed the challenges of food security to include, poor harvests due to climate conditions and conflicts such as the farmer-herders' crisis, banditry, and kidnapping. The rising pace of the rural-to –urban migration has led to a decline in agriculture production among rural households and further worsened food security in the country. Others include, extremely high poverty level among rural households, resulting in a deteriorating hunger index rank for the country, and weak coordination and implementation of the policy on Food Safety and Hygiene and that of the National Plan of Action for Food and Nutrition.

Climatic factors affecting agricultural production in Nigeria include rainfall, temperature wind and sunlight. The quantity of rain falling within a given area in a given time hinders agricultural production (FCT EMIS, n.d.). Thus, factors affecting food security include climate change and Global warming, scarcity of land for farming, and technological barriers. The United Nations Nigeria (2022) noted that undernourishment and food insecurity are rising, partly owing to low agricultural production, inadequate policy choices and persistent conflict and population displacement. More than half of all Nigerians or more than 100 million people are enduring at least moderate food insecurity (United Nations Nigeria, 2022).

Other impacts of climate change on food security is that it can affect people's food utilization capacity through decreasing productivity of plants that are rich in micronutrients or it alters the micronutrient content of specific crops through flooding of the cropland (Zewdie, 2014). Furthermore, the adverse effect of climate change has been identified to include reduction of agricultural production, changes in the suitability of land for crop production, changes in precipitation patterns, and increase in temperature could lead to longer growing seasons (Ayo, Omosebi & Suleiman, 2014). An increase in the frequency and severity of natural disasters has continued to have devastating effects on food security and thereby creating distortion and disruptions in the food security plan of the country.

Farmer-herder crisis has been consistent and persistent, plaguing efforts at food security in Nigeria. The principal driver of conflicts between farmers and herders is essentially competition for scarce resources and or economic in nature, with land-related issues at the centre, especially issues of accessibility and use of land and water resources as a consequence of climate change (Daniel, 2021). Furthermore, the act of overgrazing of cattle on farm crops by the herdsmen and the act of encroaching grazing reserves, water holes and cattle paths by the farmers are the major cause of conflict between farmers and herdsmen. This clash has continued unabated and has significantly hinder food security in Nigeria. The crisis has resulted in the displacement of farmers to secure their lives thereby deserting their farms. A report by the International Organization for Migration (IOM, 2023) documented a total of 1,190,293 internally displaced people in 191,688 households across the eight states in North-Central and North-West regions because of violence. Similarly, the Violent Database shows that in 2021, there were 86 farmer-herder incidents and 451 deaths in Nigeria. A recent report of the escalation of the crisis on 26th January, 2024 indicates that 30 people were killed in renewed violence in Nigeria's central Plateau State where clashes between Muslims herders and farmers occur. Another report suggests that in North- Central Nigeria, Farmer-herder clashes in Benue and Plateau states have intensified, with the frequency and fatality of incidents higher in the second quarter of 2023 than in the same period in 2022 (Famine Early System Network, 2023).

On the implications of farmer-herder crisis in Nigeria, a study conducted by Okoro (2018). The study concluded that Herdsmen/Farmers conflict has continued to drive population displacement, disrupt farming activities and thereby created food insecurity, distrust and unemployment. The study recommended that state governments should designate grazing land for the nomadic herdsmen and make them pay tax. Conversely, food also affect climate change because food needs to be grown and processed, transported, distributed, prepared, consumed, and sometimes, disposed of. Each of these steps creates greenhouse gases that trap the sun's heat and contribute to climate change (United Nations, n.d).

Conclusion

This paper concludes that Nigeria's food security is mostly affected by climate change. Food security cannot be guaranteed without human security. The paper harps on the need for adequate funding of agriculture, adequate security for farmers and the promotion of mechanized farming and climate-smart agriculture to mitigate the impact of climate change on food security.

Recommendations

The paper makes the following recommendations;

1. Both levels of government (Federal and State) should work around providing adequate security for farmers and mitigating the impact of climate change through promoting climate-smart agriculture, adapt and build resilience to climate change, reducing greenhouse gas emissions and investing in renewable energy and energy efficiency, promoting green manufacturing, and harnessing natural resources.
2. Promoting rural resilience activity through promotion of inclusive and sustainable agriculturally-led economic growth and strengthen resilience among people.
3. Increase synergies and collaborations among farmers, policy makers and researcher institutes and making appropriate policies and decisions at local, subnational and national levels about shot and long-term strategies to combat the impact of climate change on food security.
4. Adequate funding of agriculture by both the Federal and State Governments and leveraging on mechanised faming and provision of adequate farming inputs to drive increase agricultural productivity and modern storage facilities.
5. Access to credit facilities by farmers at low or zero interest rates and introducing suitable technologies and innovations for farming activities to sustain food security.

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