CLIMATE CHANGE IMPLICATIONS ON FLOODS AND FOOD SECURITY IN NIGERIA: THE WAY FORWARD

Onefeli, A. O.[1], Egbebi, S. A.[1]*, Akinade, O. H.[1], Ajiboye, R. O.[2] and Ngwuli, C. P.[3]
[1]Department of Forest Production and Products, University of Ibadan, Ibadan, Nigeria
[2]Department of Social and Environmental Forestry, University of Ibadan, Ibadan, Nigeria
[3]Department of Forestry and Environmental Management, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
*Corresponding Author: shalomoluwa22@gmail.com, +234 701 937 9713

ABSTRACT
Climate change is a global phenomenon which poses a serious threat to human existence. Human activities are the major drivers of the modification of the earth climate system, leading to an increase in the earth's temperature and causing global warming. Greenhouse gases (GHGs) constitute a large proportion of human activities that orchestrate global warming. Experts have revealed that the concentration of GHGs has geometrically increased and the current trend of GHG emissions, has been implicated in the estimated rise in the average global temperature by 4.5°C, in the next eight years. This will aggravate some of the consequences of climate change such as floods, reduced agricultural production and food insecurity. In Nigeria, various incidences have been linked to climate change, with increased flooding episodes, loss of agricultural produce and food scarcity as some of them. There is therefore a need for the development of proactive strategies for curtailing and mitigating the effect of climate change in Nigeria. This study was conceptualized to review the implications of climate change on flooding and food insecurity in Nigeria. It also provided some recommendations as panaceas to the problem.

Keywords: Flooding, Food security, Agricultural practices, Global warming, Greenhouse gases.

INTRODUCTION
Climate Change (CC) is the modification that occurs in climatic variables, partly due to human activities, which alter the earth's composition and result in global warming (Bourne and Bourne, 2020). Global warming is a gradual rise in the temperature of the atmosphere due to the emission of greenhouse gases (GHGs) (IPCC, 2018). These increased emissions are attributed to anthropogenic activities such as deforestation; burning of bush, wood and fossil fuels; and the combustion of solid wastes (Houghton, 2012, Borokini *et al.*, 2013; Onefeli, 2016). The GHGs are heat-trapping gases, and when there is a perturbation in the equilibrium between the artificial and natural GHGs, warming of the atmosphere is promoted or exacerbated. Hence, the level of GHGs has risen beyond natural levels, leading to a rise in global average temperatures (Idowu *et al.*, 2011; Kogo *et al.*, 2019). Current predictions suggest that the trend in GHG emissions would result in the earth experiencing a 4.5°C average increase in temperature (Adjia *et al.*, 2022). This will have detrimental consequences on agriculture, food security, biodiversity, natural ecosystems and human survival (Lawal *et al.*, 2020). In addition, there will be drastic increases in thermal expansion, melting of polar ice-caps, and torrential rainfall resulting in floods.

Adjia *et al.* (2022) ranked floods as major catastrophic natural hazards which cause irreversible damage and result in high number of casualties. Flooding usually occur after a short period of unexpected and

unpredictable downpour. As such, they are severe hydrological events that affect many elements of human existence (Farhan and Anaba, 2016; Ramkar and Yadav, 2021).

In Nigeria, there have been several incidences of flooding, which have resulted in destruction and damages in different parts of the country. The severe effects of climate change as a natural cause of floods have already been entrenched in various sections of the country (Angbulu, 2022). One of the major outcomes of flooding is food insecurity, because a major source of employment and food supply for over 70% of the population in Nigeria is agriculture (Onah *et al.,* 2016; Onwutuebe, 2019).

In Nigeria, agriculture is primarily rain-fed, with farmers in most cases struggling to plan their cropping calendar because of the unpredictable rainfall patterns and intensities. This results in unstable food production and food shortages. Food insecurity is worsened by the vulnerability of States such as Jigawa, Kebbi, and Taraba to torrential rainfall and flooding (Anabaraonye *et al.*, 2020).

There is therefore a need for proper documentation of flooding occurrences and implementation of flood control measures. This study reviewed the implications of climate change on flooding events and food insecurity in Nigeria. Specifically, the study discussed the problems and causes of climate change, identified the effect of climate change, reported some flooding events and recommended measures suitable for flood control and increasing food security in Nigeria.

Effects of Flooding

One of the major causes of climate change is the depletion of the ozone layer by GHGs released into the atmosphere (Hansen and Sato, 2012; Vojinovic and Abbott, 2012). Climate change increases the likelihood of excessive rainfall which cause flooding, due to the inability of the water saturated soil to absorb excess moisture (Blöschl, 2022). The rising sea levels, high coastal tides, extreme weather conditions, tsunamis, high speed winds, failure of dams, rapid urbanization, poor waste management systems and poor drainage systems are other causes of flooding (Salami *et al.,* 2017).

Climate change results in a longer duration of drought and increased frequencies of flooding which truncate agricultural activities and threaten renewable natural resources such as forests, fisheries and wildlife (Arora, 2019). The consequences include decreased crop and livestock production, food scarcity, loss of shelter, forced migration and increased disease outbreaks. Flooding leads to loss of lives, property damage and death of animals and plant species (Gellert, 2020). It causes soil erosion, and loss of habitats for aquatic and terrestrial organisms. It interferes with farming operations, disrupts access to food and its storage; and results in financial losses (Blanchard *et al*., 2017; Durodola 2019; Echendu, 2020a). For example, in 2022, flooding caused the death of over 500 people, with 200,000 homes destroyed and forced the migration of over 14 million people in Nigeria (Odume, 2022). Many food-producing states are being hit by flooding and it is destroying physical infrastructure and disrupting socioeconomic activities particularly in the agricultural sector. The agricultural trade flow and critical agricultural assets have been greatly affected by floods, causing food insecurity in rural communities, states and at the national level.

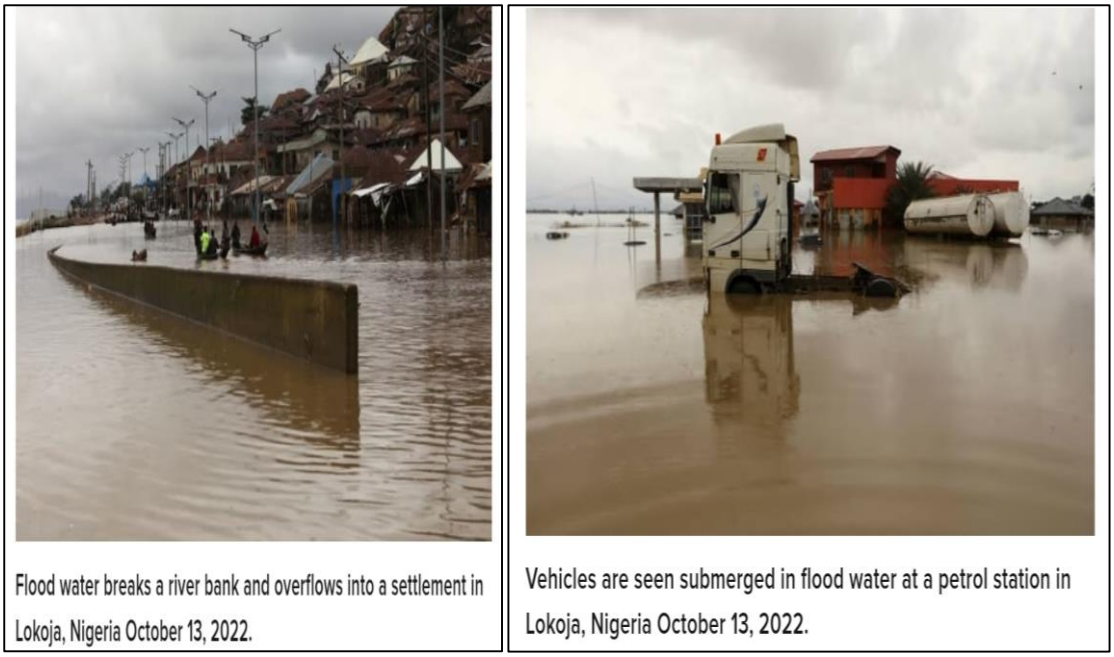
The four pillars (food availability, food accessibility, food utilization and food stability) of food security have been affected by flooding (Echendu, 2020b; Echendu, 2021a; Echendu, 2022a). Food availability which deals with the supply-side of food security and is determined by the level of food production and output from farms, has fallen below standard (Abbade, 2017). Flooding has worsened the situation through the degradation of the environment, reduction of soil fertility, displacement of livestock and other aquatic animals. Food accessibility is concerned with the sufficiency of food either for consumption or sale. It focuses on incomes, expenditures, markets and prices. The losses experienced during flooding greatly impact access to food, which becomes scarce and expensive. Disruptions in the supply chain, increment in prices of feed and seeds and destruction of farm produce and stored reserves reduce access. Food utilization which addresses the nutritional worth of food is not guaranteed by availability and accessibility. Flooding affects nutrient composition, causes soil loss and results in the production of low-quality food. Food stability is related to vulnerability because a persistent decline in productivity drives up food prices, making them expensive for most people, who then choose less nutrient-dense food and this leads to malnutrition (Hallegatte *et al.*, 2020).

Examples of Flooding Occurrences in Nigeria

In Nigeria, flooding has become the most prevalent disaster experienced in many States, especially during the rainy season. These hazards have become a major driver of food insecurity, livelihood destruction, health risks and conflicts. Climate change accelerates temperature and increases evaporation into the atmosphere, thereby leading to recurring precipitation events that cause damage during floods (Figure 1 and 2). About 31 states out of the 36 States in Nigeria have been severely impacted by floods. In 2022, it was estimated that 603 individuals lost their lives, while 2,407 people were injured. In addition, 2,504,095 were affected and 1,302,589 people were displaced. Consequently, 82,053 and 44,099 homes were totally and partially damaged, respectively. Also, 76,168 ha and 70,566 ha of farmland were totally and partially destroyed (Angalapu, 2023). The records indicate that in the year 2022, flood occurrence was similar to the data observed in 2012 (Nemine, 2015).

Flood Prevention and Food Security Strategies: The Way forward

Flood control and preventive measures refer to structural (erection of infrastructures) and non-structural (ecosystem-based) approaches used to prevent flood or mitigate its impacts (Oluchi *et al*., 2017; Peter *et al*., 2018). These measures are implemented at the local, state, sub-national, and national levels (Jha *et al*., 2012). An example of a flood prevention measure successfully carried out was in Aguleri, Umuleri in Anambra State (Onwuka *et al*., 2015). Flooding events are location-specific, so measures must align with the climatic condition and geographical features of the location, as well as the level of impact of the flood. Flood control and preventive measures help to proffer long lasting food security strategies such as improved agricultural practices, effective urban planning, local indigenous methods and flood proof infrastructures (Peter *et al*., 2018; Echendu, 2022b).



Flood water breaks a river bank and overflows into a settlement in Lokoja, Nigeria October 13, 2022.

Vehicles are seen submerged in flood water at a petrol station in Lokoja, Nigeria October 13, 2022.

Figure 1a and b: Flood disaster in Lokoja, Niger State Nigeria
Source: Newburger (2022)

Figure 2. Flood destroyed a major highway in Northern Nigeria
Source: Yusuff (2022)

Structural Flood Prevention and Control Measures

These structures are in the form of steel and concrete and may include the building of dams, wing dykes, artificial levees etc.

a. **Building of dams**: A dam is a specially constructed engineering structure, like a giant wall built across a river channel, used to obstruct the flow of water. It can serve the purpose of flood prevention by keeping the discharge of downstream water low, during heavy downpours. They provide services like hydroelectricity generation, recreation and supply of drinking water for the communities (Dipeolu and Ibem, 2020). However, a major setback to its usage is that if anything goes wrong and it fails, it causes a wide range of damages, as excess water from the reservoir is released, suddenly. In Nigeria, negligence and poor management pose threats to the construction and maintenance of dams. Also properly managed dams are required in the upstream sections of major and minor rivers. (Ogunkoya, 2022)
b. **Construction of artificial levees**: An artificial levee is a lower wall when compared to dams. They are made from large materials that are highly resistant to erosion. Levees are constructed at the side of the river to control floods and serve as take-off points for boats and people. Levees must be well constructed to avoid collapse and disastrous aftermaths. The main benefit of an artificial levee is that it provides a foundation for construction on the floodplain. For example, levees along the Mississippi River have reduced the impact of floods, since 1972 (Oluchi *et al.*, 2017).
c. **Wing dykes:** they can be placed in pairs on either side of the water body at right angles to each other. This helps keep water away from any area at risk of flood at a faster rate, at the same time aiding navigation of the water flow rate. Wing dykes lower the risk of having flooding occurrence compared to other methods.
d. **Diversion spillways or emergency spillways:** These are artificial structures that water can flow into when the water level rises. They help to divert water away from flood-prone areas, downstream or to other rivers. These spillways have gates used to control the water flow in and out. Flood diversions are vital complements to levees in flood management (Serra-Llobet *et al.*, 2021).

Non-Structural Flood Prevention and Control Measures

These measures include awareness and empowerment of the masses about climate change and flooding, regulatory measures by the government for floodplain construction, flood risk mapping, zoning, flood warning and forecasting, afforestation, and watershed management (Peter *et al*., 2018).

a. **Enhancing awareness and climate change education**: This helps the public to understand the causes and implications of natural disasters such as flood. The government can empower the masses through awareness using media platforms,

where they highlight the roles of people and correct wrong misconceptions and myths about floods (Stefanović and Gavrilović, 2015). It is necessary that the government is accountable and provides accurate information about the impacts of these events in the various communities.

b. **Regulatory measures by the government to avoid building on floodplain or flood-prone areas**: The government should enact laws that prevent building of houses along waterways, on floodplains or in flood-prone areas e.g., River banks, wetlands and low-lying beds. Rather such areas can be dedicated to land uses such as planting, recreational purposes like establishment of parks and gardens (Serra-Llobet *et al*, 2021).
c. **Flood risk mapping**: Flood hazards, risk and vulnerability maps can be produced to identify flood-prone lands in various States in the country. Such maps provide spatial representations of hazard exposures on low, medium and high scale basis and the level of vulnerability of such locations (Adedeji *et al.*, 2012; Meyer and Auriacombe, 2019).
d. **Zoning**: Lands that are prone to flooding should be grouped into different zones based on well-established flood warning systems. The different geographical features of the zones should be captured such that it becomes easier to implement precautionary measures in flood-prone areas (Peter *et al.*, 2018).
e. **Flood warning and forecasting**: Flood forecasting can be done using mathematical models and meteorological stations to predict future flood occurrences. Early warning systems that provide information on future flood occurrences are also required. Government should set up such measures to tackle floods, especially during the rainy season (Katie, 2015).
f. **Flood insurance**: Government could provide enabling environments that allow for the protection of flood-prone areas by insurance companies. This will ensure proper compensation for victims of flood disasters. The National Emergency Management Agency is one of the organizations in Nigeria that provides funds in preparation for flood insurance.
g. **Afforestation:** is an ecosystem-based approach to flood control. Trees should be planted around river basins to improve water interception and reduce surface water run-off. The planted trees help to prevent siltation of soil into the rivers and keep the productivity of the water high. This will also improve water quality and reduce mortality of aquatic organisms (Onefeli *et al.*, 2021).
h. **Watershed management:** Cultural practices such as land-use management, vegetation cover management and soil conservation can help minimize surface run-off and erosion into the river channels.

Food Security Strategies

Improved Agricultural Practices: The provision of funds and incentives to local farmers as well as mechanization of farming systems would increase

productivity. Furthermore, emphasis should be laid on research on production of improved crop varieties, which are flood-resistant and can serve as erosion breakers. For example, in 2022 early maturing plants were developed and distributed to farmers at subsidized rates in Bayelsa State to help mitigate the impact of floods (Nemine, 2015; Fakayode *et al.*, 2016). International agencies such as the Food and Agriculture Organization provide funding to government agencies to implement agricultural projects that could help manage food security crisis caused by climate change and flooding.

Effective Urban Planning: Most cities in Nigeria lack proper urban planning. Hence, there is a need for a review of land layouts, survey and mapping in urban areas. This will ensure effective zoning of flood-prone areas and easier access when developing structures to prevent floods (Echendu, 2019). When establishing industries, residential houses and agricultural areas, professionals should be consulted to ensure the landscapes are suitable for the proposed land-use and proper layouts are in place to prevent future disaster (Idoko, 2016; Echendu, 2020b). Approximately 55% of the population in Nigeria live in urban centres (Odume, 2022); and this causes a large deposit of waste materials in drainage systems and water bodies. Proper waste management should be incorporated into urban development, where waste could be used to improve farm produce. Agricultural activities can then thrive, creating strong food security for the populace at large (Onefeli, 2011; Onefeli and Oluwayomi, 2013).

Local Indigenous methods: Indigenous methods adopted by local communities to control flood should be well-documented. This could be used by other communities experiencing similar challenges. For instance, the construction of mounds was used for flood prevention in Akwa Ibom, Rivers and Ondo States (Nemine, 2015).

CONCLUSION

The challenges posed by flooding and the need for development of management strategies to control flooding have been highlighted in this article. The government and other stakeholders need to intensify efforts and collaborate to achieve effective flood management. Structural flood control structures, such as dams and wing dykes and non-structural methods like forecasting are effective strategies in flood management. A major approach to mitigating the impacts of climate change is to ensure food security and implement flood control measures.

REFERENCES

Abbade, E. (2017). Availability, access and utilization: Identifying the main fragilities for promoting food security in developing countries. *World Journal of Science Technology and Sustainable Development* 14(4): 322-335. DOI: 10.1108/WJSTSD-05-2016-0033

Adedeji, H. O., Odufuwa, B. O. and Adebayo, O. H. (2012). Building capabilities for flood disaster and hazard preparedness and risk reduction in Nigeria: Need for spatial planning and land management. *Journal of Sustainable Development in Africa* 14: 45–58.

Adjia, G. M., Fils, S. C. N., Pial, A., Bessa, H. A. and Eyong, G. (2022). Flood risk estimation of Cross River Watershed (Cameroon): GIS based morphometric analysis and

geospatial techniques. Accessed at https://www.researchgate.net/publication/364255581_2_Flood_Risk_Estimation_of_Cross_River_Watershed_Cameroon_GIS_Based_Morphometric_Analysis_and_Geospatial_Techniques#fullTextFileContent 2505–22. Accessed on August 22, 2023

Angbulu, S. (2022). Floods: Nigeria suffering climate change effects, says Buhari. Retrieved from https://punchng.com/floods-nigeria-suffering-climate-change-effects-says-buhari/. Accessed on August 22, 2023

Anabaraonye, B., Ewa, B., Wala, K. (2020). The impacts of climate change on Nigeria's health sector and innovative solutions for environmental sustainability. *Ecronicon Agriculture* 6(2): 01-07.

Angalapu, D. (2023). How flooding may affect Nigeria's 2023 elections. Retrieved from Premiumtimesng.com. https://www.premiumtimesng.com/news/headlines/562394-analysis-how-flooding-may-affect-nigerias-2023-elections.html?tztc=1. Accessed on 22 August, 2023.

Arora, N. K. (2019). Impact of climate change on agriculture production and its sustainable solutions. *Environmental Sustainability* 2: 95–96.

Blanchard, J. L., Reg, A. W., Elizabeth, A. F., Richard, S. C., Kirsty, L. N., Andrea, B. B., Büchner, M., Carozza, D. A., William, W. L. Cheung, and Elliott, J. (2017). Linked sustainability challenges and trade-offs among fisheries, aquaculture and agriculture. *Nature Ecology and Evolution* 1: 1240–1249.

Blöschl, G. (2022). Three hypotheses on changing river flood hazards. *Hydrology Earth System Sciences Discussion* https://doi.org/10.5194/hess-2022-232 Borokini T. I., Onefeli, A. O. and Babalola F. D. (2013). Inventory analysis of *Milicia excelsa* (Welw C. C. Berg.) in Ibadan (Ibadan Metropolis and University of Ibadan), Nigeria. *Journal of Plant Studies* 2 (1): 97-109.

Bourne, G. and Bourne, K. (2020). Impacts of global warming and climate change. World Wide Fund. https://doi.org/10.13140/RG.2.2.10305.51047. Accessed on August 22, 2023

Dipeolu, A. A. and Ibem E. O. (2020). Green infrastructure quality and environmental sustainability in residential neighborhoods in Lagos, Nigeria. *International Journal of Urban Sustainable Development* 12: 267–82.

Durodola, O. S. (2019). The impact of climate change induced extreme events on agriculture and food security: A review on Nigeria. *Agricultural Sciences* 10: 487–98. Echendu, A. J. (2019). Urban planning, sustainable development and flooding: A case study of Port Harcourt City, Nigeria. Master's thesis, Western Sydney University, Penrith, Australia.

Echendu, A. J. (2020a). The impact of flooding on Nigeria's sustainable development goals (SDGs). *Ecosystem Health and Sustainability* 6: 1791735.

Echendu, A. J. (2020b). Urban planning - "It's all about sustainability": Urban planners' conceptualizations of sustainable development in Port Harcourt, Nigeria. *International Journal of Sustainable Development and Planning* 15: 593–601.

Echendu, A.J. (2021a). Poverty and climate change: Two important global policy issues of our generation. *Queen's Policy Review* 12: 17–27.

Echendu, A. J. (2021b). Relationship between urban planning and flooding in Port Harcourt City, Nigeria; Insights from planning professionals. *Journal of Flood Risk Management.* 14: e12693.

Echendu, A. J. (2022a). Flooding in Nigeria and Ghana: Opportunities for partnerships in disaster-risk reduction. *Sustainability: Science, Practice and Policy* 18: 1–15.

Echendu, A.J. (2022b). Flooding, Food Security and the Sustainable Development Goals in Nigeria: An Assemblage and Systems Thinking Approach. *Social Sciences* 11: 59. https://doi.org/10.3390/socsci11020059 Fakayode, S. B., Falola, A., Obakeye, D., and Adeyemo, A. (2016). Socio-economic and flood precautions of flood affected households in lower Niger basin areas of Nigeria. *Research on Crops* 17: 633–39.

Farhan, Y. and Anaba, O. (2016). Flash flood risk estimation of Wadi Yutum (Southern Jordan) Watershed using GIS based morphometric analysis and remote sensing techniques. *Open Journal of Modern Hydrology* 6: 79-100.

Gellert, T. (2020). Floods and food shortages threaten to push Nigeria into a food crisis. Assessed at https://theowp.org/reports/floods-and-food-shortages-threaten-to-push-nigeria-into-a-food-crisis (accessed on 28 January 2022).

Hallegatte, S., Vogt-Schilb, A., Rozenberg, J., Bangalore, M., and Beaudet, C. (2020). From poverty to disaster and back: A review of literature. *Economics of Disasters and Climate Change* 4: 223–47.

Hansen, J. E. and Sato, M. (2012). Paleoclimate implications for human-made climate change. In: Berger, A., Mesinger, F. and Sijacki, D. (eds.) Climate Change. Springer, Vienna. 21-48pp. https://doi.org/10.1007/978-3-7091-0973-1_2

Houghton, R. A. (2012). Carbon emissions and the drivers of deforestation and forest degradation in the tropics. *Current Opinion in Environmental Sustainability* 4(6): 597–603. https://doi.org/10.1016/j.cosust.2012.06.006

Idoko, I. D. (2016). An impact assessment of flooding on food security among rural farmers in Dagiri Community, of Gwagwalada Area Council, Abuja, Nigeria. *Agricultural Development* 1: 6–13.

Idowu, A. A., Ayoola, S. O., Opele, A. I., and Ikenweiwe, N. B. (2011). Impact of climate change in Nigeria. *Iranica Journal of Energy and Environment*, 2(2): 145–152. IPCC, (2018). Summary for policymakers. In: Masson-Delmotte, V., Zhai, P., Pörtner, H-O., Roberts, D., Skea, J., Shukla, P. R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors,

S., Matthews, J. B. R., Chen, Y., Zhou, X., Gomis, M. I., Lonnoy, E., Maycock, T., Tignor, M. and Waterfield, T. (Eds.), Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5 ºC above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Geneva: World Meteorological Organization. 32pp.

Jha, A. K., Bloch, R. and Lammond, J. (2022). A guide to integrated urban flood risk management for the 21st Century. Washington D.C. World Bank.

Katie, G. (2015). Ten measures that must be taken to prevent more flooding in the future. Climate News. Retrieved from https://www.google.com/amp/s/www.independent.co.uk/climate-change/news/10-measures-that-must-be-taken-to-prevent-more-flooding-in-the-future-a6788866.html%3famp. Accessed on August 22, 2023.

Kogo, B. K., Kumar, L., Koech, R., and Langat, P. (2019). Modelling impacts of climate change on maize (*Zea mays* L.) growth and productivity: A review of models, outputs and limitations. *Journal of Geoscience and Environment Protection* 7(8): 76–95. https://doi.org/10.4236/gep.2019.78006

Lawal, M. F., Alarape, A. A., Adeyanju, T. E., Onefeli, A. O. and Adeyanju, A. T. (2020). Contributions of University of Ibadan Botanical Gardens to avifauna diversity conservation. *Ethiopian Journal of Environmental Studies and Management* 13 (1): 61-73.

Meyer, N. and Auriacombe, C. (2019). Good urban governance and city resilience: An Afrocentric approach to sustainable development. *Sustainability* 11: 5514.

Nemine, L. E. (2015). Flood disasters in Nigeria: Farmers and governments' mitigation efforts. *Journal of Biology, Agriculture and Healthcare* 5(14): 150-154.

Newburger, E. (2022). Flooding in Nigeria kills more than 600 people, officials say. CNBC. https://www.cnbc.com/2022/10/18/flooding-in-nigeria-kills-more-than-600-people-officials-say-.html#:~:text=Flood%20water%20breaks%20a%20river. Accessed on August 22, 2023.

Odume, N. (2022). Floods in Nigeria: building dams and planting trees among steps that should be taken to curb the damage. The Conversation Africa. Retrieved from: https://www.google.com/amp/s/theconversation.com/amp/floods-in-nigeria-building-dams-and-planting-trees-among-steps-that-should-be-taken-to-curb-the-damage-192750. Accessed on August 22, 2023.

Ogunkoya, O. O. (2022). Nigeria floods-governments mismanagement of dams is a major cause. Retrieved from https://allafrica.com/stories/202210230177.html. Accessed on August 22, 2023.

Oluchi, E. B., Chinwe, A. N., James, N. and Dickson, R. S. (2017). Effective management of flooding in Nigeria (a study of selected communities in Anambra State. *Nigerian Journal of Management Sciences* 6(1): 42-50.

Onah, N. G., Ali, A. N. and Eze, E. (2016). Mitigating climate change in Nigeria: African traditional religious values in focus. *Mediterranean Journal of Social Sciences* 7(6): 299-308.

Onefeli, A. O. (2011). Forest contributions to rural livelihood and threats to their sustainability in Nigeria. Proceedings of the 34th Annual Conference of the Forestry Association of Nigeria (FAN). 271-276pp.

Onefeli, A. O. and Oluwayomi, T. L. (2013). Potential of agroforestry to food security in Nigeria. Proceedings of the 35th Annual Conference of the Forestry Association of Nigeria (FAN). 85-106pp.

Onefeli, A. O. (2016). Assessment of undergrowth plant diversity in three different vegetation at Gambari Forest Reserve, Oyo State. Proceedings of the 1st Commonwealth Forestry Association (CFA) Conference, Nigeria Chapter. 54-60pp.

Onefeli, A. O., Agwu, P. O., Adaja, A. A., Ogana, F. N., Ige, P. O., Ogana, T. E., Odeleye, S. V. (2021). Assessment of above-ground biomass (AGB) and tree diversity across rainforest ecosystems in Nigeria. *Forests and Forest Products Journal* 21: 43-57.

Onwuka, S. U., Ikekpeazu, F. O. and Onuoha, D. C. (2015). Assessment of the causes of 2012 floods in Aguleri and Umuleri, Anambra East Local Government Area of Anambra State. *British Journal of Environmental Sciences* 3(1): 44-57.

Onwutuebe, C. J. (2019). Patriarchy and women vulnerability to adverse climate change in Nigeria. *Sage Open Journal* 9(1): 1-7. https://doi.org/10.1177/2158244019825914SAGE

Peter, A. and Adeoti, S. (2018). Non-structural flood protection measures and flood risk reduction in Nigeria. *Global Journal of Advanced Engineering Technologies and Sciences* 5(2): 20-29.

Ramkar, P. and Yadav, S. M. (2021). Flood risk index in data-scarce river basins using the AHP and GIS approach. *Natural Hazards* 109: 1119–1140. https://doi.org/10.1007/s11069-021-04871-x

Salami, R. O., Jason, K. V. M., and Giggins, H. (2017). Vulnerability of human settlements to flood risk in the core area of Ibadan metropolis, Nigeria. *Jàmbá: Journal of Disaster Risk Studies* 9: 1–14.

Serra-Llobet, A., KondolMagdaleno, F. and Keenan-Jones, D. (2021). Flood diversions and bypasses: Benefits and challenges. *Wiley Interdisciplinary Reviews: Water* 9 (1). DOI: 10.1002/wat2.1562.

Stefanović, M. and Gavrilović, Z. (2015). Local communities and challenges of torrential floods. *Organization for Security and Co-Operation in Europe, Mission to Serbia*. https://www.osce.org/files/f/documents/0/2/148301.pdf. Accessed on August 22, 2023.

Vojinovic, Z. and Abbott, M. B. (2012). Flood risk and social justice: From quantitative to qualitative flood risk assessment and mitigation. *IWA Publishing*. Retrieved from https://www.iwapublishing.com/news/flood-control-and-disaster-management. Accessed on August 22, 2023.

Yusuff K. (2022). Special Report: Floods devastated farmlands, raised fear of food security in Nigeria. Retrieved from https://www.premiumtimesng.com/news/headlines/561199-special-report-floods-devastate-farmlands-raise-fear-of-food-insecurity-in-nigeria.html. Accessed on August 22, 2023.