CLIMATE CHANGE, FOOD SECURITY, NATIONAL SECURITY and ENVIRONMENTAL RESOURCES

GLOBAL ISSUES & LOCAL PERSPECTIVES

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PUPLISHED BY:

Society for Agriculture, Environmental Resources & Management (SAEREM)

SAEREM BOOK CHAPTERS2023: First published 2024: ISBN 978-978-60709-9-5

First published 2024

SAEREM World

Nigeria

Typeset in Times New Roman

Climate Change, Food Security, National Security and Environmental Resources

Global Issues & Local Perspectives

ISBN 978-978-60709-9-5

Printed at: SAEREM World

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous climate change, food security, national security and environmental resources issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate change, food security, national security and environmental resources issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate change, food security, national security and environmental resources necessary in policy making process that will stimulate increase in food production and environmental sustainability.

Climate Change, Food Security, National Security and Environmental resources: Global issues and Local Perspectives is organized in four parts. Part One deals with Climate Change with Six Chapters, Part Two is concerned with Food Security with Nine chapters, Part Three deals with National Security with Five Chapters, while Part Four pertains Environmental Resources, has Five Chapters.

Ahmed Makarfi / Eteyen Nyong

April 2024

SAEREM BOOK CHAPTERS2023: First published 2024: ISBN 978-978-60709-9-5

Chapter 26

Climate Change Impacts on Water Resources in Nigeria

Muhammad Muhammad Makki, and Umar Faruk Lawan

Introduction

Climate change, as defined by the UN, is the long-term alteration of temperature and weather patterns. These changes may be caused by significant volcanic eruptions or variations in the sun's activity. However, human activity has been the primary cause of climate change since the 1800s, mostly as a result of the burning of fossil fuels like coal, oil, and gas. Fossil fuel combustion releases greenhouse gases into the atmosphere, which encircle the planet like a blanket and trap solar heat, causing temperatures to rise. Methane and carbon dioxide are the two primary greenhouse gases responsible for climate change. These result, for instance, from burning coal to heat a building or gasoline to operate a vehicle. Carbon dioxide can also be released through land clearing and forest destruction. Methane emissions are primarily produced by the oil and gas and agricultural industries. Land use, buildings, transportation, energy, and industry are some of the main industries that emit greenhouse gases.

As a result of variations in the atmosphere and interactions between it and other geologic, chemical, biological, and geographic elements of the Earth system, the Britannica defines climate change as the recurring alteration of Earth's temperature.

The recent explanation of climate change by the World Health Organization is as follows: There are several ways in which climate change is affecting people's lives and health. In addition to endangering decades' worth of advancements in global health, it poses a threat to the fundamental components of good health, including clean air, safe drinking water, a plentiful supply of nutrient-rich food, and a secure place to live. The combined effects of heat stress, malaria, diarrhea, and malnutrition are predicted to result in an additional 250 000 deaths annually between 2030 and 2050 due to climate change. By 2030, the direct costs of health damage are projected to be between $2 and $4 billion annually. The least equipped to handle the situation without help to prepare and

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react will be those with inadequate health infrastructure, which is primarily found in developing nations. Fossil fuel extraction and burning produce greenhouse gas emissions, which are a major cause of air pollution and climate change. Numerous laws and individual actions, like decisions about food, energy use, and transportation, have the potential to lower greenhouse gas emissions and have a significant positive impact on public health, especially by reducing air pollution. For instance, phasing out energy systems that emit pollutants or encouraging the use of public transit and physical activity could reduce carbon emissions as well as the burden of indoor and outdoor air pollution, which contributes to 7 million preventable deaths annually. Numerous factors, such as the increased frequency of extreme weather events like heat waves, storms, and floods, the disruption of food systems, the rise in zoonoses and vector-, food-, and water-borne illnesses, and mental health problems, are already having an impact on health as a result of climate change. In addition, a number of the social determinants of health, including social support networks, equality, and access to healthcare, are being negatively impacted by climate change. The most vulnerable and disadvantaged groups, such as women, children, ethnic minorities, impoverished communities, migrants or displaced people, older populations, and those with underlying medical conditions, are disproportionately affected by these climate-sensitive health risks. The vulnerability of populations, their ability to withstand the current rate of climate change, and the rate and scope of adaptation will be the primary determinants of the short- to medium-term health impacts of climate change. Longer term consequences will progressively rely on how much transformative action is done right now to cut emissions and prevent exceeding hazardous temperature thresholds and possible irreversible tipping points.

Global warming, or the continuous rise in the world's average temperature and its impact on the climate system, is referred to as climate change. Broadly speaking, long-term changes in Earth's climate in the past are also considered to be part of climate change. The current rise in global average temperature is more rapid than previous changes, and is primarily caused by humans burning fossil fuels (Lynas *et al.*, 2021). Fossil fuel use, deforestation, and some agricultural and industrial practices add to greenhouse gases, notably carbon dioxide and methane. Climate change threatens people with increased flooding, extreme heat, increased food and water scarcity, more disease, and economic loss. Human migration and conflict

can also be a result (Joint Environmental Audit, 2015). The World Health Organization (WHO) states that the greatest threat to global health in the twenty-first century is climate change.

Water Resources in Nigeria: Surface Water Resources

Nigeria divides its eight hydrological areas (HAs) from its basins. (Federal Ministry of Water Resources, National Water Resources Policy; 2016). Nigeria org The lower reaches of the Niger Basin are made up of the Niger North, Niger Central, Niger South, Upper Benue, and Lower Benue HAs. Together, they drain nearly two-thirds of the nation and produce roughly 60% of all runoff. They also divide the nation's basins into eight Hydrological Areas (HA). (Federal Ministry of Water Resources, National Water Resources Policy; 2016). The Niger Delta, which spans 70,000 km2 and is home to 7% of the world's mangroves, is the third largest delta globally. The Niger River rises in Guinea and empties into the Gulf of Guinea (FAO, 2020). The largest and most significant tributary of the Niger River in Nigeria is the Benue River.

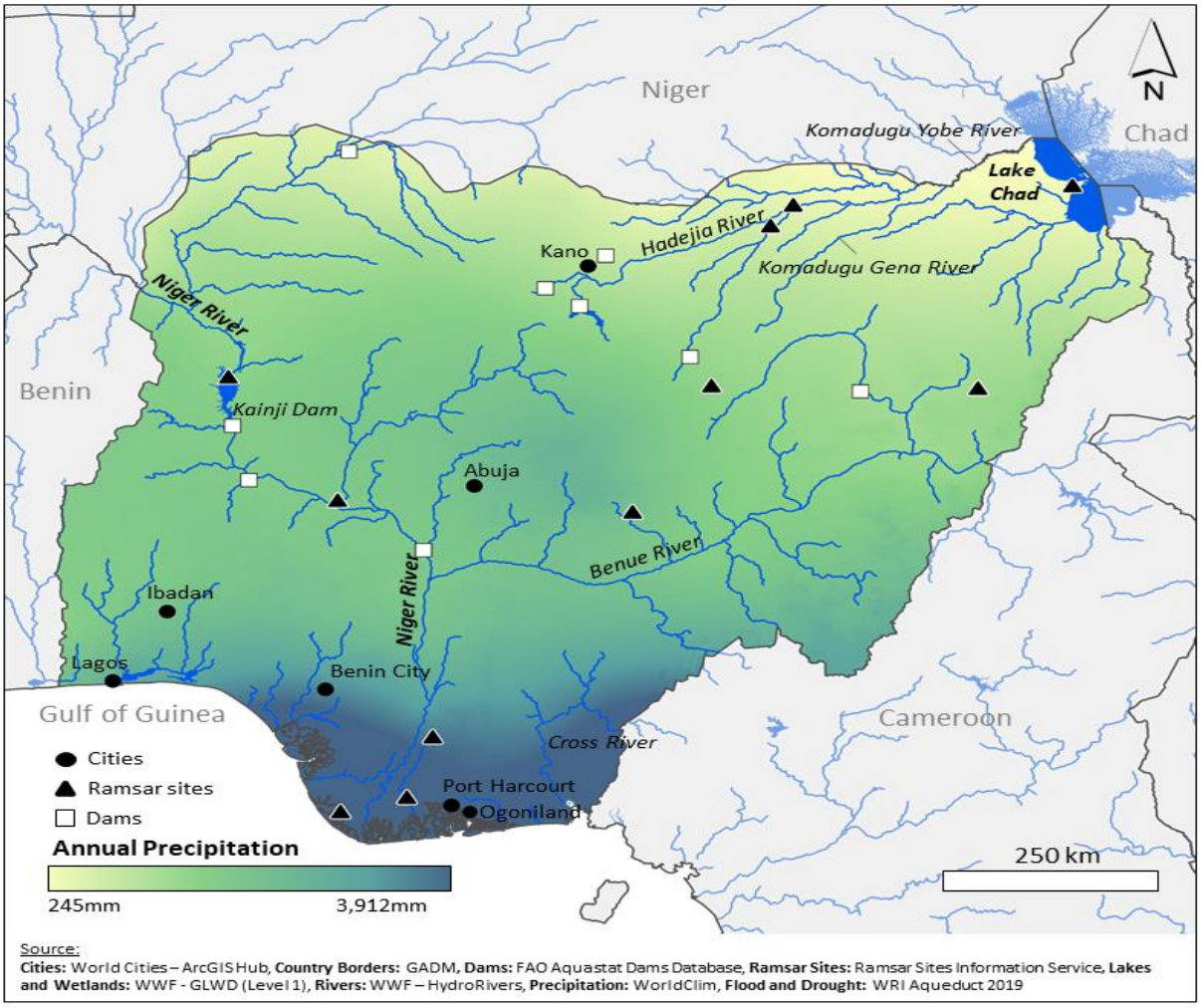
Draining the western boundaries of the eight-country Lake Chad Basin, which forms Lake Chad along the Nigeria-Chad-Cameroon border, is the northeastern Lake Chad HA. The Komadougou Yobe (FAO, 2016) is the largest river in the Chad Basin HA. It has several seasonal tributaries, such as the Hadejia, Jama'are, and Komadougou Gena. Due to overexploitation and drought, Lake Chad has receded, resulting in a reduction in the amount of water available in the Lake Chad HA. Lake Chad covered 25,000 km² in the 1960s (Vivekananda et al., 2019), with approximately 25% of its surface located in Nigeria (Joint Environmental Audit, 2015). Agricultural communities surrounding the lake experienced a significant increase in water demand during this time (Vivekananda et al., 2019). Lake Chad's coverage was 90% reduced to 2,000 km2 by major Sahelian droughts; however, the lake's coverage has partially recovered to 14,000 km2 (Pham-Duc et al., 2020). While the Eastern Littoral HA, which includes the Cross and Imo Rivers, experiences high precipitation and produces roughly 30% of the nation's runoff, the Western Littoral HA has comparatively little runoff (FAO, 2016).

TABLE 1: Water Resources Data

YEAR	NIGERIA	SUB-SAHARAN AFRICA (MEDIAN)

LONG-TERM AVERAGE PRECIPITATION (MM/YEAR)	2017	1,150	1,032
TOTAL RENEWABLE FRESHWATER RESOURCES (TRWR) (MCM/YEAR)	2017	286,200	38,385
FALKENMARK INDEX - TRWR PER CAPITA (M3/YEAR)	2017	1,499	2,519
TOTAL RENEWABLE SURFACE WATER (MCM/YEAR)	2017	279,200	36,970
TOTAL RENEWABLE GROUNDWATER (MCM/YEAR)	2017	87,000	7,470
TOTAL FRESHWATER WITHDRAWAL (TFWW) (MCM/YEAR)	2010	12,470	649
TOTAL DAM CAPACITY (MCM)	2015	50,670	1,777
DEPENDENCY RATIO (%)	2017	22.78	22.78
INTERANNUAL VARIABILITY	2013	1.2	1.55
SEASONAL VARIABILITY	2013	3.6	3.15
ENVIRONMENTAL FLOW REQUIREMENTS (MCM/YEAR)	2017	157,200	18,570
SDG 6.4.2 WATER STRESS (%)	2010	9.67	5.70

FIGURE 1: MAP OF WATER RESOURCES



Groundwater Resources

According to Adelana et al. (2012), the majority of Nigeria's groundwater is found in sedimentary basins or basement complexes. Although they are less common, alluvium aquifers are the most productive types of groundwater systems. According to Adelana et al. (2012), groundwater recharge rates are highest in the southeast (281–1,047 mm/year) and lowest in the northwest (4–28 mm/year). Sixty percent of Nigeria is made up of basement complexes, which are dispersed across the country's southwest, central region, and eastern border with Cameroon. The majority of these groundwater systems have low to moderate well yields and shallow water tables (5–15 m). Nigeria's Earth-wise Hydrogeology. Most of the northeast, northwest, and the upper Niger and Benue Rivers are covered in sedimentary aquifers. The central region, northeast, and northwest

contain the highest yielding aquifers. In the northern sedimentary basin, confined and unconfined layers are commonly found in aquifers. The depths of unconfined aquifers vary from 15 to 75 meters in the northwest to 30 to 100 meters in the northeast. The majority of the Niger Delta is supported by alluvium aquifers, which generally trace the courses of the Niger and Benue Rivers in relatively narrow bands.17 The shallowest depths (0–10 m) in these aquifers allow for easy access to groundwater with high yields (Earthwise Hydrogeology of Nigeria).

The Impact of Climate Change on Water Resources in Nigeria

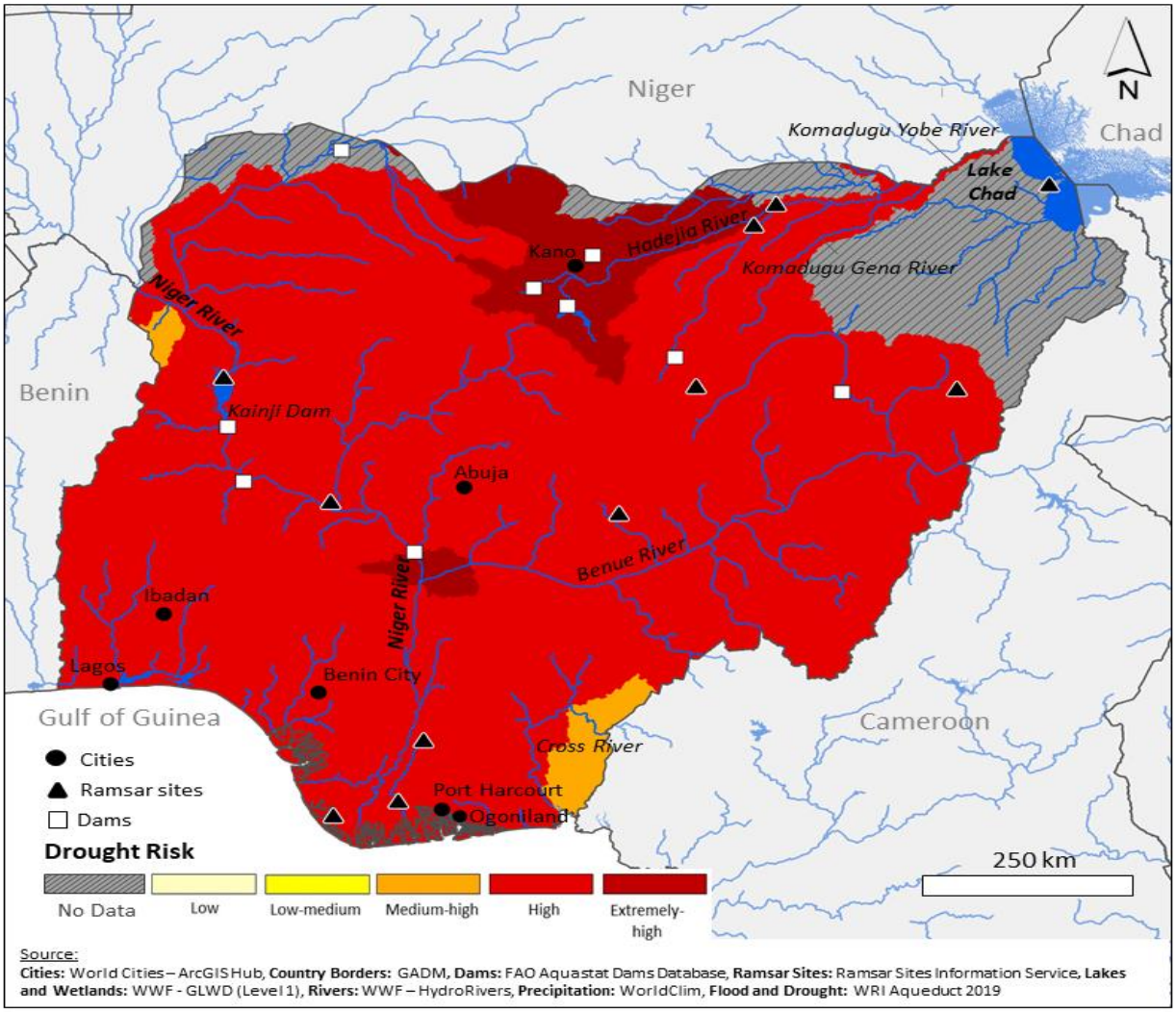
There is 1,062 mm of precipitation on average per year, with the south receiving the most and the north receiving the least. There is significant seasonal variability in the water supply because most of Nigeria experiences distinct wet and dry seasons (USAID, Climate Risk Profile: Nigeria, Fact Sheet; 2019). (see Table 1). In contrast to the south, where it lasts at least nine months (March-November), the north experiences a shorter wet season (May-September).

Rainfall overall has decreased due to climate change, particularly in northern Nigeria. The amount of water available will be further reduced by rising temperatures and evaporation. The average temperature increased by 0.8°C between 1960 and 2006 due to climate change, with a particularly sharp increase since 1980 (USAID, Climate Risk Profile: Nigeria, Fact Sheet; 2019). In addition, there was a decrease in annual precipitation (Butu, A. W.; Emeribe, C. N, 2019), and there were more heat waves in the Guinea and Sahel regions between 1971 and 2012 (Abatan et al., 2016). Wet season rainfall variability has increased, and dry seasons have grown longer (Elisha et al., 2017). According to Shiru et al. (2018), extreme flooding has increased, but droughts are also occurring more frequently and affecting larger areas. Over the previous 30 years, rainfall in northern Nigeria has decreased by 25% (Haider, 2019). Temperatures are expected to rise by an additional 1.9–3.7°C due to climate change, while total precipitation may slightly increase. It is anticipated that increased evaporation will result in a decrease in total water availability (World Bank Group, 2021). A 1.5–3 foot rise in sea level could submerge an area larger than 11,000 square miles.

In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment

2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). In the southeast, where numerous river banks have collapsed, this has accelerated gully erosion (Lohdip, Y. N. and Gongden, J. J., 2013). Widespread flooding struck nearly every state in Nigeria in 2012, resulting in 600,000 houses being destroyed

or severely damaged, over 2 million people being displaced, and an estimated $17 billion in economic losses (Post-Disaster Needs Assessment 2012 Floods; Government of Nigeria, 2013). The probability of desertification and drought risks in the north are rising due to increased rainfall variability and evaporation. According to Haider (2019), climate change will continue to reduce rainfall in northern Nigeria and increase the frequency of extreme droughts. These risks will increase with desertification. Apart from dry spells, inadequate management of water resources, alterations in land use, excessive grazing, and deforestation also contribute to desertification. The 11 northernmost states have between 50 and 75 percent of their land affected by desertification. Desertification is causing the loss of almost half of the vegetation in the northernmost states between 1984 and 2016 (Nwilo et al., 2020) and is moving southward at a rate of 0.6 kilometers per year (Snigdha, 20121). Wetland coverage has been greatly decreased (Adepelumi et al., 2009) and oases and buried water points have been threatened by an increasing number of sand dunes (Toye, 2002).



References

Abatan, A. A.; Abiodun, B. J.; Lawal, K. A.; Gutowski, W. J. Trends in Extreme Temperature over Nigeria from Percentile-Based Threshold Indices. Int. J. Climatol. 2016, 36 (6), 2527–2540. https://doi.org/10.1002/joc.4510.

Adelana, S. M. A. Nigeria. In Groundwater Availability and Use in Subsaharan Africa: A Review of 15 Countries; Pavelic, P., Giordano, M., Keraita, B., Ramesh, V., Rao, T., Eds.; International Water Management Institute (IWMI): Colombo, Sri Lanka, 2012; p 274.

Adepelumi, A. A.; Ako, B. D.; Ajayi, T. R.; Afolabi, O.; Omotoso, E. J. Delineation of Saltwater Intrusion into the Freshwater Aquifer of Lekki Peninsula, Lagos, Nigeria. Environ. Geol. 2009, 56 (5), 927–933. https://doi.org/10.1007/s00254-008-1194-3.

Butu, A. W.; Emeribe, C. N. Spatial Patterns of Climatic Variability and Water Budget over {Sudan} {Savannah} {Region} of {Nigeria}. Afr. J. Environ. Sci. Technol. 2019, 13 (21), 465–481. https://doi.org/10.5897/AJEST2019.2726.

Cirella, G.; Iyalomhe, F. O. Flooding Conceptual Review: Sustainability-Focalized Best Practices in Nigeria. Appl. Sci. 2018, 8 (9). https://www.mdpi. com/2076-3417/8/9/1558/htm#.

Earthwise Hydrogeology of Nigeria http://earthwise.bgs.ac.uk/index.php/Hydrogeology_of_Nigeria#:~:text=Nigeria has the largest population and the largest economy in Africa.&text=Nigeria has extensive surface water,domestic%2C agricultural and industrial supplies. (accessed 2021 -04 -28).

Elisha, I.; Sawa, B. A.; Lawrence, E. U. Evidence of Climate Change and Adaptation Strategies among Grain Farmers in Sokoto State, Nigeria. IOSR J. Environ. Sci. Toxicol. Food Technol. 2017, 11 (3), 1–7. http://dx.doi.org/10.9790/2402-1103020107.

FAO. AQUASTAT Country Profile - Nigeria; Rome, Italy, 2016.

FAO. The State of the World's Forests 2020. Forests, Biodiversity and People; Rome, 2020. https://doi.org/10.4060/ca8642en.

Federal Ministry of Environment Special Climate Change Unit. National Adaptation Strategy and Plan of Action on Climate Change for Nigeria NASPA-CCN); 2011.

Federal Ministry of Environment. Third National Communication (TNC) of the Federal Republic of Nigeria under the United Nations Framework Convention on Climate Change (UNFCCC); 2020.

Federal Ministry of Water Resources. National Water Resources Policy; 2016.

Government of Nigeria. Nigeria. Post-Disaster Needs Assessment 2012 Floods; 2013.

Haider, H. Climate Change in Nigeria: Impacts and Responses; Knowledge, evidence and learning for development, 2019.

https://www.britannica.com/science/climate-change/Greenhouse-gases

https://www.un.org/en/climatechange/what-is-climate-change

https://www.who.int/health-topics/climate-change

Joint Environmental Audit. Joint Environmental Audit on the Drying up of Lake Chad; 2015.

Joint Environmental Audit. Joint Environmental Audit on the Drying up of Lake Chad; 2015.

Lohdip, Y. N.; Gongden, J. J. Nigerian Water Bodies In Jeopardy: The Need For Sustainable Management And Security. In Water REsources Management VII; Brebbia, C. A., Ed.; WIT Press, 2013; p 171:11-22. https://doi.org/10.2495/WRM130021.

Lynas, Mark; Houlton, Benjamin Z.; Perry, Simon (19 October 2021). "Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature". *Environmental Research Letters*. **16** (11): 114005.

Nigeria Water Resources, USAID's Sustainable Water Partnership activity

Njoku, C.; Efiong, J.; Ayara, N.-A. N. A Geospatial Expose of Flood-Risk and Vulnerable Areas in Nigeria. Int. J. Appl. Geospatial Res. 2020, 11 (3), 1–24. http://dx.doi.org/10.4018/IJAGR.20200701.oa1.

Nwilo, P. C.; Olayinka, D. N.; Okolie, C. J.; Emmanuel, E. I.; Orji, M. J.; Daramola, O. E. Impacts of Land Cover Changes on Desertification in Northern Nigeria and Implications on the Lake Chad Basin. Journal of Arid Environments 2020, 181. https://doi.org/10.1016 /j.jaridenv.2020.104190.

Pham-Duc, B.; Sylvestre, F.; Papa, F.; Frappart, F.; Bouchez, C.; Cretaux, J.-F. The Lake Chad Hydrology under Current Climate Change. Sci. Rep. 2020, 10 (5498).

Pham-Duc, B.; Sylvestre, F.; Papa, F.; Frappart, F.; Bouchez, C.; Cretaux, J.-F. The Lake Chad Hydrology under Current Climate Change. Sci. Rep. 2020, 10 (5498).

Shiru, M. S.; Shahid, S.; Alias, N.; Chung, E.-S. Trend Analysis of Droughts during Crop Growing Seasons of Nigeria. Sustainability 2018, 10 (3), 871. https://doi.org/10.3390/su10030871.

Snigdha, D. 35 per cent of Nigeria fast turning into desert, admits government https://www.downtoearth.org.in/news/35-per-cent-of-nigeria-fast- turning-into-desert-admits-government-45852 (accessed 2021 -04 -26).

Toye, O. Desertification Threatens Economy, Food Security http://www.ipsnews.net/2002/08/environment-nigeria-desertification-threatens- economy-food-security/ (accessed 2021 -04 -28).

USAID. Climate Risk Profile: Nigeria, Fact Sheet; 2019.

Vivekananda, J.; Wall, M.; Sylvestre, F.; Nagarajan, C.; Brown, O. Shoring Up Stability: Addressing Climate and Fragility Risks in the Lake Chad Region; Berlin, 2019.

WHO calls for urgent action to protect health from climate change – Sign the call". *World Health Organization*. November 2015. Archived from the original on 3 January 2021. Retrieved 2 September 2020.

World Bank Nigeria Projections https://climateknowledgeportal.worldbank.org/country/nigeria/climate-data-projections (accessed 2021 -07 -13).