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WATER RESOURCES PROFILE SERIES

The Water Resources Profile Series synthesizes information on water resources, water quality, the water-related dimensions of climate change, and water governance and provides an overview of the most critical water resources challenges and stress factors within USAID Water for the World Act High Priority Countries. The profile includes: a summary of available surface and groundwater resources; analysis of surface and groundwater availability and quality challenges related to water and land use practices; discussion of climate change risks; and synthesis of governance issues affecting water resources management institutions and service providers.

Nigeria Water Resources Profile Overview

Nigeria has a large endowment of freshwater resources (286,200 MCM) and 23 percent of this supply originates outside the country. Renewable water supply (1,499 m^3/capita) is just below the Falkenmark Water Stress[i] threshold of 1,500 m^3/capita due to Nigeria's large population (210 million), however, withdrawals are low relative to supply (9.67 percent) and well below the SDG 6.4.2 water stress threshold.[ii] Water stress is generally highest in the north whereas water is abundant in the south.

The Niger River is the most prominent Basin in Nigeria. The five Hydrological Areas that comprise the lower Niger Basin drain almost two-thirds of the country and account for about 60 percent of total runoff. The Niger Delta is the third largest in the world and features extensive mangrove coverage and biodiversity.

Water stress in northern Nigeria is increasing from rising municipal and irrigation water demand and declining groundwater levels. The recession of Lake Chad beyond Nigeria's borders, desertification, and more frequent and intense drought due to climate change have compounded water stress. Increasing competition over land and water resources between pastoralists and farmers is also contributing to regional instability and conflict.

Flooding is the most serious and frequent natural disaster and threatens communities, livelihoods, and infrastructure. Poor land use planning and inadequate storm water management elevates flood risks in cities, especially Lagos, which is worsened by rising sea levels. Climate change will increase flood risks nationwide, especially in southern Nigeria.

Oil extraction and processing has caused widespread contamination of surface and groundwater in the Niger Delta. Over the last 50 years, hundreds of oil spills have destroyed coastal wetlands and mangroves, degraded agricultural lands, and created widespread public health crises.

Comprehensive water quality studies are lacking, which leads to uncertainty regarding the extent and severity of contamination from municipalities, industry, and natural sources. Most industrial and municipal waste is not treated. Industrial hubs in cities like Lagos and Kano pollute surface and groundwater with heavy metals. Naturally-occurring fluoride contamination affects groundwater in central and northern Nigeria.

Limited coordination, funding, and low technical capacity impede effective water resources management and planning. Poor management of transboundary basins, including the Niger and Lake Chad Basins, drive water stress, affect hydropower generation, and in some cases, increase flood risks.

[i]The Falkenmark Water Stress Index measures water scarcity as the amount of renewable freshwater that is available for each person each year. A country is said to be experiencing water stress when water availability is below 1,700 m^3 per person per year; below 1,000 m^3 is considered water scarcity; and below 500 m^3 is absolute or severe water scarcity.

[ii]SDG 6.4.2 measures water stress as the percentage of freshwater withdrawals against total renewable freshwater resources. The water stress thresholds are: no stress <25%, low 25%-50%, medium 50%-75%, high 75%-100%, and critical >100%.

WINROCK INTERNATIONAL · TETRA TECH · IUCN · mWater · SEI Stockholm Environment Institute · World Resources Institute · The CEO Water Mandate

Water Resources Availability

KEY TAKEAWAYS

- Water scarcity is highest in northern Nigeria where perennial surface waters are limited. Lake Chad has largely receded beyond Nigeria's borders.
- The Niger River is the most prominent Basin in Nigeria. The five Hydrological Areas that comprise the lower Niger Basin drain almost two-thirds of the country and account for about 60 percent of total runoff. The Niger Delta is the third largest in the world and features extensive mangrove coverage and biodiversity.
- Aquifer productivity is highly variable. Nigeria's alluvium aquifers are very productive but are not widespread, while sedimentary basin aquifers in the northeast have moderate yields.

This section summarizes key characteristics of surface and groundwater resources. Table 1 summarizes key water resources data and Figure 1 presents key surface water resources, wetlands, and dams.

Surface Water Resources

Nigeria's surface waters primarily drain through the Niger and Lake Chad Basin, in addition to several smaller coastal river basins.[5] Nigeria organizes its basins into eight Hydrological Areas (HA).[6] The Niger North, Niger Central, Niger South, Upper Benue, and Lower Benue HAs form the lower reaches of the Niger Basin. Collectively, they drain almost two-thirds of the country and account for about 60 percent of total runoff.[6–8] The Niger River originates in Guinea and outlets to the Gulf of Guinea through the Niger Delta, which is the third largest delta in the world covering 70,000 km^2 and containing seven percent of the world's mangroves.[9,10] The Benue River is the largest and most important tributary of the Niger River in Nigeria.

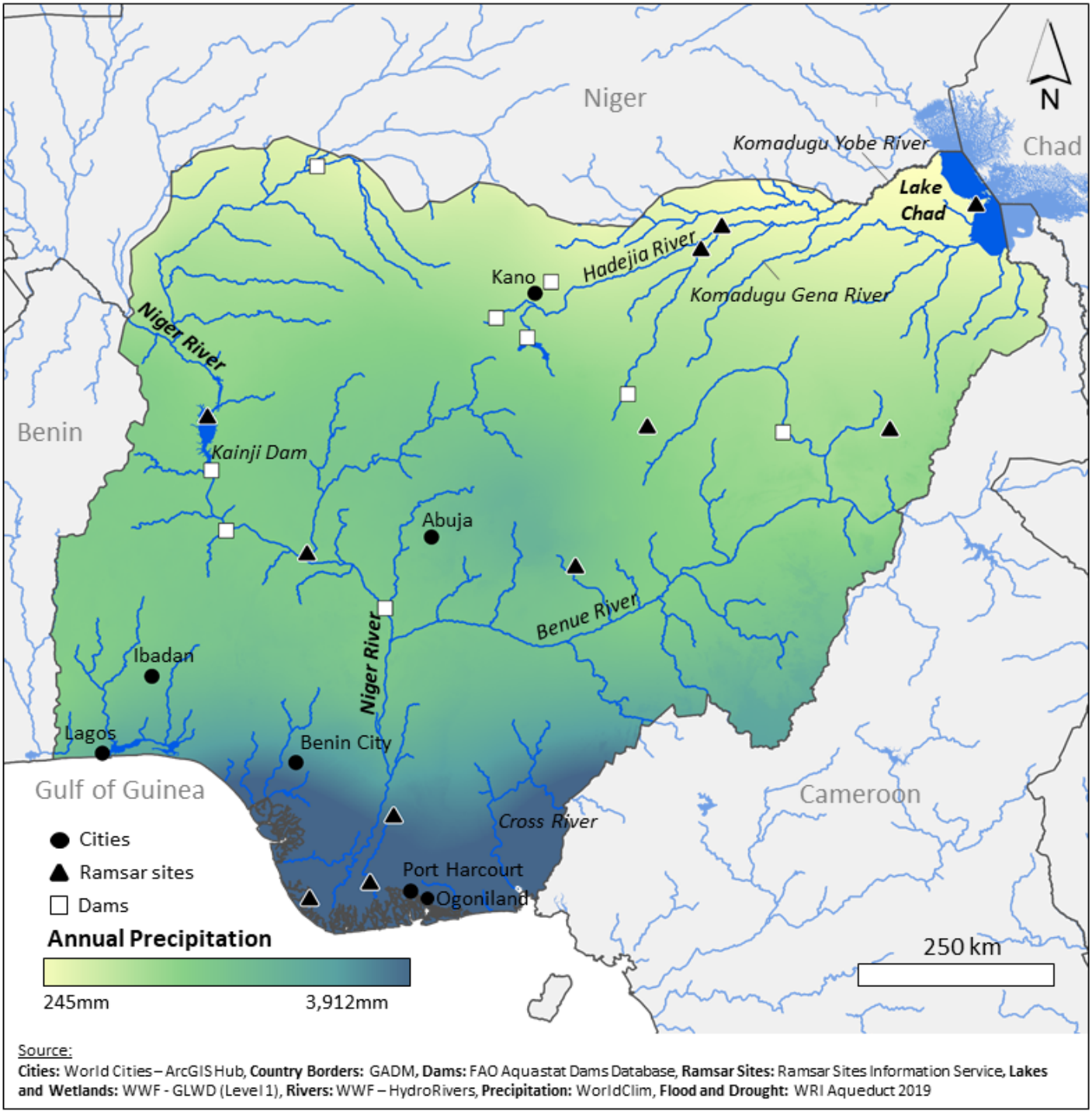
The northeastern Lake Chad HA drains the western limits of the Lake Chad Basin, which spans eight countries and forms Lake Chad along the border between Nigeria, Chad, and Cameroon. The largest river in the Chad Basin HA is the Komadougou Yobe,[7] which has a number of seasonal tributaries, including the Hadejia, Jama'are, and Komadougou Gena.[6,7] Water availability in the Lake Chad HA has declined due to the recession of Lake Chad as a result of drought and overexploitation. In the 1960s, Lake Chad spanned 25,000 km^2 [11] and had roughly one-quarter of its surface within Nigeria.[12] During this time, demand for water increased significantly from agricultural communities around the lake.[11] Major Sahelian droughts reduced Lake Chad's coverage by 90 percent to 2,000 km^2,[14] however, the lake's coverage has somewhat recovered to 14,000 km^2.[14] The Western Littoral HA has relatively low runoff, whereas the Eastern Littoral HA, which includes the Cross and Imo Rivers, has high precipitation and generates about 30 percent of national runoff.[7,8]

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

Source: FAO Aquastat

FIGURE 1: MAP OF WATER RESOURCES



Groundwater Resources

Most of Nigeria's groundwater exists in basement complexes or sedimentary basins.[17,18] Alluvium aquifers are less common but are the most productive groundwater systems. Groundwater recharge rates are lowest in the northwest (estimates from 4-28mm/year) and highest in the southeast (estimates from 281-1,047mm/year).[17] Basement complexes cover 60 percent of Nigeria[7] and are located throughout the southwest, in the central region, and along the eastern border with Cameroon. Most of these groundwater systems have shallow depths to the water table (5-15m) and low to moderate well yields.[18] Sedimentary aquifers underlay most of the northeast and northwest, and along the upper reaches of the Niger and Benue Rivers. The best yielding aquifers are in the northwest, northeast, and in the central region. Aquifers in the northern sedimentary basin typically have both confined and unconfined layers. Unconfined aquifer depths range between 15-75m in the northwest and 30-100m in the northeast.[18] Alluvium aquifers broadly follow the paths of the Niger and Benue Rivers in relatively narrow bands, and underlie most of the Niger Delta.[17] In these aquifers, groundwater can be easily accessed at shallowest depths (0-10m) with high yields.[18]

Surface Water Outlook

KEY TAKEAWAYS

- Water stress is highest in northeastern Nigeria and driven by growing surface water demand for irrigation and municipal use. Only 41 percent of freshwater abstractions are from surface water. Cropland expansion and key dams in the northeast reduce wetland and viable pasturage for herders, harm key ecosystems, and exacerbate regional security challenges from increased competition over water and land.
- Southern Nigeria is vulnerable to flooding, especially in Lagos. Flood risks are compounded by poor urban planning and limited storm water management infrastructure.
- Lack of industrial and municipal waste treatment has led to high concentrations of heavy metals and biological/chemical oxygen demand (BOD/COD), threatening public health and destroying ecosystems.
- Oil spills have severely degraded the Niger Delta and threaten public health. Contaminants persist in the environment for decades and have decreased fishery production and aquatic biodiversity.

This section describes key sources of demand and uses of surface water, and associated challenges stemming from water availability and water quality challenges.

Agriculture (44 percent), municipal/domestic (40 percent), and industry (16 percent) are the principal sources of demand for freshwater and approximately 41 percent of all freshwater abstractions are from surface water. Nigeria's 2013 National Water Resources Master plan projects that total surface water demand will more than triple by 2030. The largest increases will be in the Upper Benue, Lake Chad, and Western Littoral HAs due to growing demand for irrigation.[20] Municipal demand is concentrated in the Niger Central and Western Littoral HAs whereas agricultural demand is concentrated in the Lake Chad and Niger North HAs.[20] Nigeria also has over 200 dams.[5] The Kainji, Shiroro, and Jebba Dams in the Niger Basin account for 70 percent of Nigeria's total dam storage capacity.[19]

Seasonal surface water availability and drought in northern Nigeria increase vulnerability to ecosystem degradation and regional instability. Around 70 percent of all livestock is in northeastern Nigeria. Major droughts in the 1970s killed 13 percent of the region's livestock, and cut the agriculture sector's contribution to the GDP by more than half.[21–24] Key dams on the Hadejia and Komadugu-Yobe River have significantly reduced the coverage of key wetlands, especially Hadejia-Nguru wetlands and reduced Lake Chad's coverage and surrounding pastures.[12,25,26]

Lake Chad has high inter-annual and inter-seasonal rainfall variability. As a shallow lake, its coverage fluctuates greatly with rainfall patterns, affecting the extent and viability of pastures, croplands, and fisheries.[11,26] High poverty rates and unequal access to land and water resources amplify existing socio-economic tensions among ethnic and religious groups.[24,30,31] Food and water insecurity in northern Nigeria have been important factors in helping Boko Haram recruit fighters[27] while violent clashes between pastoralists and farmers are partly attributed to water scarcity and desertification.[28,29]

Lack of infrastructure and poor urban planning accentuate flood risks throughout Nigeria and especially in Lagos and coastal cities. Approximately 30 percent of Local Government Areas (LGAs) have medium to high flood risk. The highest risks are around the Niger Delta, along the Niger, Benue, and Cross Rivers, and in Lagos State.[33] Poor urban planning and enforcement of existing zoning regulations has led to uncontrolled development in coastal zones and flood plains.[4] Lagos City is one of the largest and fastest growing cities in the world, and over two-thirds of its population reside in low lying flood plains.[34,35] Storm water infrastructure and drainage systems cover less than half of Lagos and most are not maintained. Further, many drainage systems are uncovered channels and are commonly used as dump sites for solid waste, which increases surface water contamination and health risks during floods.[4]

Untreated industrial and municipal effluent, as well as agricultural and municipal runoff contaminate surface waters and create risks to public health and ecosystems. Less than 10 percent of industrial effluent is treated. Contamination from heavy metal pollution, mostly lead and chromium, in addition to oil and grease, high turbidity, and high biological/chemical oxygen demand (BOD/COD) are widespread.[8] High BOD/COD levels can kill aquatic species and disrupt ecosystems. Water quality risks from industry are especially high in the southwest near the Lagos[38,39] and in the north near Kano.[40] Apart from Abuja and Lagos, functional wastewater treatment plants are limited.[37] Additionally, excess fertilizer use, poor land use planning, and dams are increasing eutrophication in rivers, lakes, and reservoirs, destroying ecosystems and inhibiting recreational use of surface waters.[43,44] Algal blooms have been observed in Rumuji Lake in the Niger Delta region.[45]

Oil spills and untreated effluent from oil refineries have severely degraded the Niger Delta. Nigeria is the 10th largest oil producer in the world[46] due to the rich oil deposits in the Niger Delta.[47] Oil spills have discharged an estimated 13 million barrels of crude oil into the environment[30] and destroyed coastal wetlands and mangroves, degraded agricultural lands, and created widespread public health crises. Oil spills have contributed to high concentrations of heavy metals such as cadmium, chromium, and lead in numerous watercourses, particularly in Rivers and Delta States. Pollution from cadmium and lead is the most severe, with their maximum concentrations found over 100 times the WHO guideline values for drinking water.[48,49] While environmental and social impact assessments are required in Nigeria, local compliance and enforcement of environmental regulations are often lacking.[47] The impacts of these spills threaten public health and can devastate ecosystems and biodiversity. Fishery production and populations of key aquatic organisms are declining in the Niger Delta due to oil spillage.[50,51] Despite cleanup efforts, contaminants from an oil spill from over 40 years ago have persisted in the Ogoniland area, demonstrating the long-term consequences that these events can have.[52]

Groundwater Outlook

KEY TAKEAWAYS

- Groundwater is the main source of drinking water for rural and urban populations and is the main source of irrigation demand through small-scale, traditional systems (fadama). Declining groundwater levels in the north and northeast from over-abstraction and lower recharge may inhibit water access for vulnerable populations.
- Pollution is a major issue throughout Nigeria, but risks are highest along the coast due to oil spills and saline intrusion from over-pumping. Untreated industrial and municipal waste from large industrial centers such as Lagos and Kano cause high concentrations of toxic heavy metals.
- Geogenic contaminants such as fluoride and some heavy metals present serious health risks, but comprehensive studies are needed to better understand their extent and severity.

This section describes key sources of demand and uses of groundwater, and associated challenges stemming from water availability and water quality challenges.

More than half of all freshwater abstractions are from groundwater, mostly for irrigation and domestic use. Around three-quarters of all irrigation withdrawals are from groundwater through traditional, dry-season flood plain irrigation known as *fadama*.[19] Groundwater is also the main domestic water source for approximately 60 percent of the population in rural and urban areas.[53] However, data on groundwater use and sustainability is limited and requires more systematic monitoring.[54]

Groundwater levels in northern and northeastern Nigeria are declining from over-abstraction and insufficient recharge attributed to urbanization and wetland degradation from dams. Average water levels in shallow aquifers in the northeast have declined over 13 meters.[55] Groundwater is generally available at lower depths, however, deeper wells are more expensive.[17,24] Recharge rates have declined significantly as dams have reduced the extent of wet season inundation of flood plains.[12] Research and systematic monitoring of groundwater levels throughout southern Nigeria is lacking, although there is some indication that over-pumping is contributing to subsidence (land sinking) in coastal cities such as Lagos.[58,59] Additionally, groundwater demand is high in the northern Kano region, which is home to one-third of the total population.[56] Despite above average precipitation in recent years, groundwater levels across the Kano metropolitan area are declining, largely due to over-abstraction and urbanization which reduce recharge.[60]

High concentrations of fluoride and heavy metals from anthropogenic and geogenic sources threaten public health. Naturally high fluoride levels contribute to widespread fluorosis in some parts of Nigeria.[54,61] Fluoride concentrations are higher in central and northern Nigeria, with one national survey showing that 30 percent of groundwater sources exceed the WHO guideline value for drinking water for fluoride.[62] Heavy metals such as lead, cadmium, arsenic, and selenium have been detected in groundwater in the southwestern city of Ibadan, although contamination from antimony is highest and most widespread and likely derives from natural and anthropogenic sources.[63,64] Similarly, lead pollution from industrial and municipal waste is widespread in shallow and deep wells in Lagos.[65] Additionally, inadequate sanitation systems in many cities, including Lagos, have led to high concentrations of E. Coli and nitrates in shallow wells.[66]

Saltwater intrusion into aquifers along the southern coast has increased due to overexploitation of groundwater. Groundwater resources used for drinking supply in the coastal area of Lagos and in communities in Delta State and in Ondo State have been affected by saltwater intrusion.[67,68] Groundwater monitoring wells

are lacking in Lagos, although some studies have found saline intrusion in wells as far as 3km inland.[69] Rising sea levels from climate change and land subsidence in coastal cities will increase saline intrusion.

Oil spills in the Niger Delta degrade groundwater quality and pollute water points with carcinogenic hydrocarbons. Groundwater sampled in areas with a history of oil spillage have shown high turbidity, low pH, and low dissolved oxygen at levels that may not be suitable for human consumption.[71] In Ogoniland, one water quality study close to a oil pipeline found an 8 cm layer of refined oil floating on the groundwater table which serves community wells.[52]

Water Resources and Climate

KEY TAKEAWAYS

- Precipitation will increase in southern Nigeria and decrease in northern Nigeria. Rainfall intensity will increase nationwide, which will increase the impacts of flooding. Rising sea levels will also impact coastal cities, including Lagos.
- Rainfall variability, droughts, and desertification are increasing, particularly in the northern Sahelian zone. This will increase competition over increasingly scarce water resources and could increase regional security challenges.

This section covers climate variability and climate change, their impacts on water availability and water quality, and the risks they pose to local communities and their economies.

Average annual precipitation is 1,062 mm, with precipitation highest in the south and lowest in the north. Most of Nigeria experiences distinct wet and dry seasons,[72] which causes high seasonal variability in water supply (see Table 1). The wet season is shorter (May-September) in the north compared to the south where it lasts at least 9 months (March-November).

Climate change has decreased total rainfall, especially in northern Nigeria. Increasing temperatures and evaporation will further deplete water availability. Climate change has caused average temperatures to increase by 0.8°C between 1960 and 2006, with a particularly steep increase since 1980,[72] while annual precipitation has decreased.[73–75] Between 1971 and 2012, heat waves have increased in the Guinea and Sahel regions.[76] Dry seasons have become longer and wet season rainfall variability has increased.[77,78] Droughts are also more frequent and affect larger areas,[79] while extreme flooding has increased. In northern Nigeria, rainfall has declined by 25 percent in the past 30 years.[80] Climate change is projected to further increase temperatures by 1.9-3.7°C, while total precipitation may increase slightly. Total water availability is projected to decrease due to increased evaporation.[81] Sea levels may rise between 1.5-3 feet, potentially submerging more than 11,000 square miles, where many of the most densely populated cities and towns are located, including Lagos.[30]

Flooding is the most severe and common natural disaster, particularly in the south. More intense rainfall will worsen flooding. An estimated 20 percent of the population face flood risks.[82] Flood risks are highest in riverine communities in the downstream reaches of the Niger, Benue, and Cross Rivers, and Lagos State.[33] Lower basin states throughout southern Nigeria have experienced a 20 percent increase in recorded volumes of torrential rains in the past 40 years.[83] This has accelerated gully erosion in the southeast where many river banks have collapsed.[39] In 2012, widespread flooding affected almost every Nigerian state, damaging or destroying 600,000 houses, displacing over 2 million people, and causing almost USD $17 billion in losses to the economy.[84,85]

Increasing rainfall variability and evaporation increase drought risks and likelihood of desertification in the north. Climate change will continue to lower rainfall in northern Nigeria and increase the frequency of severe droughts.[80,81] Desertification will worsen these risks. In addition to drought, desertification is driven by poor water resources management and land use changes, overgrazing, and deforestation. Between 50-75 percent of the land in the 11 northernmost states are impacted by desertification. Desertification is progressing southward at a rate of 0.6 kilometers per year,[87] and has contributed to the loss of nearly half the vegetation in the northernmost states between 1984 and 2016.[88] A growing number of sand dunes have threatened oases and buried water points,[89] and significantly reduced wetland coverage.[68]

FIGURE 2: DROUGHT RISK

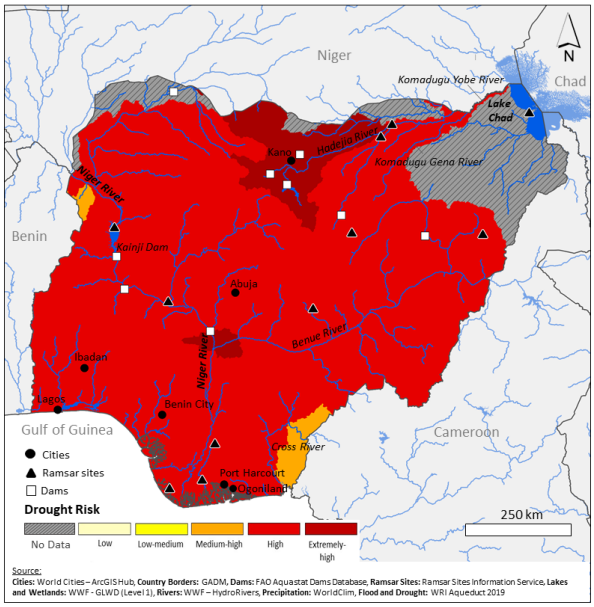
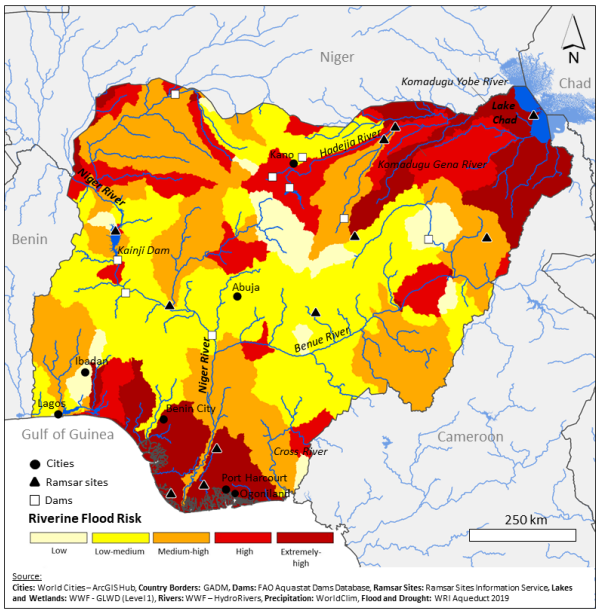


FIGURE 3. RIVERINE FLOOD RISK



Water Policy and Governance

KEY TAKEAWAYS

- Key water management entities do not align with hydrological boundaries and have limited coordination in basin planning and the design and operation of hydraulic infrastructure. Low technical capacity and funding also impede water management efforts.
- Limited management of transboundary basins reduces water availability for hydropower generation and pastures for grazing in several basins.
- Surface and groundwater quality monitoring are not comprehensive, inhibiting informed decision-making and basin management.

This section provides an overview of key policies, institutions, and management challenges. Key laws, policies, and plans are summarized in Table 2 and the roles and responsibilities of select transboundary, national, and sub-national water management entities are summarized in Table 3.

TABLE 2. KEY LAWS, POLICIES, AND PLANS

Name	Year	Purpose
National Water Resources Policy	2016	Originally drafted in 2004, the National Water Policy was approved in 2016. The policy establishes that all water is a national asset and defines planning and development through an integrated water resources management framework.
Water Resources Master Plan	2013	Assesses water resources supply and demand from2010 to 2030 and defines basin development priorities and risks.
Minerals and Mining Act	2007	Grants Ministry of Mines and Steel Development (MMSD) water use permitting rights when they concern mining exploration and operation.
The National Inland Waterways Authority (NIWA) Act	1997	Established NIWA and defines its responsibilities towards river navigability, riverbank stabilization, and dam development.
Water Resources Act	1993	Established the Federal Ministry of Water Resources as the lead institution in charge of water resources development, licensing, planning, and use.
River Basins Development Authority Act	1990	Established 12 River Basin Development Agencies (RBDA) that are responsible for developing surface and groundwater resources, prioritizing water use for domestic and agricultural purposes. The act was originally enacted in 1976 but has been revised several times.

TABLE 3: WATER RESOURCES MANAGEMENT ENTITIES

Mandate	Institution	Roles and Responsibilities
Transboundary	Niger Basin Authority (NBA)	Commissioned in 1980, the NBA's nine member states are Niger, Benin, Chad, Guinea, Côte d'Ivoire, Mali, Nigeria, Cameroon, and Burkina Faso. Supports integrated basin development related to energy, water resources, agriculture, animal husbandry, fisheries, forestry, and transportation.
	Lake Chad Basin Commission (LCBC)	Established in 1964, members include Cameroon, Niger, Nigeria, Chad, the Republic of Central Africa, and Libya to coordinate the sustainable development and equitable use of Lake Chad, regional peace and security, and environmental conservation.
National	Federal Ministry of Water Resources (FMWR)	Lead governmental entity in charge of water management and allocation between states. Oversees all 12 RBDAs, in addition to other water sector entities such as the Nigeria Hydrological Services Agency (NIHSA), the Nigeria Integrated Water Resources Management Commission (NIWRMC), and the National Water Resources Institute (NWRI).
	Nigeria Integrated Water Resources Management Commission (NIWRMC)	Overseen by the FMWR, the NIWRMC is the central coordinating body for Catchment Management Offices (CMO). Manages water use regulations and licensing, strengthens CMO capacity, and formulates Catchment Management Plans based on stakeholder consultation.
	National Environmental Standards and Regulations Enforcement Agency (NESREA)	Housed within the Federal Ministry of the Environment, NESREA is responsible for issuing environmental permits, including for effluent discharge, and monitoring compliance of permit holders.
	National Council on Water Resources (NCWR)	Formulates and approves water sector policy, laws, strategy, master plans, and the development and implementation of large infrastructure.
Sub-national	River Basin Development Authorities (RBDA)	

Nigeria's federal system divides water management responsibilities between federal, state, and local institutions. In 2017, a comprehensive national water resources bill was proposed to consolidate and clarify existing laws, centralize water resources management through a national council, and establish a regulatory framework for water resources. However, the bill has been controversial due to its provisions for privatization of water service delivery and consolidation of water management responsibilities within the central government. Approval of the law remains pending.[99–101]

Lack of coordination and overlapping responsibilities among the different institutions and low funding and technical capacity impede water resources management. Water management responsibilities do not consistently follow hydrological or administrative boundaries. This leads to overlapping responsibilities between institutions and undermines basin management approaches. For example, RBDAs follow state administrative, rather than hydrological, boundaries. RBDAs within the same basin and HA often do not coordinate and instead prioritize irrigation expansion within their administrative jurisdiction. This can impact water availability and water quality for downstream states.[102] Within the Niger Basin, there is limited coordination between the six RBDAs responsible for planning, design, and operation of key hydraulic infrastructure.[103]

Further, technical capacity is often low. One assessment of the Cross River Basin Development Agency highlighted the lack of key technical staff, including geographic information system and remote sensing expertise, hydrologists, and water resources managers.[104] Capacity issues are compounded by inadequate data, and poor data management systems.[54] NESREA struggles to fulfill its mandates due to technical capacity constraints, in addition to a lack of transparency and autonomy from political interests, fragmented environmental laws, lack of public participation, and limited enforcement of permits.[105]

Nigeria is significantly impacted by poor management and coordination in transboundary basins. The NBA lacks funding and commitment from member states.[106] Inflows to Nigeria's Kainji Reservoir have been decreasing for decades, possibly from over abstraction in upper basin states. Uncontrolled and uncoordinated management in the Lake Chad Basin leads to over exploitation of Lake Chad and has reduced lake coverage and pastures in Nigeria.[12] Poor management of Cameroon's Lagdo Dam has led to reduced flows on the Benue River, and Nigeria claims that uncoordinated floodgate releases have caused major flooding in downstream villages.[108,109]

Water Quality Monitoring

Several government agencies have distinct mandates for water quality monitoring, but surface and groundwater are not comprehensively or consistently monitored. CMOs are broadly responsible for monitoring water quality within their respective HAs and maintaining databases for all hydrological and hydrogeological information.[92] The Federal Ministry of Health (FMoH) and the FMWR (through its Department of Water Quality Control and Sanitation) are responsible for monitoring drinking water quality, but they both lack funding and technical capacity, and there is a lack of coordination.[110–112] Most surface and groundwater quality studies have been carried out by researchers at universities, research institutes, and government institutes.[38]

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