



RESILIENT WATER
ACCELERATOR

ARUP



THE CITY WATER
RESILIENCE APPROACH

CITY CHARACTERISATION REPORT
LAGOS

ABOUT THE CITY WATER RESILIENCE APPROACH

The City Water Resilience Approach (CWRA) helps cities build the capacity of urban water systems to endure, adapt and transform in the face of new challenges for the benefit of all city residents. It has been developed to guide decisions by a range of stakeholders including government, private sector, academic and civil society actors. Ultimately, the approach will inform how water programmes and projects are planned, designed, delivered, and operated to improve outcomes to individuals relying on safe water systems for their health and wellbeing.

ABOUT OURWATER

This digital tool helps cities better understand their local water basin, including the types of shocks and stresses confronted, their impact on natural and man-made infrastructural systems, and the interaction between key stakeholders involved in urban water management.

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LETTER FROM THE LAGOS STATE MINISTRY OF THE ENVIRONMENT AND WATER RESOURCES

We are pleased to present the City Characterisation Report (CCR) of Lagos as part of the City Water Resilience Approach (CWRA). The CWRA is being undertaken as a component of wider efforts by the Resilience Water Accelerator (RWA) which recognizes the critical importance of water resilience in our city.

The Lagos State Government aligns with the strategic aim of the RWA. The primary aim is to address the challenges of climate change and water security by attracting investment into the water sector. The initiative supports programme design and the production of high-quality "bankable" projects that aim to increase the amount of climate finance going to water but also explores ways to increase private investment in services that can support vulnerable communities.

Ranked as one of the largest economies in Africa, Lagos is a burgeoning innovation and business hub - attracting millions of people seeking better opportunities from other states and West African nations. However, as one of Africa's most populous cities, Lagos faces unique challenges in water availability, quality, and management. The CWRA provides a comprehensive framework to assess and enhance our city's water resilience, understanding the interdependencies between water systems, human activities, and the environment. This report is a significant step towards a sustainable and resilient water future.

The Lagos CCR serves as a comprehensive snapshot, examining connections between supply, demand, quality, and governance. It identifies vulnerabilities and strengths, forming a foundation for targeted strategies across sectors. Through this report, we have a deeper understanding of the dynamics influencing water availability, accessibility, and sustainability in Lagos.

Collaborative governance, stakeholder engagement, and community participation are crucial for water resilience. By identifying risks, vulnerabilities, and opportunities, we can implement integrated solutions and robust policies for sustainable development. This report is a starting point for informed decision-making and action. Our challenges are complex, requiring continuous monitoring, adaptive management, and stakeholder collaboration. Together, we can navigate towards a resilient and sustainable water future for Lagos. We appreciate the contributions of experts, researchers, and stakeholders, whose efforts have provided an evidence-based understanding of our water landscape. The Lagos State Ministry of the Environment & Water Resources welcomes the initiative of the Resilient Water Accelerator (RWA) to have initiated this process and is committed to utilizing the report's findings, translating recommendations into policies, programs, and projects to protect and enhance our water resources for current and future generations.

We urge all stakeholders to actively participate in the CWRA's follow-on actions and contribute to creating a water-resilient Lagos. Let us forge a future where water is accessible, ecosystems thrive, and communities prosper. With collective action and commitment, we can build a resilient Lagos that inspires other cities worldwide.



Engr. Nurudeen Olalekan Shodeinde

Permanent Secretary,
Office of Drainage Services and Water Resources,
Lagos State Ministry of the Environment & Water Resources.

EXECUTIVE SUMMARY

This City Characterisation Report is part of the work of the Resilient Water Accelerator (RWA) in Lagos to boost climate resilience through clean and reliable water resources and services. It is an important milestone in assessing the water basin and systems, key assets, and governance through applying the City Water Resilience Approach (CWRA). The CWRA process in Lagos aims to inform downstream actions, such as project prioritisation, by developing an understanding of the city's water system and of the water-related shocks and stresses the city faces.

Lagos is one of Africa's largest cities with a population of over 20 million people. It is also one of the fastest growing cities in Africa.

Surrounded by wetlands, lagoons and the Atlantic Ocean, Lagos is battling water related challenges. Lagos has a complex water system with both surface and groundwater supplies. Water and wetlands represent more than 22% of Lagos' total land area, and the city struggles to manage its water infrastructure. Despite being surrounded by water, only 10% of people living in Lagos have access to municipal water supply.

The work presented in this report has identified several water-related shocks and stresses that the city's water system faces. These are partly caused, but often exacerbated by, climate change. A key challenge the city struggles with on a regular basis is flooding, caused by different

factors including an insufficient drainage system and loss of blue and green infrastructure.

Examples of stress on the water system are the groundwater exploitation from the vast uncontrolled exploitation of aquifers, as well as underground and surface water pollution. Lagos also suffers from a lack of clear mandates in the water space, with several entities holding overlapping responsibilities. Despite efforts to increase access to safe water and sanitation, there is still limited coverage due to an unprecedented increase in water demand and the high cost associated with an improvement of service levels. Therefore, a main stress the city needs to overcome is a lack of investment into the water sector. This covers both the lack

of new infrastructure investments, as well as the rehabilitation, operation and maintenance of existing services.

Findings from this report are anticipated to be a first step towards a more holistic view of the water sector in Lagos. This information provides the necessary basis to inform decision makers why investments are needed and demonstrates the importance of RWA's mission to attract funding to the sector.





1

INTRODUCTION

Home to the youngest and fastest growing population in the world, African cities are urbanizing at an explosive rate. Population projections by the United Nations estimate that, by 2050, the current African population of 1.1 billion will double, with 80% of this increase happening in cities.¹ African cities face major challenges relating to water management. Considering projected population growth and urbanisation, compounded by the effects of climate change, there is an urgent need for an efficient and effective urban water management system that guarantees reliable and sufficient water services for the inhabitants of African cities.

Lagos is one of Africa's largest cities with a population of over 20 million people. It is also one of the fastest growing cities in Africa with a growth of 77 people per hour between 2010 and 2030. Surrounded by wetlands, lagoons and the Atlantic Ocean, Lagos is battling water related challenges. The city is also vulnerable to the impacts of climate change, including sea level rise and increased frequency and severity of extreme weather events. Water is a critical resource in Lagos, and the city's water resilience is an important factor in its overall resilience to these challenges. These challenges present a significant threat to the growth and development of the city. To move towards sustainable urbanisation, the city needs to be resilient to hazards including those associated with climate change.

The Resilient Water Accelerator (RWA) strives to address these needs by providing novel strategies and tools that support cities in building water resilience at the urban scale. Part of RWA's strategy to work towards urban water resilience, is taking the City Water Resilience Approach (CWRA) to Lagos.

¹World Economic Forum | African Cities Will Double in Population by 2050. Here Are 4 Ways to Make Sure They Thrive," n.d. <https://www.weforum.org/agenda/2018/06/Africa-urbanization-cities-double-population-2050-4+ways-thrive/>.

1.1 ABOUT THE RESILIENT WATER ACCELERATOR

As climatic conditions challenge millions of people, it is critical that we accelerate financial flows to the communities most in need, to ensure they have safe access to water in future. The RWA is a new initiative that aims to boost climate finance to build the climate resilience of 50 million vulnerable people living in water-stressed areas by 2030. The Accelerator will enable climate vulnerable communities to secure clean and reliable water resources and services by helping design comprehensive climate-resilient water security programmes and unlock new sources of financing. The Accelerator helps tackle three key barriers that low-and middle-income countries face in delivering on climate actions.

- **Investment complexities:** The Accelerator addresses the need for bespoke solutions towards building resilience that do not fit with the 'large project' mentality of many private and public financing institutions; and aims to develop and implement projects at the community level.
- **Enabling environment challenges:** The Accelerator recognizes that the most in-need hotspots often lack the strong enabling environment (due to institutional weakness, risks, or high upfront costs) that investors require; and aims to strengthen the enabling environment for bringing in diverse sources of investment by strengthening the transparency and building up financial architecture to a level where public and private investors can feel confident that their financial commitments will achieve climate resilience through multi-sectoral collaboration and enhanced sustainable water security.
- **Lack of collaboration:** The Accelerator aims to facilitate ambitious collaboration, bringing together a wide range of stakeholders

within countries and globally to create multi-sectoral solutions for building climate resilience. The Accelerator is currently being led by an interim Steering Committee including the African Development Bank, Arup, Global Water Partnership, Sustainable Markets Initiative, Government of the Netherlands, UK Government, WaterAid, and World Resources Institute.

The Accelerator has set some ambitious goals, including raising up to \$20 million in programmatic funding and launching activities in at least 5 locations, beginning with Bangladesh, and Nigeria. Through partner organizations, the Accelerator has identified a liaison manager for each priority country to gather intelligence and kickstart conversations with key stakeholders. The Accelerator has also appointed a chief executive and has hired a country engagement coordinator in each of the pilot countries to oversee the Accelerator's activities on the ground and ensure that in-country teams have access to the support needed to deliver successful programmes.

1.2 THE CITY WATER RESILIENCE APPROACH

A water-resilient city is one that can survive and thrive in the face of shocks and stresses related specifically to water - ranging from drought to flooding, storm surges, and sea level rise – and can adequately mitigate the impact of all shocks and stresses on the urban water system (e.g., the impact of an earthquake on key water infrastructure). Resilience in this context means that the city exhibits the capacity to:

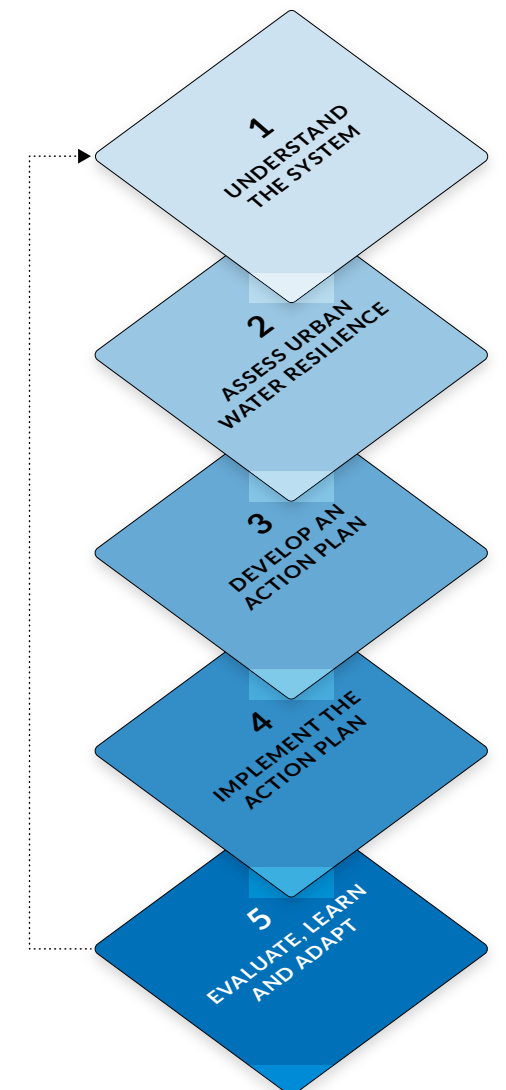
- Provide access to high quality water resources to residents for all uses (Domestic, Industrial, Agricultural, Recreation, etc.).
- Protect residents from water-related hazards.
- Connect residents and their needs through water-based mobility.

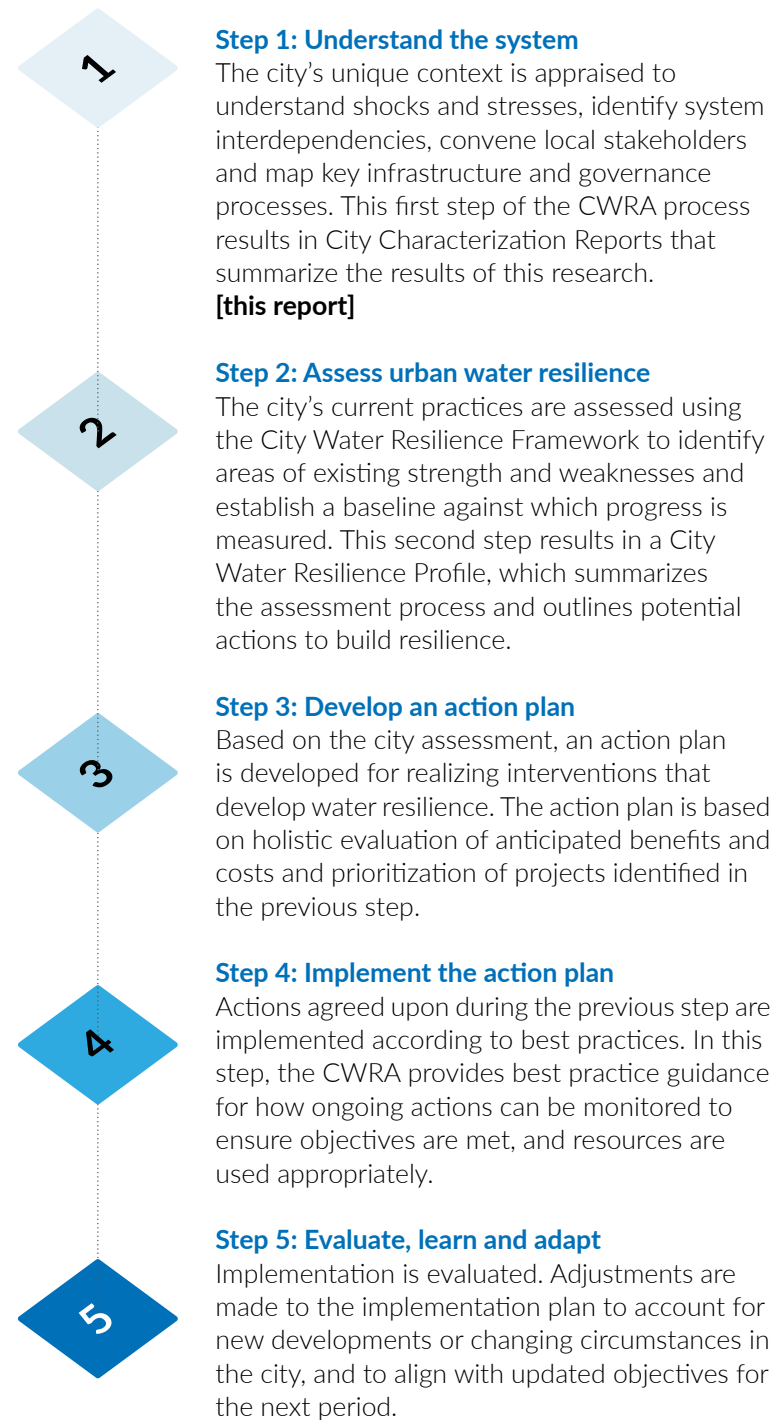
The City Water Resilience Approach (CWRA) responds to a demand for new approaches, innovative tools, and techniques for achieving these capacities. The CWRA process outlines a path for developing urban water resilience and provides a suite of tools to help cities survive and thrive in the face of water-related shocks and stresses.

The CWRA is based on fieldwork and desk research, collaborative partnerships with subject matter experts, and direct engagement with city partners. The approach was developed through investigations in eight cities, and consultation with over 700 individual stakeholders by Arup, working with the Stockholm International Water Institute (SIWI), 100 Resilient Cities (100RC), the Organization for Economic Co-Operation and Development (OECD) and in close collaboration with city partners from Cape Town, Amman, Mexico City, Greater Miami and the Beaches, Hull, Rotterdam, Thessaloniki, and Greater Manchester. Each partner city confronts persistent water-related shocks or suffers

chronic water-related stresses and is committed to co-creating water resilience approaches. The cities represent diverse geographies, and face a range of shocks and stresses, in a variety of socio-political contexts.

The approach outlines five steps to guide partners through initial stakeholder engagement and baseline assessment, to action planning, implementation and monitoring of new initiatives that build water resilience.





To guide cities through this process, the CWRA offers a suite of resources that target specific challenges identified by cities in their efforts to build water resilience:

OURWATER

OurWater is a digital tool that helps cities better understand the types of shocks and stresses they confront, their impact on natural and man-made infrastructural systems, and the interaction between key stakeholders involved in urban water management. The OurWater tool is used in Step 1 of the CWRA to map the infrastructure and governance arrangements that define the urban water system.

THE CITY WATER RESILIENCE FRAMEWORK (CWRF)

CWRF assesses the resilience of a city to water-based shocks and stresses and allows the city to identify and prioritize future action. Understanding their resilience helps cities formulate a clear vision of what urban water resilience means to them, including what specific conditions must be in place to achieve this vision, what efforts will be required to build resilience and what actors are involved. The CWRF is the primary tool used in Step 2 to assess urban water resilience, and the focal point for workshops conducted in the city.

1.3 LAGOS RESILIENCE JOURNEY

Lagos is Nigeria's largest city, its economic capital and one of the world's fastest growing cities. The city is a melting pot where people from diverse cultural backgrounds converge, because of its leading position in innovation, governance and infrastructure. It is rich in opportunities and increasingly striving to provide the social safeguards that will optimize the resourcefulness of its people for a prosperous future.

Lagos' history is characterized by tremendous urbanisation and rapid population expansion that have outrun sustainable urban planning, posing increasingly difficult problems for the city and its governmental system. Lagos is a complex city - it is faced with challenges such as disease outbreaks, coastal erosion, flooding, building collapse, high unemployment, traffic congestion, inadequate physical and social infrastructure, inadequate transportation systems, formal-informal economic contestation, erratic power supply, civil unrest, urban fires and an inadequate health system. These are examples of stresses and shocks that affect the economic development of the city.

In 2016, Lagos State joined the 100 Resilient Cities Network and established a Resilience Office in Lagos within the Ministry of Budget and Economic Planning. The Lagos State Resilience Office (LASRO) published the Lagos Resilience Strategy (LRS) in 2020 as the state's first urban resilience strategy document, articulating an integrated approach to tackling the shocks and stresses that Lagos has experienced and may encounter in the future. The LRS is the result of three years of collaborative effort and action by stakeholders from various sectors of Lagos' social, economic, and political landscape. It reflects the collective goals and vision for Lagos, as well as the efforts recommended to achieve them.

The stresses and shocks highlighted in the LRS include:

Stresses:

1. Unemployment and Underemployment
2. Formal-Informal Economic Contestation
3. **Erratic Power Supply**
4. **Inadequate Physical and Social Infrastructure**
5. Traffic Congestion
6. **Inadequate Health System**
7. **Overpopulation/Overcrowding**
8. Inadequate Public Transportation
9. **Inadequate Water Supply**

Shocks:

1. **Economic Downturn**
2. **Riot and Civil Unrest**
3. **Storm Surge**
4. **Flooding/Severe Storms**
5. **Disease Outbreaks**
6. Building Collapse
7. Forced Eviction
8. Major Road Accidents
9. Urban Fires

Those directly related to water resilience (in bold) as well as others identified in our research will be discussed in subsequent sections.

To address these shocks and stresses holistically, the LRS outlines a multi-level, and cross-functional approach consisting of 3 pillars, 10 targets, and 31 initiatives/sub-actions arranged in order of priority. Several of these initiatives address the challenges facing the water sector directly or indirectly. These will be assessed and discussed in more detail in the succeeding sections.

Since the strategy's publication in 2020, the LASRO has been involved in programs aimed at reviewing the extent to which strategy initiatives have been implemented by government ministries, departments, and agencies, as well as identifying new opportunities to be integrated into the resilience agenda.

2

LAGOS - THE CITY
CONTEXT

2.1 GOVERNANCE

Lagos is Nigeria's most populous city, rising from pre-colonial indigenous fishing and farming settlements. When Britain captured Lagos in 1861, it was controlled as a city-state with its own independent administration, and it remained a separate colony until 1951. In 1953, Western Nigeria was constituted into a federal territory that included Lagos. Following the outbreak of Nigeria's civil war in 1967, the country was divided into 12 states, one of which is Lagos. Prior to 1967, Lagos served as the capital of Nigeria and was controlled directly by the Federal Government as a Federal Territory.

Until 1991, Lagos was both a state and the federal capital, but the latter was moved to Abuja. Lagos remains the country's financial capital and most populous city. Its government is structured into executive, legislative, and judiciary clusters, with the Governor leading the State Executive responsible for policy development and implementation. The state government has various ministries overseeing governance components such as education, health, transportation, and economic growth. Local governments are significant in Lagos, with each local government area (LGA) led by a mayor and council, responsible for implementing local policies and collaborating with the state government to address community needs.



▲
Map of Lagos State Showing Local
Government Areas

2.2 LOCATION AND TOPOGRAPHY

Lagos is a collection of large islands in a wide lagoon in Benin's Bight, located within Southwestern Nigeria's coastal plain. The region covers roughly 3,577km², 22% of which is water. It has a population density of almost 7,000 people per km², and is located on swampy mangroves along Nigeria's Atlantic Coastline. The natural vegetation is saltwater mangrove swamp forest but has been replaced by impermeable surfaces due to rapid urbanization.²

2.3 CLIMATE

Lagos experiences a tropical savanna climate with an average annual rainfall of 1500mm. The wet season starts in March and ends in October, while the dry season starts in November and ends in February. The wettest month is June with precipitation reaching above 300mm, while the driest month is January with precipitation as low as 13mm.³ Lagos is located near the equator, and has only a slight seasonal temperature variation, with mean high temperatures ranging from 28 to 33°C.⁴



▲ Map of Nigeria showing Lagos State's Geographical and Political Boundary

(2) Olajide, O., & Lawanson, T. (2014). "Climate change and livelihood vulnerabilities of low-income coastal communities in Lagos, Nigeria." *International Journal of Urban Sustainable Development*, 6 (1), 42-51

(3) Lagos, Nigeria Koppen Climate Classification (Weatherbase). (n.d.). Weatherbase. Retrieved January 10, 2023, from <http://www.weatherbase.com/weather/weather-summary.php?s=10256>

(4) Wikiwand - Lagos. (n.d.). Wikiwand. Retrieved January 10, 2023, from <https://wikiwand.com/en/Lagos>

2.4 DEMOGRAPHICS

Lagos is the most populous and urbanized metropolitan area in Nigeria. Some forecasts expect it to become the world's largest metropolis with a population of 80 million by 2100⁵. Lagos has a young population, with 54% of the total population under 25 years old and median age of 22 years. With a high literacy rate of over 95% for young adults in 2010, it is known for its high mobility as many individuals move in and out for job and other opportunities.

Despite the high infant mortality rate of 49 per 1000 live births in 2017 and a total fertility rate of 4 births per woman, Nigeria has made progress in increasing the average national life expectancy from 47 to 54 years between 2000 and 2016. Lagos has a relatively well-educated population, with a high percentage having completed at least some secondary education. The city boasts several universities and other higher education institutions, offering educational opportunities to both local and international students.

Overall, the demography of Lagos reflects the city's diverse and dynamic character and is an important factor in its economic and cultural growth.

2.5 ECONOMIC CONTEXT

Lagos is a major economic hub, with a diverse commercial sector that encompasses banking, technology, entertainment, and manufacturing. In 2021, Lagos had a GDP of N26.6 trillion, which accounted for about 15% of Nigeria's GDP. Lagos attracts over 60% of industrial investment and is home to nearly 90% of corporate headquarters. It has around 3.2 million Micro, Small and Medium Scale Enterprises (MSMEs), with the majority being in the informal sector. These MSMEs account for 95% of new job creation and 67% of working adults.

In 2020, the Lagos State Government generated over N30 billion monthly, but only a small fraction of the State's 10 million potential taxpayers pay taxes legally. Tax reforms implemented between 1999 and 2016 resulted in an increase in annual revenue from N10 billion to N313 billion. Lagos is also home to the Nigerian Stock Exchange and generates over 50% of Nigeria's port revenue, accounting for over 80% of the country's foreign trade flows. There are numerous incentives available to local and foreign investors, including a five-year tax cut for investors who establish pioneer firms in various sectors of the economy.

(5) "Lagos Is Expected to Become the World's Largest City by 2100," November 22, 2022. <https://africa.businessinsider.com/local/lifestyle/lagos-is-expected-to-become-the-worlds-largest-city-by-2100/h8kdm47>

2.6 URBAN DEVELOPMENT

Lagos has undergone significant urbanization in recent years, leading to the creation of new residential and commercial areas. However, this expansion has resulted in various drawbacks, including inadequate public infrastructure, traffic congestion, and environmental concerns. Unregulated land use, urban sprawl, lack of affordable housing, encroachment on existing stormwater management systems, and inadequate enforcement of urban plans have resulted in frequent urban flooding, particularly in informal settlements.

To address these challenges, the Lagos State Government has launched several initiatives and policies aimed at promoting sustainable and inclusive urban growth. These include measures to increase housing affordability, promote green spaces and sustainable building practices, and support economic development and job creation through programs such as the Lagos Innovation Trust, which provides funding and assistance for start-ups and entrepreneurs.

Overall, urban development in Lagos is an ongoing and complex process that will require a range of strategies and solutions to address the challenges of rapid urbanization. With the right policies and efforts in place, Lagos can continue to grow and prosper sustainably.



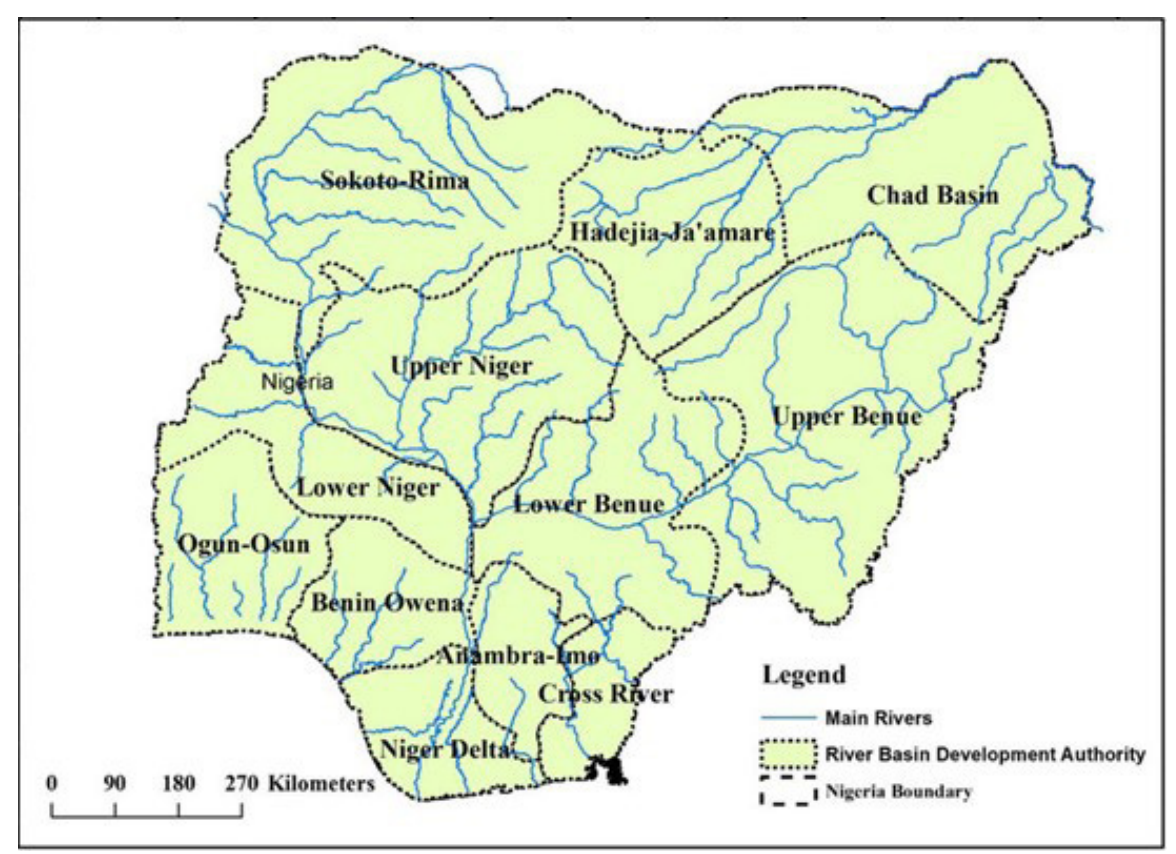
3

UNDERSTANDING LAGOS' WATER SYSTEM

3.1 OVERVIEW OF NIGERIA RIVER BASINS

The territory of Nigeria is divided into twelve river basins. The basins are divided by geopolitical lines and are managed by the River Basin Development Authorities (RBDAs), under the Federal Ministry of Water Resources in Nigeria (FMWR). The organization was established in 1970 in response to the ongoing fall in agricultural yields caused by the 1970s oil boom and the Sahel drought. Through proper

utilization and administration of the Niger river, the River Basin Development Authority (RBDA) helps in the planning, management, and development of river basins for overall agricultural, technological, economic, and social transformation in the country. ⁶



▲ Nigeria's River Basins

3.1.1 THE LAGOS RIVER BASIN

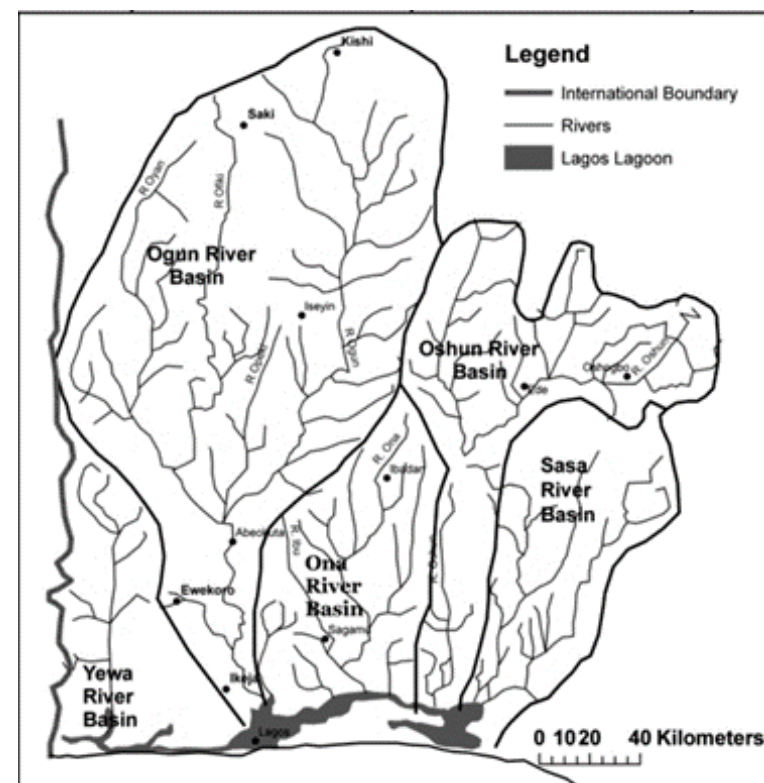
The Ogun-Osun River Basin Development Authority (OORBDA) is responsible for the management of the Ogun River, Osun River, Sasa River, Ona River, and Yewa River basins, which includes part of Lagos state. The OORBDA region spans the states of Osun, Oyo, Ogun, and Lagos and has a total land area of over 66,000km². It is drained by the Ogun and Osun rivers, as well as other tributaries and minor rivers such as the Sasa, Ona, Ibu, Ofiki, and Yewa.⁷

Data on mean annual rainfall in OORBDA over the last 30 years show a range of approximately 1,200mm in the north to approximately 2,300mm in the south. The monthly rainfall distribution shows a distinct dry season from November to March, followed by a rainy season separated into two periods: April to July and August to October.⁸

Lagos has a complex water system with both surface and groundwater supplies. Water and wetlands represent more than 22% of Lagos' total land area,⁹ and the city struggles to manage its water infrastructure. The primary river that flows into the Lagos Lagoon is the Ogun River, which starts in Sepeteri, Oyo State and runs through Ogun and Lagos States. The Yewa, Aye, Owo, Oworu, and Osun rivers are among many that flow into the Lagos lagoons. The principal lagoons and creeks in Lagos include the Lagos Lagoon, Lekki Lagoon, Ologe Lagoon, Kuramo Waters, Apapa Lagoon, Badagry Creek, Five Cowrie Creek, and Port Novo Creeks. As groundwater resources, the Lagos Water System encompasses shallow and deep aquifers.

3.1.2 OGUN RIVER BASIN

The Ogun River flows through Lagos before discharging into the Lagos Lagoon. It is a major source of drinking water for the city as it feeds



◀ The Ogun-Oshun River Basin

the city's municipal water supply system's two primary water treatment plants, Adiyen Water Treatment Plant and Iju Water Treatment Plant. The Ogun-Osun River Basin, is an important supply of water for agriculture, industry, and household consumption in the region, and supports a diverse range of habitats such as forests, wetlands, and savannas. The basin offers essential ecological services and supports many people's livelihoods in the region. The Ogun-Osun River Basin, on the other hand, is encountering a wide range of environmental challenges, including pollution, deforestation, over-extraction of water resources, and climate change.

The environmental challenges described above have a significant impact on the health and sustainability of the Ogun-Osun River Basin's ecosystem and the well-being of the people who rely on it, as well as the Lagos water system. In recent years, various efforts have been undertaken to address these issues and safeguard the long-term viability of the basin and the water system. These initiatives include implementing pollution-control measures, restoring degraded habitats, promoting sustainable land-use practices, and improving water treatment and distribution infrastructure. It is important to note that the health and sustainability of the Ogun-Osun River Basin and the Lagos water system are interdependent, and effective basin management is crucial for ensuring the long-term availability of freshwater resources for the city and its surrounding areas.

3.1.3 ATLANTIC OCEAN

The Atlantic Ocean is a crucial element in the Lagos water system. The Atlantic Ocean and the Lagos Lagoon are linked by various waterways that enable tidal water to move in and out of the lagoon. This tidal movement is critical

for the health and biodiversity of the Lagos lagoon environment, as well as for the fishing, transportation, and tourist sectors that rely on it.

On the other hand, the Atlantic Ocean poses several challenges to the Lagos water system, including pollution, coastal erosion, and saltwater intrusion into aquifers. It has a significant impact on the water system in Lagos, influencing tides, sea levels, rainfall, and ocean currents. To maintain the long-term sustainability of the city's water supplies and to safeguard the health and richness of the coastal environment, these problems must be managed effectively.

The ocean's tidal movements directly affect the tides in Lagos Lagoon and the surrounding coastal areas, which can cause fluctuations in water levels. Also, as sea levels continue to rise globally due to climate change, Lagos is facing the threat of coastal flooding and erosion. Ocean currents can also impact water temperature and water circulation in the lagoons, which in turn affects the health of marine ecosystems.

(7)*Ekeu-wei, Iguniwari & Blackburn, George & Giovannettone, Jason. (2020). Accounting for the Effects of Climate Variability in Regional Flood Frequency Estimates in Western Nigeria. *Journal of Water Resource and Protection*. 12. 690-713. 10.4236/jwarp.2020.128042."

(8)*Ewemoje, Temitayo & Ewemoje, Olusegun. (2011). Best Distribution and Plotting Positions of Daily Maximum Flood Estimation at Ona River in Ogun-Oshun River Basin, Nigeria. *Agricultural Engineering International: CIGR Journal*. 13."

(9)*BNRCC (Building Nigeria's Response to Climate Change Project), 2012. *Towards a Lagos State climate change adaptation strategy. Report prepared for the Honourable Commissioner of Environment, Lagos State.*

(10)*Oke et al. (2015) *Comparative Analysis of Groundwater Recharge Estimation Value Obtained Using Empirical Methods in Ogun and Oshun River Basins, Ife Journal of Science vol. 17, no. 1.*"



▲
The Lagos Island
Area of Lagos

3.1.4 THE LAGOS LAGOON

The Lagos Lagoon is a large estuarine system located in the southwestern part of Nigeria, bordered by the city of Lagos on the west and the Atlantic Ocean on the south. It is approximately 40 km long and varies in width from 2 km to 20 km with a total area of approximately 11,000km². The lagoon is fed by several rivers, including the Otu Creek, the Epe River, and the Badagry Creek, and feeds into the Atlantic Ocean through the narrow Bar Beach channel. It is an important resource for the local population, providing fish and other seafood, as well as serving as a transportation route. Its ecosystem supports a variety of fish, crustacean, and bird species, and it also plays a crucial role in the local economy, providing livelihoods for many people through fishing and aquaculture. The lagoon is also facing significant challenges, such as pollution from industrial and domestic sources, overfishing, and encroachment of

coastal areas, which threaten its ecological health and the livelihoods of the people who depend on it.

3.1.5 WETLANDS

Lagos is home to several valuable ecological assets, including wetlands that have undergone significant changes due to rapid urbanization in recent decades. The continued depletion of these wetlands to make way for urban development has left the city extremely vulnerable to intense rainfall, which is exacerbated by factors such as its low-lying coastal geography and weak flood control infrastructure. Additionally, the city's wetland systems and Lagoon are no longer able to effectively absorb runoff water, contributing to the recurrent flooding that disrupts social and economic activities. Lagos is home to two types of wetlands: swamps and mangroves, which serve as transitional zones between the urban

areas and nearby water bodies. To mitigate the increasing risk of flooding and biodiversity loss resulting from wetland reduction, there is a pressing need for investment in the restoration and preservation of these wetlands. By preserving these valuable ecosystems, the city's resilience to climate-related hazards can be improved.

3.1.6 GROUNDWATER

Households and industries in Lagos are the main water consumers, and due to the significant gap between water demand and supply, many rely on boreholes and wells as their primary water source.¹¹ This is facilitated by the geological composition of Lagos, which consists of sand and gravel aquifers. These aquifers are the primary source of drinking water for the population of Lagos, with four main aquifers in the sedimentary basin.

The first shallow aquifer is located along the Atlantic coast and river valleys and is primarily used for small private domestic supplies through dug wells and shallow boreholes. The second and third aquifers are located in the Coastal Plains Sands Formation and are exploited through boreholes and dug wells from private water borehole drilling companies. These aquifers provide substantial quantities of water for private, public, and industrial water supplies and are the main source of groundwater in the city. The fourth aquifer, the deep and highly productive Abeokuta formation, is only accessed by a few boreholes mainly located in the Ikeja industrial area.

While the exploitation of these aquifers currently provides a reliable and continuous means of obtaining water, unregulated abstraction poses a significant threat to the water system. Overdrafting of groundwater in coastal

locations can lead to seawater intrusion into the aquifer system, as well as pollution from sewage and industrial effluents, increasing the risk of waterborne infections. Contamination by pollutants such as chemicals, sewage, and industrial waste can render the water unfit for human consumption. Additionally, aquifers can deplete when the extraction rate exceeds the rate of recharge.

To protect the long-term interests of consumers with regard to the quality, price, and reliability of water utility services received from service providers, the Lagos State Water Regulatory Commission (LSWC) is in charge of approving and reviewing standards of performance of services and ensuring that water supply and sewage services are carried out properly. Investment in more sustainable and efficient water supply systems is needed to meet the growing demand for water in Lagos and to mitigate the negative impacts of overreliance on groundwater sources.

(11) Aladejana, J.A.; Kalin, R.M.; Sentenac, P.; Hassan, I. Hydrostratigraphic characterization of shallow coastal aquifer of Eastern Basin, S/W Nigeria, using integrated hydrogeophysical approach; implications for saltwater intrusions. *Geosciences* 2020, 10, 65.

3.2 LAGOS WATER SUPPLY INFRASTRUCTURE

Portable water supply in Lagos dates back to the construction of the Iju water works, which was commissioned in 1915 to serve the Lagos Island area. The Iju waterworks received water from the Ogun River and had a design capacity of 2.4 million gallons per day (mgd), which has now been raised to 45 mgd. As the population of Lagos increased, additional water supply infrastructure was built, including the Ishasi waterworks in 1977 with a design capacity of 4 mgd, the Adiyari waterworks with a design capacity of 70 mgd, and the Akute water intake in 1991.

Despite facing numerous obstacles, the Lagos State government has prioritized improving the city's water infrastructure. The government is committed to water supply, wastewater treatment, and water transportation and is willing to invest in new water treatment facilities and distribution network modifications. To address water scarcity, the Lagos Water Corporation developed a Lagos Water Supply Master Plan as a roadmap to increase the State's water production capacity to 745 million gallons per day by 2020. The Lagos Water Corporation (LWC) is the city's major water management and supply agency, owned and funded by the Lagos State Government. The LWC primarily extracts water from the Ogun-Oshun River Basin, purifies it, and supplies it to Lagos residents through underground distribution pipe networks.

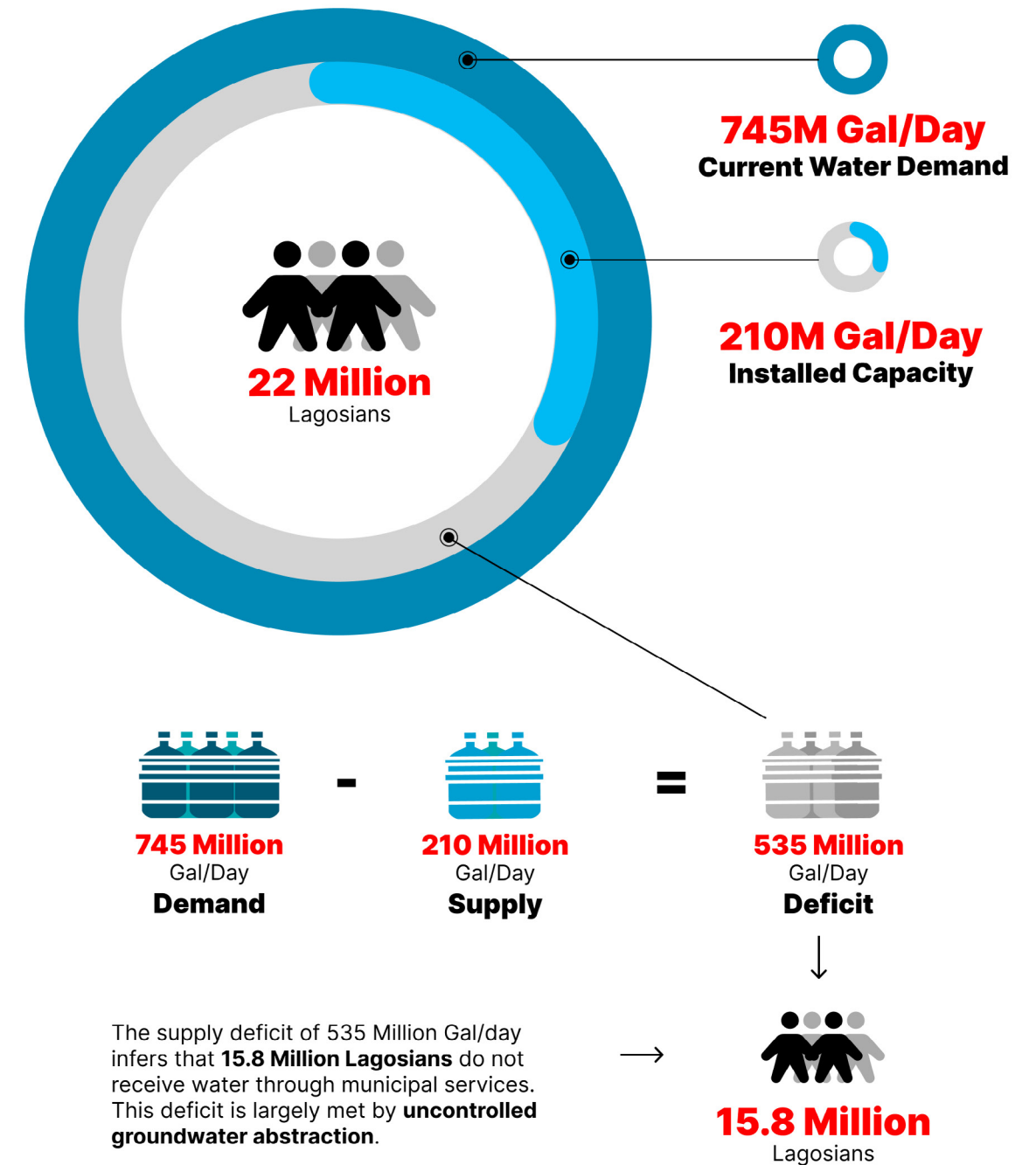
Unfortunately, a lack of investment and maintenance has led to an inadequate and unreliable water distribution system in Lagos. Water treatment plants and pipe distribution systems are poorly managed, resulting in insufficient water treatment and substantial water loss and pollution. The deterioration of the distribution network has caused many households to experience poor water pressure and extended periods without water, leading to a reliance on private boreholes and water

vendors. The LWC is now unable to meet the current water demand of over 745 mgd, and the Lagos Water Supply Master Plan estimates that upgrading and retooling the Lagos water supply systems will require US\$3 billion over a period of five years from 2020-2025.

The public water supply in Lagos faces various challenges, including insufficient revenue generation, competition for funding from other sectors, lack of private sector investment, high public debt, and the Lagos State government's limited commitment to and prioritization of water infrastructure development. Despite these challenges, the LWC operates 11 service areas, 3 major waterworks, and 48 mini/micro water works. The current total installed water production capacity in Lagos is 210 million gallons per day, significantly lower than the current demand.

To address the challenges facing the water supply sector, the Lagos State government is seeking collaboration and partnerships with private investors, strengthening the legal, regulatory, and institutional framework, and driving investment. Currently, work is underway on the second phase of the 70 mgd Adiyari water scheme, and plans are in place to begin an extensive rehabilitation of the Adiyari phase one water scheme. Additionally, the government is dredging the Ogun River to ensure a sufficient supply of raw water to the waterworks. With the growing population of Lagos, there are significant opportunities for private investment in the water supply sector, and the Lagos State government is committed to addressing the challenges and improving the water supply infrastructure.

Water supply- demand disparity in Lagos state.



3.3 TRANSPORTATION, SHIPPING & LOGISTICS

Water transportation in Lagos has immense potential, thanks to the city's close proximity to the Atlantic Ocean, as well as the presence of several lagoons and creeks. Given the ongoing traffic congestion that has plagued the city, water transportation has gained increasing attention in recent times. Both commuters and tourists can benefit from the ferry boats and speed boats that are available as services in the water transportation sector.

Currently, water transport is carried out by both formal and informal vessels, which transport passengers and goods. However, informal vessels face operational challenges, such as high fuel prices and limited schedules. The Lagos State Waterways Authority (LASWA) is responsible for overseeing water transport in Lagos. They supervise operations on the 12 water transport routes in Lagos. To further promote water transportation, the Lagos State government is constructing nine additional jetties across the state.

Despite the progress made in the sector, it still faces certain challenges, such as the prevalence of hyacinths that block navigable paths, and shallow rivers that are not suitable for larger ferries. Safety is also a major concern for residents of Lagos, as boat mishaps caused 147 deaths between 2006 and 2015. This underscores the need for stronger regulation and continued investment in the water transportation sector in Lagos.

3.3.1 SEAPORTS

Lagos state boasts three seaports of the total of seven in Nigeria. The first and largest, the Lagos/Apapa Port, is situated near the Bight of Benin in the Apapa area of Lagos State, which serves as the economic hub of Nigeria. Also known as the Premiere port, this port is the oldest and largest in the country, offering unparalleled land area and cargo handling volume.

Located to the west of Apapa and adjacent to the Lagos Port Complex, the Tin Can Island port is the second busiest in Nigeria. Established in 1975 to accommodate the growing import and export trade that emerged following the oil boom in Nigeria, this port was constructed to alleviate congestion at the Lagos port by diverting excess cargo.

The Lekki Deep Sea Port is the newest of the three, currently operational but still under construction. Located in the Lagos Free Zone, this multi-purpose, deep seaport is the largest in Nigeria and one of the largest in West Africa. With an expected capacity of approximately 6 million TEUs of containers and a significant volume of liquid and dry bulk non-containerized cargoes, this port is equipped to handle ships that can transport over 14,500 containers per day. The port is financed by private investors and a consortium of banks who have contributed \$1.5 billion as of March 2021 to the project's funding.

3.4 AGRICULTURE

Agriculture plays a significant role in the city's water system and at the same time, water is a critical input for agricultural production and plays an important role in food security. This puts pressure on the city's water resources and leads to competition for water between different sectors. Agricultural activities also have a significant impact on the quality of the city's water resources. i.e., the use of chemicals such as pesticides and fertilizers can contaminate the water, reducing its quality and making it unsuitable for drinking and other uses.

However, the role of agriculture in Lagos city's water system and its contribution to food security is not significant due to the limited availability of arable land and the rapid urbanization of the city. According to the Lagos State Ministry of Agriculture, the state has a total land area of 1,171 km², of which only about 22% is arable land. The state government has made efforts to promote agriculture through various programs and initiatives, including the establishment of the Lagos State Agro-Processing, Productivity Enhancement and Livelihood Improvement Support (APPEALS) project, which aims to improve agricultural productivity and increase access to markets for farmers.

Flooding is a major challenge faced in Lagos, and the agricultural sector is directly linked to this. Improper land and soil management can lead to flooding. Flooding can also cause damage to crops, homes, and infrastructure, and increase the risk of water-borne diseases. While contributing to soil erosion, agricultural activities can have a negative impact on the quality of the city's water resources. Eroded soil can clog waterways and reduce the capacity of water reservoirs, leading to reduced water availability and increased water quality problems. The sector is also vulnerable to the impacts of climate change leading to water scarcity, thereby creating a negative impact on agricultural productivity and the local economy.

While agriculture may not be a significant contributor to Lagos city's water system and food security, the state government recognizes its importance and has made efforts to support the sector.

3.5 DRAINAGE

Drainage is a major issue, due to the city's rapid population growth and urbanization. Lagos, experiencing high levels of rainfall, is dependent on effective drainage as a critical component of its infrastructure. However, the city's inadequate drainage systems have resulted in frequent and severe flooding, causing damage to properties, crops, and infrastructure, and putting the lives of residents at risk. The causes of the drainage problems in Lagos are complex and include factors such as poor urban planning, lack of investment in infrastructure, illegal construction on waterways and wetlands, and the indiscriminate disposal of solid and liquid chemical wastes in the drainage system. Climate change and sea level rise are also contributing to the worsening of the drainage situation in Lagos.

To address the drainage issues in Lagos, the government has implemented several initiatives, including the construction of new drainage channels, the rehabilitation of existing channels, and the development of flood early warning systems. The government has also implemented policies to regulate development and control land use, such as the prohibition of construction on waterways and wetlands. However, much more needs to be done to fully address the drainage problems in Lagos. In addition to government action, the private sector, non-governmental organizations, and local communities must work together to improve the drainage systems and reduce the risk of flooding, which costs the city as much as \$4 billion per year in terms of damages, economic productivity and mortality¹².

(12) <https://reliefweb.int/report/nigeria/technical-report-lagos-floods-interconnected-disaster-risks-20212022>

3.6 WATER SUPPLY, SANITATION AND PUBLIC HEALTH

The water supply and sanitation infrastructure of Lagos is grossly inadequate and unable to meet the needs of its rapidly growing population. This results in public health crises that pose serious threats to the well-being of residents and the city's future. One of the biggest challenges facing Lagos is the lack of access to safe drinking water. According to recent estimates, less than 40% of residents have access to safe drinking water, while the rest are forced to rely on contaminated sources or buy water from private vendors. This lack of access to safe drinking water is a major contributor to the high rates of water-borne diseases, such as cholera, dysentery, and typhoid, that are common in the city.

In addition to the lack of access to safe drinking water, the city's sanitation infrastructure is also inadequate. Less than 50% of residents have

access to adequate sanitation facilities, and most of the city's sewage is not properly managed. This has serious consequences for the health of residents and the city's water bodies, which are being polluted with dangerous chemicals and pathogens.

The inadequate water and sanitation infrastructure in Lagos can be attributed to several factors, such as poor planning and inadequate investment. To address these challenges and improve the city's water and sanitation services, it will be necessary to take a multi-faceted approach that addresses the root causes of the crisis. An example is increasing investment in the city's water and sanitation infrastructure. This will require increased funding from the government, as well as support from international organizations and the private sector.

Adiyon Water Treatment Plant, Lagos



In addition, it will be important to improve the management and governance of the city's water and sanitation services, to ensure that resources are being used effectively and efficiently. Another important step is promoting public education and awareness about the importance of safe drinking water and adequate sanitation. This will include educating residents about the dangers of drinking contaminated water, the importance of using proper sanitation facilities, and the role they can play in improving the city's water and sanitation services.

Finally, it will be important to work with communities to develop community-based solutions to the city's water and sanitation challenges. This can include supporting community-led initiatives to improve water and sanitation services, as well as engaging communities in the planning and implementation of water and sanitation projects. The water and sanitation crisis in Lagos is a major challenge that requires urgent action. Improving the city's water and sanitation services will require increased investment, improved governance and management, public education and awareness, and community-based solutions. By addressing these challenges, it can be ensured that residents have access to safe drinking water and adequate sanitation, and help to build a healthier, more sustainable future for the city.



3.7 WASTEWATER

Lagos State is a vital hub for Nigeria's manufacturing industry, accounting for a significant 40% of the country's manufacturing output. However, this development comes at a cost to the environment, with industrial pollution discharged directly into the Lagos Lagoon. Domestic waste disposal is also a pressing concern, as sewage is often collected and disposed of in locations north of Lagos Island, Ikoyi, and Victoria Island. Additionally, during the rainy season, a substantial amount of oil from stormwater and river discharges reaches the lagoon. To tackle this issue, the Lagos State government has taken steps to enforce pollution control measures to minimize the discharge of harmful pollutants.

A recent study conducted by the University of Lagos found that the borehole water samples taken from the campus contained inorganic ions, nutrients, and trace elements that exceeded drinking-water standards. Saltwater intrusion from the surrounding lagoon has also affected the coastal aquifer beneath the university campus. Similarly, a separate study of 30 shallow wells in Lagos revealed that water from these wells exceeded minimal international and local water quality criteria in at least one parameter.

Several samples contained E. Coli bacteria, indicating contamination from faecal matter caused by septic tanks located too close to the boreholes. It is essential to treat drinking water taken from groundwater sources in certain areas of Lagos to prevent serious health risks.

Waterborne diseases pose a significant health threat to the Nigerian population. The World Bank's Water and Sanitation Program (WSP) estimated that premature deaths due to water-related illnesses cost Nigeria N445 billion in 2012.¹³ The country spent approximately US\$190 million on health services for diarrhoeal illness and related diseases such as malnutrition. Diarrhoea is a common ailment caused by contaminated water and accounts for 9% of under-five mortality in Lagos. Cholera epidemics are also common in the state, with 252 cases reported in 2008 alone. Investing in effective water and sanitation services is crucial to improving public health outcomes in Lagos State.

(13) <https://documents1.worldbank.org/curated/en/855961468297356898/pdf/681260WSP0ESI0000Box367907B0PUBLIC0.pdf>



4

CHARACTERISING
RESILIENCE

Resilience in cities is the ability to absorb, recover, and prepare for future shocks and stresses (economic, environmental, social, and institutional) that impact its sustainable development. In the context of water, "resilience" refers to a city's ability to effectively manage its capacity to endure, adapt, and transform its water resources. In the case of Lagos, Nigeria, a coastal metropolis with a fast-growing population, climate change, population growth, inadequate infrastructure, economic and political instability, and environmental degradation all put a stress on the city's water resources.

Resilience requires cities to reduce vulnerability to shocks and stresses. According to a recent Environews Nigeria report, despite being in existence for almost 100 years, over 80% of Lagos residents lack access to public water supply¹⁴ - and even then, the available water may not be safe to drink. The implications of this extend beyond public health, as they have a ripple effect on economic growth and worsen the problem of poverty.

To develop effective strategies for providing clean water to Lagos residents, protecting them from water-related hazards, and improving the city's water transportation infrastructure, it is crucial to understand the key shocks and stresses that impact water resilience in Lagos. However, cities typically face a combination of acute and chronic challenges that greatly influence their water resources. Chronic stresses, primarily caused by climate change, can exacerbate existing risks and lead to the emergence of new risks. The following are some of the major shocks and stresses affecting the city's water system.

(14) 1. Simire, M. "Over 80% of Lagosians lack access to public water supply - Report - EnviroNews Nigeria," 2022.

4.1 KEY WATER-RELATED SHOCKS FACED BY THE CITY

4.1.1 FLOODING

Lagos is prone to frequent floods due to its coastal location and poorly maintained drainage infrastructure. To avert flooding disasters in the state, the Lagos State Emergency Management Agency conducted a flood risk assessment adopting an integrated system combining remotely sensed data and GIS. The topography of Lagos State spans between above 70m to below sea level. The lowest point in the state is located in Lagos Island, making this area the most vulnerable to floods. The report also shows that almost 1000km², nearly 30% of total land area of Lagos State, is at a high risk of flooding.

Low-lying urban areas, informal settlements, and slums that house impoverished and marginalized communities are more vulnerable to flooding, as they often lack proper infrastructure and sanitation facilities. The temporary housing in these areas exacerbates the effects of floods, putting residents at risk of drowning, exposure to

contaminated water, and the spread of water-borne diseases. The impact of floods on Lagos inhabitants' health and safety is a significant concern.

Flooding poses a significant threat to water resilience in Lagos, and it is linked to other challenges such as rising sea levels, uncontrolled urbanization, inadequate infrastructure management, ineffective wastewater treatment, and climate change. These challenges have far-reaching implications beyond the immediate flooding in the city and will be further explored in the following sections.

(15) Lagos State Emergency Management Agency (LASEMA) 2022, *Flood Vulnerability Assessment and Mapping of Lagos State Using GIS Technique*



Poorly Managed/Inexistent Drainage Systems

The most common cause of flooding in Lagos during rainstorms is the lack of proper drainage systems, which are either poorly maintained or non-existent. In many parts of the city, rectangular or trapezoidal open channels and wide-spanning canals are the prevailing drainage systems. However, these systems are often clogged with waste, which is largely attributed to poor solid waste management practices in various areas of the city. Drainage blockages have become a major issue in Lagos due to the absence of covers and a lack of maintenance culture for most of the drainage systems.

Rapid Loss of Blue and Green Infrastructure

Grey infrastructure, such as buildings and roads, blue infrastructure, such as water bodies, and green infrastructure, such as trees and parks, are commonly used terms in urban and land-use planning. However, the encroachment of critical blue and green infrastructure in Lagos has become a serious and pressing issue due to the rapid and uncontrolled urban development, combined with the impacts of climate change. This has resulted in negative consequences for the environment and public health.

The increased amount of grey infrastructure, such as roads and buildings, has reduced the surface area for water absorption and led to rapid runoff, causing flooding during storms.

The unregulated growth and expansion of the city has also resulted in the loss of wetlands, lagoons, and beaches, leading to water quality degradation, increased risk of flooding, and loss of important habitats for wildlife. These areas play a critical role in managing water resources and maintaining the health of aquatic ecosystems. Moreover, the conversion of agricultural land to urban uses has resulted in the loss of green areas and flora, worsening water shortages and placing pressure on food security. Green infrastructure in Lagos provides critical ecosystem services such as water retention, air filtration, and carbon sequestration, and its loss has major consequences for the city's and its citizens' health.

The consequences of urbanization and the loss of essential blue and green infrastructure have been worsened by rising sea levels due to climate change. This makes it more challenging for the city to meet the needs of its fast-growing population while reacting to the effects of climate change. Therefore, the encroachment of vital blue and green infrastructure in Lagos is a huge and critical issue that requires urgent attention to prevent negative consequences for water management, the environment, and public health.

Dam Release

Flooding in Lagos is compounded by the discharge of substantial amounts of water from nearby municipal dams into the Lagos Lagoon and its tributaries. As river levels rise to precarious heights, they breach their banks and inundate low-lying regions in neighbouring cities, including areas of Lagos. This type of flooding has caused widespread damage to communities and infrastructure. The surplus water discharged from the multipurpose Oyan Dam reservoir, which spans the Oyan River, a tributary of the Ogun River in Ogun State, is a major cause of flooding in several towns, particularly the Isheri community located along the Lagos-Ibadan expressway.

4.1.2 DISEASE OUTBREAK

One of the foremost challenges that affect water resilience in Lagos is disease outbreaks. The Lagos State Ministry of Health reports that the city has experienced several disease outbreaks in recent years, including cholera, Lassa fever, and the COVID-19 pandemic. These outbreaks often lead to an upsurge in demand for water as individuals seek to maintain good hygiene to prevent the spread of disease. However, the increased demand can exert pressure on the already strained water supply and distribution systems, given the city's dense population.

Moreover, a lack of access to clean water can exacerbate the spread of diseases during an outbreak. For instance, in the context of Lagos and the COVID-19 pandemic, people may resort to using contaminated water sources for their daily needs, which further compounds the spread of the disease. Disease outbreaks can have significant economic and health impacts on the city. The Lagos State government had to allocate millions of dollars to tackle the COVID-19 pandemic in 2020, which diverted resources away from critical areas such as water infrastructure investment and maintenance.

4.2 KEY WATER-RELATED STRESSES FACED BY THE CITY

4.2.1 LACK OF INVESTMENT IN INFRASTRUCTURE AND SERVICES

In recent years, a major challenge in Lagos has been a lack of capital investment in water-related infrastructure. This is due to a variety of factors, the most important of which being political and economic instability. The situation has hampered investment and generated uncertainty for investors not just within Lagos, but Nigeria as a nation. The country's general economic instability has resulted in a decline in foreign investment and funding for infrastructure projects, including water and sanitation services. This instability has been worsened by variations in the crude oil price, which is a major source of funding for the government. The government has continually sought to prioritize other sectors where resource demand is reduced, such as transportation and housing.

Further major contributors to the lack of investment include the absence of a sector policy with clear mandates and a lack of workable Public Private Partnership models. There is a need for sector laws that guarantee the security of investments and minimise the interference in tariff setting to protect the cost-recovery of investments.

4.2.2 ERRATIC POWER SUPPLY

Water and energy are interdependent. The interdependency of water and energy is set to intensify in the coming years, with significant implications for both energy and water security. Each resource faces rising demands and constraints in many regions because of economic and population growth, as well as climate change.¹⁶ Energy is essential for almost every aspect of water supply, from water production, pumping, distribution, treatment, desalination, and recycling, to make it available for human consumption and use. In Lagos, the

most significant infrastructural and development challenge is the supply of electricity. Lagos solely depends on Nigeria's national grid for public energy supply and receives an average of 1,000MW from two distribution companies, Eko and Ikeja, for slightly over 12 hours a day.

Power outages as a result from the erratic supply have a direct impact on water supply, causing disruptions to the service. This has led to several instances of the Lagos Water Corporation facilities failing to operate to capacity, for example at Lekki, Saka Tinubu and Alexander treatment plants. At a time when both energy and water are under increasing stress, viewing both holistically adds tremendous value: water saved translates to energy saved, and energy saved means water saved.

4.2.3 INADEQUATE HEALTH SYSTEM

The health system in Lagos State is a complex mix of public and private providers, with a focus on primary healthcare delivery. The Lagos State Government has made efforts to improve the health system by increasing funding, building new health facilities, and hiring more healthcare workers. Despite these efforts, the health system still faces challenges such as inadequate infrastructure, shortage of healthcare personnel, inadequate funding, and limited access to essential medicines and equipment. The system is overwhelmed, with long wait times and overcrowded facilities. The health system also faces challenges such as inadequate public health education and awareness, leading to the spread of preventable diseases. The health system struggles with the prevalence of infectious and non-communicable diseases, with limited access to care for those in need. These factors combined make it difficult for the health system in Lagos to provide quality care to the people, particularly those in less developed areas, resulting in poor health outcomes.

According to UNICEF Nigeria, poor access to adequate water and sanitation remains a major contributor to high morbidity and death rates among children under the age of five in the country. The use of contaminated drinking water and inadequate sanitary conditions increase vulnerability to water-borne diseases, including diarrhoea, which kills more than 70,000 children under the age of five each year.

4.2.4 GROUNDWATER OVER EXPLOITATION AND CONTAMINATION

Groundwater over-exploitation is a significant challenge in several areas of Lagos, where private boreholes and wells extract water for drinking, agriculture, and other purposes. However, as water demand increases, groundwater supplies are being depleted at a faster rate than they can be replenished. This over-extraction has led to reduced water quality, diminished water supply, and land subsidence, impacting the health and well-being of the local population. Managing groundwater resources is crucial for sustainable access to this essential resource and building water resilience in the long term.

Pollution of groundwater aquifers is a growing concern in Lagos, threatening the health and well-being of both people and ecosystems. Sewage, industrial waste, septic tanks, and chemicals from surface and subsurface pipelines are polluting the city's groundwater, notably on Lagos Island, leading to poor water quality and rendering it unsuitable for human consumption and other purposes. Population growth and inadequate investment in waste management and water treatment facilities exacerbate these issues. Addressing groundwater pollution is crucial to ensure access to safe water and preserve the health of the environment and people in Lagos.

4.2.5 INADEQUATE PUBLIC WATER SUPPLY SYSTEMS

At least 50% of the water supply to the Lagos public water network is provided by two major waterworks, Iju and Adiyin, which are managed by the Lagos Water Corporation (LWC). In addition to these large plants, a number of minor and micro waterworks have been constructed across the city since 1980. There are currently 4 major water treatment plants and 48 mini/micro waterworks, with a combined maximum capacity of approximately 210mgd. However, it is reported that the overall production capacity utilization is less than 60% due to power shortages and maintenance concerns. Beyond these, a lack of maintenance and investment has made these plants inadequate and unreliable for public supply. Other systemic issues that have contributed to the underutilization of Lagos State's water treatment plants and micro waterworks are aging infrastructure, poor maintenance, inadequate funding, inefficient operations, water wastage, and population growth.

Boreholes and wells provide a large fraction of the population's primary water source. With a gap between supply and demand estimated at 407 mgd, LWC provides a geographic network coverage of only about 44% of the State. Given this, their services are only available to approximately 10% of the State's population, either through standpipes or connections to individual residences. Boreholes, shallow or open wells, water tankers, and water sellers are the main sources of supply for households without network connection. According to a UN-Habitat assessment that examined drinking water availability by income level, less than 1% of families in the "extremely poor" category in Lagos State have connections to piped water.

Despite this, only a small portion of homes treat their drinking water, emphasizing the significance of preventing aquifer water contamination. Households of all income levels, particularly the poor in slum settlements, are frequently forced to choose between polluted wells and expensive alternatives such as water tankers and street vendors. The Nigerian open data portal presents these wells as the foremost water supply source by percentage for households in Lagos at 34% while tanker's supply to an average 15% homes.

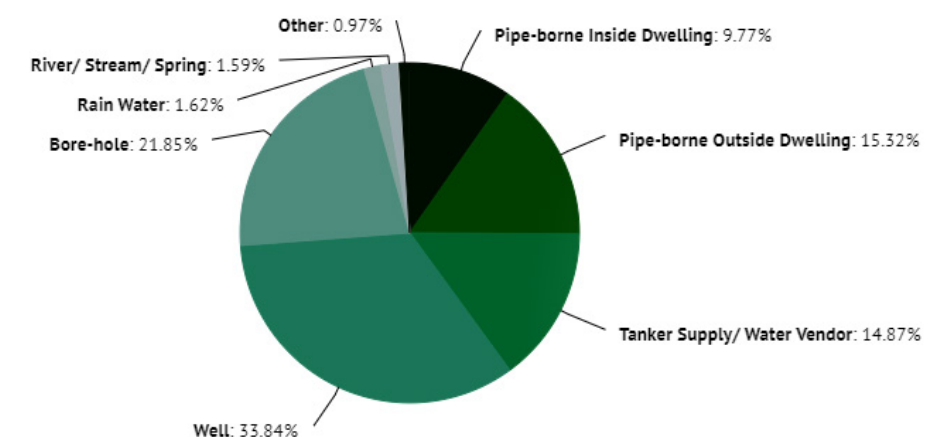
The price of water sold by water tankers in Lagos varies depending on the location, distance, and demand. However, on average, water tankers in Lagos sell water at a price range of N1000 to N5000 per 1000 litres. The cost can be higher or lower depending on the factors mentioned earlier. The LWC sells water to its customers at different rates depending on the volume of water consumed irrespective of location.

In Lagos, one tanker truck of water is fourteen times more expensive than piped water. Other sources have stated that water tankers can charge up to 500% more per litre than the LWC tariff. The Lagos state administration met violent opposition when it planned to expand the LWC's water network into regions where water tankers operate. The 'Water lords' have also been known to vandalize the water network to protect their business model.

Private individuals and companies own water tankers in Lagos state and utilize them for business purposes to provide water to houses and commercial establishments. Because they are not required to divulge their ownership information, the owners of these tankers remain unknown to the general public. The Water Distribution Committee (WDC) of the Lagos State Water Regulatory Commission monitors the activities of private water tanker operators in the state on behalf of the Lagos State Government. The Commission is responsible to ensure that water tankers meet safety and quality standards, as well as that they serve individuals and businesses with clean and drinking water.

The Lagos State Water Corporation (LWC) is in control of the state's water supply pricing and billing. Under the LWC's metered billing system, customers are charged based on the amount of water they use. The LWC also includes a consumption-based pricing system, with higher fees for users who use more than a certain amount. There is lack of reliable data on water allocation percentages across industries and water pricing schemes in Lagos. The fragmented nature of Lagos' water business, combined with a scarcity of reliable data, makes giving specific information on these challenges difficult.

Distribution of Households by Main Source of Water Supply in Lagos, 2006
Source: The Nigerian Bureau of Statistics, Nigerian Open Data Portal



4.2.6 POLLUTION

Domestic waste, plastics, sewage, storm water runoff, and a significant number of pollutants from manufacturing industries are discharged into the Lagos Lagoon daily. These pollutants have contributed to the lagoon's degradation and caused both physical and chemical changes in the water, making it visibly green and full of debris.

This water contamination is causing a range of health problems for the residents and depleting its value. This has also resulted in widespread water-borne diseases, particularly in low-income communities that lack access to clean water and proper sanitation facilities such as the Makoko floating settlement. The failure to effectively manage sewage in Lagos has created an environmental hazard that threatens the well-

being of the city's residents and undermines its economic development. The situation is dire and requires immediate action by the government, private sector, and local communities to address the issue and ensure the long-term sustainability of Lagos' water security and sanitation.

Beyond pollution of surface water, studies have shown that water from boreholes and shallow wells in Lagos often fails to meet drinking water standards, with high levels of inorganic ions, nutrients, and trace elements, as well as the presence of bacteria like E. coli, indicating contamination from pollutants and sewage. These findings are a cause for concern, as drinking water from groundwater sources in some parts of Lagos poses a significant health hazard.



4.2.7 OVERLAPPING RESPONSIBILITIES BETWEEN AGENCIES/MINISTRIES

The complex and overlapping responsibilities of agencies and ministries have resulted in an inefficient and convoluted system for water resilience in Lagos. The fragmentation of the water sector is characterized by the existence of different institutions with conflicting mandates, leading to poor coordination, conflicting policies, and limited progress towards sustainable water management. One example of this fragmentation is the confusion among private sector operators and residents regarding who to contact for wastewater infractions between the Lagos State Wastewater Management Authority and the Lagos State Water Regulatory Commission.

In addition, several agencies have created departments within themselves critical to various sectors, leading to duplicated functions and lack of collaboration with higher MDAs. For instance, while the Ministry of Health and Ministry of Infrastructure are responsible for health and infrastructure matters in schools respectively, agencies such as the State Universal Basic Education Board (SUBEB) have sub-departments of health and infrastructure without adequate coordination with the higher MDAs.

4.2.8 CLIMATE CHANGE

The city's rapidly growing population and its location on the coast makes it particularly vulnerable to impacts, including rising temperatures, sea level rise, air pollution and increased rainfall variability. These changes have implications for water availability, water quality, and infrastructure resilience. Water is involved in all components of the climate system (atmosphere, hydrosphere, cryosphere, land surface and biosphere). Therefore, climate change affects water through a number of mechanisms. Water supply services are highly

vulnerable to drought, extreme precipitation, and sea level rise.

Recently, the Climate Systems Analysis Group of the University of Cape Town developed two climate change scenarios for the Building Nigeria's Response to Climate Change (BNRCC) project. Nigeria is likely to experience a warmer climate in the future. However, areas near the coast are expected to warm up at a slower rate. Nigeria is likely to experience an increase in warming from 1.4 °C to 5.8°C through the period of 1990 to 2100 . This national increase in atmospheric temperature and an increase in surface water temperature may also cause decreased flows in Ogun/Osun River Basins caused by longer and more frequent dry seasons; and a reduction in dissolved oxygen content, mixing patterns, and self-purification capacity leading to increases in algal blooms. The depletion of groundwater reserves is anticipated to continue beyond the mid-century, according to projections, leading to a reduction in groundwater storage . This may exacerbate the issues of saltwater intrusion and subsidence.

The increase in temperature is predicted to have several impacts on the availability, quality, and accessibility of water, and it could also have significant health and economic impacts. For one, the increase in temperature is expected to lead to increased water demand for agriculture and increased pest infestation, food storage losses, higher rates of evaporation and algal blooms that could threaten water quality.

Sea level rise

With rising global temperatures, melting glaciers, and expanding seawater, the Lagos coastlines have become increasingly vulnerable to the impacts of sea level rise, a complex and challenging issue which has led to flooding, coastline erosion, and saltwater intrusion. Addressing it requires a multi-faceted approach

that incorporates investments in infrastructure, planning and zoning, and environmental conservation measures. The problem is exacerbated by factors such as land subsidence, urbanization, and inadequate shore protection infrastructure. The consequences of coastal sea level rise in Lagos are becoming far-reaching.

By the end of this century, global sea levels are projected to rise between 1.3 to 1.6m . This puts Lagos in a precarious position given that a significant portion of its coastline is low-lying. In a 2012 study, the University of Plymouth, UK, estimated that a sea-level rise of 1-3m “will have a catastrophic effect on human activities” in Nigerian coastal environments. Sea level projections for the region of Lagos in the most recent Intergovernmental Panel on Climate Change (IPCC) report shows that by the year 2100, the city will experience a 54-cm sea level rise under the RCP4.5 scenario and a 75-cm rise under the RCP8.5 scenario (worst case).

Saltwater intrusion

Saltwater intrusion is a challenge for the city, being a direct impact of over abstraction, geological factors, human activities and sea levels rising. This is having a significant impact on the availability of salt-free drinking water and the livelihoods of residents. In addition, the

increased salinity of the water is causing harm to crop, fishes, and other aquatic species, further exacerbating the economic and food security impacts of the problem. Given the growing threat posed by saltwater intrusion in Lagos, it is important that effective and sustainable solutions be implemented to protect the city's water supply and secure access to clean water for its residents. To tackle this problem, several solutions can be implemented, including the construction of coastal protection measures like seawalls and mangroves, the implementation of sustainable water management practices to reduce over-extraction of groundwater, the development of alternative water sources such as treated wastewater and rainwater harvesting, raising awareness about the issue, and government intervention through funding and regulation.

Changing precipitation patterns

Although climate change is predicted to result in less rain overall in Lagos, the intensity of the rain during each occurrence is predicted to rise, increasing the danger of floods . These shifts in precipitation may result in changes in water availability and a reduction of stored water in Lagos Water Corporation's Adiyari and Iju reservoirs, fed with seasonal rivers and increased evapotranspiration which will reduce



water availability and result in salinisation of water resources and lower groundwater levels. Lagos is known to have a high concentration of impervious sandy surfaces and limited blue-green infrastructure. These factors combined with the predicted increased precipitation intensity from climate change, can overwhelm the current drainage systems in the state again resulting in flooding, which not only damages property but also threatens lives.

4.2.9 HIGHLY VULNERABLE GROUPS

Despite its potential for economic growth, Lagos is faced with a multitude of challenges, including poverty, poor living conditions, and limited access to basic services such as education, healthcare, and infrastructure. The urban poor, who predominantly reside in informal settlements and slums such as Makoko, Ajegunle, and Ijora, are among the most vulnerable groups in Lagos. These areas are characterized by overcrowding, poor sanitation, and limited access to basic services, which increase the risk of disease outbreaks and the spread of infections. In addition, residents of these areas are often exposed to environmental pollution, such as air and water pollution, which can have long-term health effects.

Women and children in Lagos are particularly vulnerable due to their limited access to basic services. Women often bear the burden of household responsibilities, particularly childcare, which can limit their access to education and job opportunities, leading to poverty and poor health. Similarly, children are vulnerable to malnutrition, poor health, and limited access to education. The elderly in Lagos also face challenges, such as limited access to healthcare and social isolation, while people with disabilities often face barriers to accessing basic services and facilities.

Small business owners in Lagos are economically vulnerable, with the COVID-19 pandemic and related lockdowns having a significant impact on their operations. The city's rural farmers, who rely on agriculture for their livelihoods, are also at risk due to the conversion of farmland and natural resources to urban development projects, leading to limited access to land and water resources.

5

WATER GOVERNANCE

Governance of water in Lagos is quite complex, as it spans the boundaries the different existing governmental levels in Nigeria and supporting agencies. The federal, state, local governments, international funders, civil societies, and river basin authorities are just some of the different levels of government and other stakeholders that have direct or indirect influence over the water system. In Nigeria, the federal, state, and local governments all share responsibility for water provision. The management of water resources falls under the jurisdiction of the

federal government, state governments are primarily in charge of providing water to cities, and local governments and communities are in charge of providing water to rural areas . These governmental levels are responsible for the overall management and regulation of the water sector, however other stakeholders including civil society organizations and local communities also play an important role in advocating for better access to water and providing innovative solutions, such as community-managed water systems.

5.1 FEDERAL GOVERNANCE

At the national level in Nigeria, there are a number of governing bodies responsible for water management. These governing bodies are responsible for formulating policies, providing oversight, and ensuring compliance with regulations in the water sector. The Federal Executive Council (FEC) is the highest decision-making body in Nigeria's Federal government and is responsible for setting national policies and programs for water resources development and management. The FEC is responsible for approving major water projects and policies proposed by the Federal Ministry of Water Resources (FMWR) and other water sector agencies.

The Federal Ministry of Water Resources (FMWR) is the primary agency responsible for water governance in Nigeria. The FMWR is charged with the development, management, and regulation of water resources in Nigeria. The agency is also responsible for the formulation and implementation of policies, programs, and projects for the development, management, and utilization of Nigeria's water resources . This includes planning and execution of water resources projects across the country, as well as construction of dams, irrigation systems, and water supply schemes.

In addition, the FMWR is responsible for the regulation and monitoring of water use in Nigeria. The agency develops and enforces regulations and standards for the use of water resources, and it also monitors the quality and quantity of water resources to ensure compliance with these regulations. The FMWR also collaborates with other stakeholders in the water sector, including state governments, River Basin Development Authorities, and private sector players, to promote sustainable water governance and the efficient use of water resources in Nigeria. Through these collaborations, the agency can leverage

resources and expertise from various sources to improve water governance in the country.

In May 2007, the FEC approved the establishment of the Nigeria Integrated Water Resources Management Commission (NIWRMC). The Commission is tasked with assisting the FMWR to regulate and control the rights by all persons to develop and use water resources shared by more than one state. The Nigeria Integrated Water Resources Management Commission is responsible for regulating policies, ensuring safety and quality, issuing licenses, monitoring license holders, reporting on performance and charges, conducting studies, receiving and investigating complaints, protecting consumers, facilitating technical assistance, and performing other functions related to the development and management of water resources in Nigeria.

In addition to the above, several agencies have been made available to support the NIWRMC. These institutions include the Water Resources Regulatory Commission, Catchment Management Offices and Committees/ River Hydrological Area Organization, the National Council of Water Resources, Nigeria Hydrological Services Agency, River Basin Development Authorities, the National Water Resources Institute, the National Environmental Standards and Regulations Enforcement Agency, the Nigerian Meteorological Agency, the National Inland Waterways Authority and the Federal Environmental Protection Agency (FEPA). While some of these institutions are already established, their roles, operational boundaries, and responsibilities need to be reviewed to consider the proposed Catchment Management Offices and Committees.

5.2 STATE GOVERNANCE

Within Lagos State, the main water governance actors are the Ministries, Departments and Agencies.

The core institutions at this level include:

- Lagos State Ministry of Environment and Water Resources (MOEWR)
- Lagos Water Corporation (LWC)
- Lagos State Water Regulatory Commission (LSWRC)
- Lagos State Wastewater Management Office
- Ministry of Waterfront Infrastructure Development
- Lagos Waste Management Authority
- Lagos State Environmental Protection Agency
- Environmental Sanitation Corps Agency

MOEWR is the body responsible for initiating, formulating, and implementing policies as well as coordinating environmental programs in the State. The Lagos Water Corporation is the government-owned utility in charge of developing, operating, and maintaining Lagos' water supply system across eight regions and 31 zones. The agency primarily serves Lagos State's urban areas. The Lagos State Regulatory Commission (LSWRC), established by the Lagos Water Sector Law of 2004, began operations in 2012. The regulatory body regulates and controls water and wastewater activities in Lagos State (such as extraction, production, use, tariff approval) to ensure the provision of "efficient, qualitative, affordable, and sustainable water supply and wastewater management services" as well as the financial sustainability of the water and sanitation agencies. LSWRC is also responsible for monitoring potable water quality in within state.

The Lagos State Wastewater Management Office is responsible for providing and maintaining a sewer system within the state. It also makes provisions for on-site sewage collection systems and ensure that the contents of these systems are properly disposed of through sewage disposal works. Additionally, they are tasked with preparing development plans for the establishment and upkeep of public wastewater and sewerage services in the state. Lagos State Environmental Protection Agency (LASEPA), which was established in 1996, is responsible for maintaining the quality of groundwater and surface water sources. The Ministry of Waterfront Infrastructure development in Lagos, created in 2007, is charged with ensuring the development of the waterfronts and protection of shorelines across the state.

5.3 LOCAL GOVERNANCE

Local governments have been rendered mostly administrative with minimal influence as representative local government entities, because many local services are delivered by the state. Within the Ministry of Environment and Water Resources, the Rural and Sanitation Unit under the Office of the Drainage & Water Resources focuses on providing water for the rural communities Ministry of Local Government & Community Affairs are also key service providers in the water who deliver water and sanitation infrastructure and services in some peri-urban communities in Lagos .

Community Development Associations also exist within the state which play a critical role in water governance through water user associations, and youth groups that are responsible for managing and maintaining community water infrastructure, such as boreholes, wells, and water tanks. They may also be responsible for mobilizing community members to contribute to the financing of water infrastructure and services. There are also water vendors who sell water to households and communities. These vendors

may or may not be licensed by the government. Their roles and responsibilities include sourcing and treating water, setting prices, and delivering water to customers.



5.4 BASIN GOVERNANCE

Water basins in Nigeria are managed by River Basin Development Authorities (RBDAs), which are parastatals of the Federal Government of Nigeria. The RBDAs are governed by a board of directors appointed by the Federal Government and are responsible for the implementation of water projects and programs within their respective basins. They were established to harness and develop the nation's water resource potentials, as well as to serve as veritable vehicles for comprehensive and integrated rural development in Nigeria. There are 12 major RBDAs, each responsible for the management of water resources within its jurisdiction.

The board is responsible for setting policies and guidelines for the development and management of water resources within the basin, as well as overseeing the implementation of water projects and programs. The River Basin Development Authorities work closely with other stakeholders in the water sector, including government agencies, private sector players, and civil society organizations, to promote the sustainable and equitable use of water resources within their respective basins.

The Ogun-Oshun River Basin Development Authority (OORBDA) concentrates on the development and management of water resources' potential of Osun, Oyo, Ogun, and Lagos State. The OORBDA concentrates on the development and management of all the areas drained by Ogun, Oshun, Sasa Rivers, including their tributaries which are also linked to Lagos State. OORBDA is an agency to Federal Ministry of Water Resources set up by the Federal Government to carry out several functions including, for example, water source development for agriculture, flood and erosion control, water infrastructure development and pollution control etc. Thus, the function of the Authority can be seen as an overall

development and optimization of the Land and Water Resources potentials of its area of operation-the area drained by the Ogun, Oshun, and Sasa Rivers and their tributaries and smaller rivers.

5.5 LEGAL FRAMEWORK PLANS AND PROGRAMMES

This section includes legislations, plans and actions that define or regulate the exploitation, distribution, and use of water resources in Lagos. They include the following: The Land Use Act and Associated Legislations, Water Resource Decree of 1993, The National Water Policy, Lagos State Environmental Management and Protection Law, 2017, Lagos State Water Sector Law, 2018

The Land Use Act is the foundational legal framework for water resource exploitation in Nigeria. The government is vested with vast powers on land ownership, significantly giving it authority over land resources like groundwater. The Water Resource Decree of 1993 grants the federal government exclusive rights to all surface and ground water sources shared by at least two states. The decree, however, allows people to access and use water for domestic purposes. It also allows people with property rights to exploit and use the groundwater beneath their property. The National Water Policy of 2004 is another guiding document for the management of Nigeria's water resources. The policy's goal was to promote the sustainable exploitation and management of national water resources to meet the needs of both current and future generations. As a result, it is a synthesis of other frameworks such as the Water Act of 1993, the development of the National Water Resources Master Plan in 1995, and the Water Resources Management Reform Programme, which began in 1997. The policy framework is an attempt to harmonize and consolidate water-related goals into a clear and coherent blueprint.

Further key pieces of legislation include the Lagos State Environmental Management and Protection Law, 2017 and the Lagos State Water Sector Law, 2018. Despite numerous policies, legal and institutional regimes evolved by government for the management of water resources to satisfy national water needs, the deficiencies persist. This is likely because satisfying water needs appears a lesser priority for government as the aspirations are not duly pursued with purposeful, systematic funding and

implementation. Thus far, many communities do not have access to water fit for consumption and all issues relating to this reality is largely the failure of government, and economic conditions of the people.

Below are examples of relevant water programs in Lagos focused on adaptation and resilience:

- a. Lagos Water Supply and Sanitation Project: This project is a partnership between the Lagos State Government and the World Bank, aimed at improving water supply and sanitation services in the state. The project includes investments in infrastructure, such as the construction of new water treatment plants and the rehabilitation of existing ones, as well as the expansion of water distribution networks.
- b. Lagos Resilience Strategy: This strategy was developed by the Lagos State Government in collaboration with the Rockefeller Foundation's 100 Resilient Cities program. The strategy includes a focus on water management and includes initiatives such as the development of a flood early warning system and the implementation of a rainwater harvesting program.
- c. Lagos Urban Water Sector Reform: This program is aimed at improving the efficiency and effectiveness of the water sector in Lagos, with a focus on increasing access to safe drinking water and improving the resilience of water infrastructure. The program includes initiatives such as the development of a water safety plan and the implementation of a leak detection and repair program.
- d. Lagos State Water Sector Law: This law was passed in 2015 and provides a legal framework for the management and regulation of the water sector in Lagos. The law includes provisions for the protection and conservation of water resources, as well as measures to promote the resilience of water infrastructure.

6

ONGOING
AND PLANNED
RESILIENCE
ACTIVITIES

6.1 ARUP SPONGE CITIES

In March 2022, Arup released the Global Sponge Cities Snapshot. The study used digital tools to understand the natural absorbency of cities to cope with increasingly heavy rainfall. Its purpose was to highlight the importance of understanding a city's natural ability to manage heavy rainfall - as a critical first step to enhancing this ability. Arup examined seven cities across the world with different urban profiles: Auckland, London, Mumbai, Nairobi, New York, Shanghai, and Singapore. This approach was taken to several African cities, including Lagos.

Using the Terrain AI land-mapping tool, Arup measured the amount of green and blue space within the urban environment; the hydrological properties of the soil, and the water runoff potential for green areas to determine its overall sponginess and thereby providing a basis for stakeholder engagement with a view to exploring nature-based solutions for city-wide applications.

The results of the analysis, which considered a 150km² sample size of the Lagos Island/ Lekki Axis, showed Lagos to be ranked in the middle, with 58% permeable surface and 39% sponginess. Results for other African cities are presented in the table below.

The Lagos water crisis is closely linked to issues regarding the natural environment and biodiversity. Water resource quantity and quality are dependent on healthy ecosystems, which provide various services such as water filtration, nutrient cycling, and flood control. Human activities such as deforestation, land-use change, and pollution, on the other hand, have harmed many ecosystems, resulting in water resource depletion and contamination.

Nature-based solutions (NBS) provide a promising approach to address the water crisis by restoring and enhancing natural ecosystems to improve water availability and quality. NBS can include a range of measures, such as reforestation, wetland restoration, soil conservation, and green infrastructure. These measures can help to improve water storage, reduce erosion and sedimentation, and filter pollutants, among other benefits.

Africa Sponge Cities Ranking

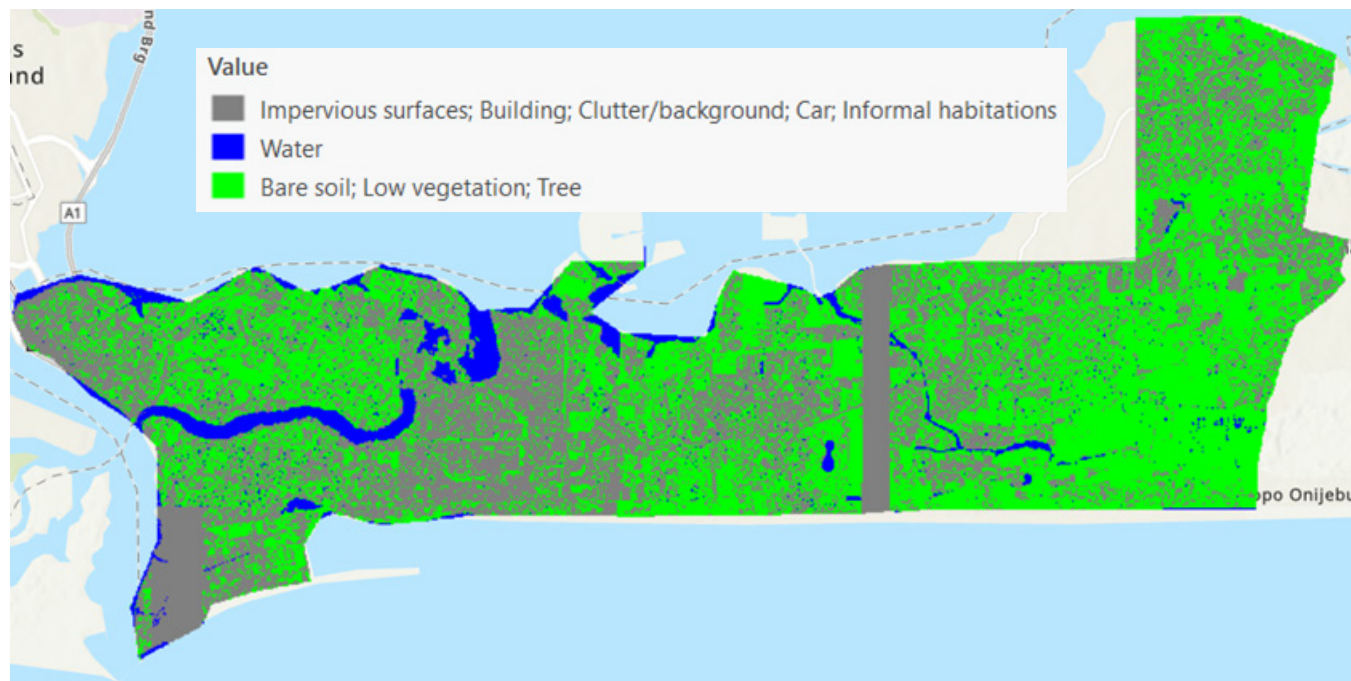
Rank	City	Permeable Surfaces (%)	Sponginess (%)	Soil Classification	Soil Characteristics	
					Sand %	Clay %
1	Kigali	67	43	High runoff potential	<50	>40
2	Durban	59	40	Moderately high runoff	<50	20-40
3	Lagos	58	39	Moderately high runoff	<50	20-40
4	Nairobi	52	34	High runoff potential	<50	> 40
5	Cairo	29	20	Moderately high runoff	<50	20-40

On Water Day at COP27, relevant stakeholders including Lagos state MDA's, LASRO, Urban planners, Private Sector and Academia were convened for an engagement workshop on the "sponginess" of Lagos. The focus of the event was to discuss how nature-based solutions can help

Lagos become more resilient to flooding. The Stakeholders, ideas, and observations from the interactions at the Lagos Sponge Cities workshop have been captured as part of this report and will continue to shape the thinking going forward especially in the area of flood management.



Lagos- Land Use Classification



Lagos- Permeable Surfaces

6.2 LAGOS RESILIENCE STRATEGY

The initiatives driven by the Lagos Resilience Office, which incorporate a community-based approach and focus on alternative, inclusive mechanisms for funding public water supply in Lagos, are supported by existing structures. The initiatives aim to make the state less vulnerable to shocks caused by disease outbreaks, floods, severe storms, building collapses, and urban fires. Overall, the strategy facilitates efficiency, innovation, and inclusiveness in the city by rethinking the status quo, ensuring that Lagos's future development transcends traditional concepts and takes a cross-sectoral planning and implementation approach. The following overview outlines ongoing and planned resilience activities:

1. Governance

- Strengthen the state's emergency response system.
- Expand use of the Lagos state citizens gate platform for effective e-governance.
- Strengthen the state's capacity for collection, analysis, and dissemination of data.

2. City Planning

- Strengthen the Lagos urban renewal programme.
- Strengthen the implementation of operative physical development plans.

3. Portable Water Supply and Sanitation

- Expand and protect water sources to improve Lagos' water supply.
- Develop an integrated waste management system.
- Construction of community wastewater treatment plants.
- The provision of public toilets and bathrooms in each local government and local council development area.

4. Water Transportation

- Implement the Lagos State Strategic Transport Master Plan (LSTMP)
- Expand the water transportation network with increased private sector participation

5. Agriculture

- Regenerate farm centres and explore urban agriculture opportunities to strengthen food security.

Details of the Lagos Resilience Strategy can be found here: http://www.lagosresilience.net/Downloads/Lagos_Resilience_Strategy.pdf

6.3 MOBILISING FINANCE FOR A WATER RESILIENT FUTURE IN LAGOS

At an online workshop on “Mobilising finance for a water resilient future in Lagos” on 14 March 2023, the work of the Resilient Water Accelerator was introduced, along with findings from this initial CWRA assessment. It gathered perspectives and opinions on the state of the city’s water resilience, as well as priority areas and financing options for the project pipeline in Lagos. Engineer Nurudeen Olalekan Shodeinde (PS, Office of Drainage and Water Resources, MoW) welcomed the launch of the RWA, highlighting the need to support high quality bankable projects aimed at increasing the amount of climate finance for the water sector, as well as exploring ways to increase private investments that would ultimately assist vulnerable communities. Engineer Shodeinde provided an overview of challenges the water sector is facing, especially a lack of investment, and stressed that Lagos State is willing to welcome initiatives that aim to alleviate this situation.

According to a report by the African Development Bank (AfDB), the water investment gap in Lagos is estimated to be around \$4.3 billion. This gap is due to inadequate investment in water infrastructure and services, which has resulted in a lack of access to safe water and sanitation in many parts of the city. To address these gaps, the AfDB recommends increased investment in water infrastructure and services, including the rehabilitation and expansion of existing infrastructure, the construction of new infrastructure, and the improvement of water governance and management. The report also highlights the importance of private sector participation and innovative financing mechanisms to bridge the investment gap and achieve sustainable water and sanitation services in Lagos.

The findings from the above-mentioned online workshop have already contributed to consultations at the UN Water Conference in New York in March 2023. These conversations with policy makers and investment experts have looked at the challenges Lagos faces, but also helped to raise awareness of the overlapping water challenges which align this work with the global water security agenda. At the heart of the UN Water agenda is increasing collaboration and convergence, and the workshop findings and report will be used to sketch a shared water vision and possible actions in line with the City Water Resilience Framework. This inclusive approach was welcomed during the UN Water discussions as a practical way to build legitimacy and draw in contributions from multiple organisations and initiatives. Following this discussion and reflections in New York and over the spring of 2023, stakeholders will be reconvened, and evidence gathered to develop clear proposals for an investable and transformative water security programme.

7

NEXT STEPS

Having concluded baseline study of the Lagos water system, the next level of the City Water Resilience Approach will commence. This stage encompasses a stakeholder-led assessment of the urban water resilience in Lagos, to confirm the status of water resilience and the various proposed interventions in the state.

At this stage, updating of the project pipeline will continue with the RWA, further developing the initial engagement with the Lagos State Government. As we progress through the successive CWRA stages, the project pipeline will continue to be evaluated, refined and prioritized until a clear action plan for the state is developed which would provide the basis for long-term, large-scale investment on the required interventions within Lagos.

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- Ministry of Finance
- Ministry of Economic Planning and Budgeting
- Lagos Water Corporation
- Lagos State Wastewater Management Office
- Lagos State Water Regulatory Commission
- Lagos State Resilience Office
- Public Works Corporation
- Debt Management Office
- Lagos Waste Management Authority
- Lagos State Office for Sustainable Development Goals and Investments
- Lagos State Office of Public Private Partnerships
- Ministry of Local Government and Chieftaincy Affairs
- Ojodu Local Council Development Area
- WaterAid Nigeria
- Arctic Infrastructure
- Foreign Commonwealth and Development Office
- African Development Bank
- International Finance Cooperation



CONTACT INFORMATION

Martin Shouler | Arup
Martin.Shouler@arup.com

Kate Hughes | Resilient Water Accelerator
KateHughes@wateraid.org