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WATER RESOURCES PROFILE SERIES

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

# Democratic Republic of the Congo Water Resources Profile Overview

The Democratic Republic of the Congo (DRC) has an abundance of water resources and low stress. Over 50 percent of the continent of Africa's surface water reserves and approximately one-quarter of the continent's water resources are in DRC. The total volume of freshwater withdrawn by major economic sectors is 0.2 percent of the total resource endowment[i] and total annual renewable water resources per person is 15,773 $m^3$, far exceeding the Falkenmark Water Stress Index[ii] threshold for water stress. The vast resources of the Congo Basin contribute to year-round surface water flows. Approximately 30 percent of water resources originate in neighboring countries.

Surface and groundwater pollution poses a risk to public health and biodiversity. Mining in the southern Copperbelt of Katanga has increased concentrations of trace metals and pollutants such as mercury, lead, cadmium, and copper in surface water. High concentrations of fecal coliforms from poor sanitation systems and unprotected drinking water sources have contaminated drinking water, especially near large urban centers like Kinshasa. Deforestation has led to sedimentation of surface waters, especially along the eastern border and near Kinshasa.

Climate change will increase temperatures and alter rainfall, which could affect river regimes, annual runoff, and water availability. The south is most at risk for drought and reduced rainfall, however, most regions will experience more intense rainfall and increased flood risks.

The water sector is fragmented, underfunded, and lacking in critical capacities and qualified staff who can fulfill core water management responsibilities. These impediments have constrained implementation of water sector improvements and wider programming initiatives at a national and local level and have increased reliance upon donors for funding and technical assistance.

DRC has no national water quality monitoring programs. The lack of data limits regulatory capacity and enforcement and increases vulnerability to water-related environmental and public health safety risks.

[i]SDG 6.4.2 measures water stress as the percentage of freshwater withdrawals against total renewable freshwater resources. The water stress thresholds are: no stress <25%, low 25%-50%, medium 50%-75%, high 75%-100%, and critical >100%.
[ii]The Falkenmark Water Stress Index measures water scarcity as the amount of renewable freshwater that is available for each person each year. A country is said to be experiencing water stress when water availability is below 1,700 $m^3$ per person per year; below 1,000 $m^3$ is considered water scarcity; and below 500 $m^3$ is absolute or severe water scarcity.

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# Water Resources Availability

**KEY TAKEAWAYS**

- Over 50 percent of Africa's surface water and approximately one-quarter of Africa's internal renewable water is in DRC, making it the most water-rich country in sub-Saharan Africa.
- The Congo River Basin covers 98 percent of the country and is the most important drainage basin.
- Groundwater productivity is highest in Cuvette Centrale and Oubangui in the center and northwest, although more research is needed on groundwater availability.

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

## Surface Water Resources

Over 50 percent of the continent of Africa's surface water reserves and approximately one-quarter of the continent's water resources are in DRC, making it the most water-abundant country in sub-Saharan Africa.[2] Most renewable water resources are from surface water.[1] Vast river networks stretch over 20,000 km and lakes and rivers (86,080 $km^2$) account for approximately 3.5 percent of DRC's land area.[3,4] The Congo River Basin covers 98 percent of the country and spans 3.8 million $km^2$ across eight countries. Approximately 62 percent of the basin is in the DRC.[3,4] The Congo River is Africa's largest by volume,[4] the second largest basin in the world, and the world's deepest river.[3] The Congo River maintains consistent flow throughout the year[5,6] as it is replenished by 20 major tributaries in four main sub-catchments: 1) the Lualaba/Tanganyika in the southeast, 2) Kwa-Kasaï in the southwest, 3) Oubangui in the northwest, and 4) the main Congo flowing through the center.[4,7]

The Nile Basin accounts for two percent of DRC's land area on the eastern border and drains into the Semliki River watershed. Despite its small size, the watershed contributes approximately 4,600 MCM per year or 20 percent of the White Nile River's flow.[3,4] DRC also shares Lake Albert, Lake Edward, Lake Kivu, and Lake Tanganyika in the Nile Basin with Uganda, Rwanda, Tanzania, Burundi, and Zambia.8 Twelve percent of DRC is protected land, including nearly 12 million hectares in four Ramsar wetland sites: Parc national des Mangroves, Parc national des Virunga, Bassin de la Lufira, and Ngiri-Tumba-Maindombe, the largest transboundary Ramsar site in the world.[9,10]

DRC has 18 large dams[iii] and the greatest hydroelectric potential in Africa. Hydroelectricity comprises 99.7 percent of DRC's electricity.[11] The largest are the two Inga Dams built in 1972 and 1982 on the Congo River. Located just south of Kinshasa, their current generation

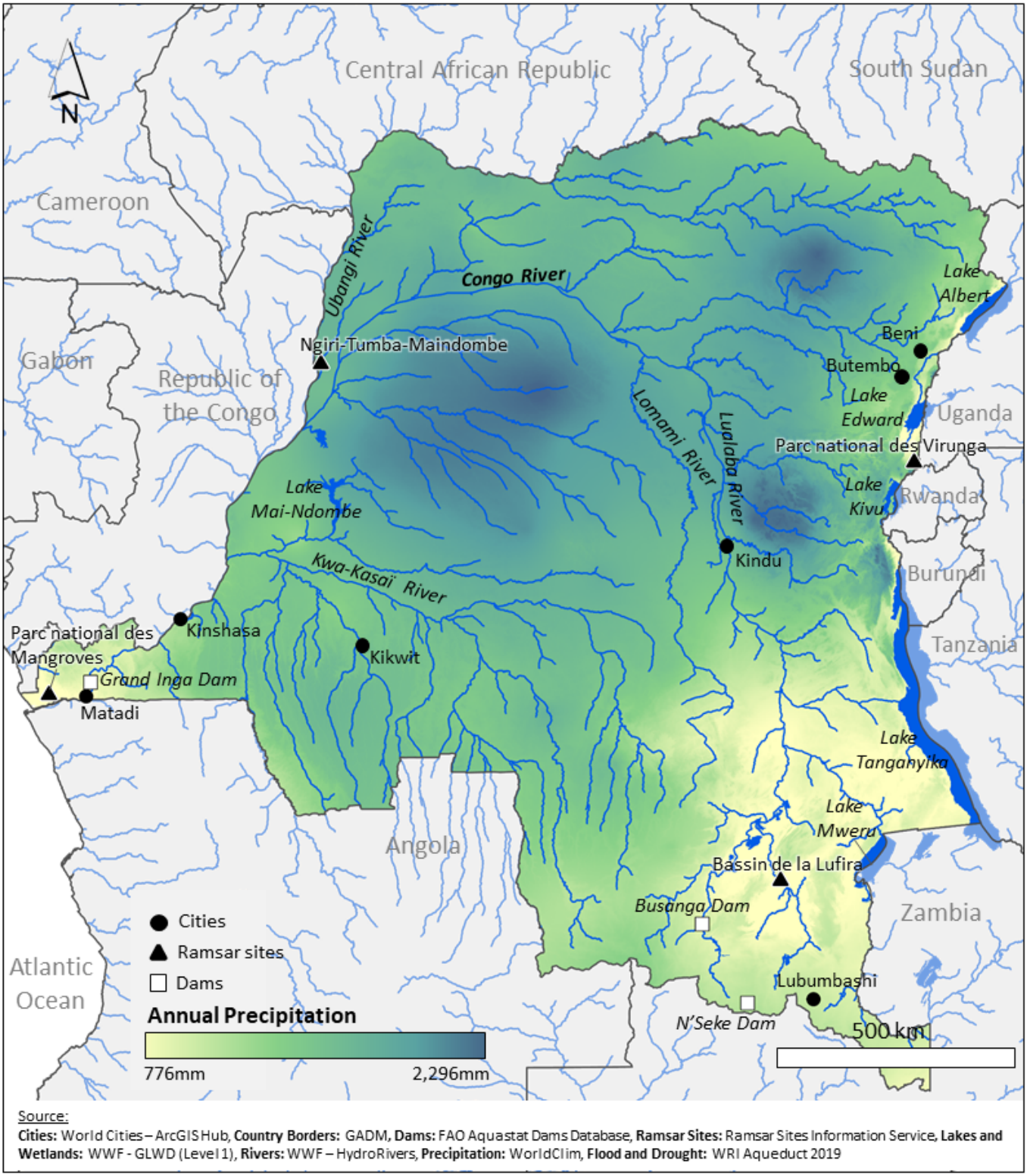
**TABLE 1. WATER RESOURCES DATA**

| | Year | DRC | Sub-Saharan Africa (median) |
|---|---|---|---|
| Long-term average precipitation (mm/year) | 2017 | 1,543 | 1,032 |
| Total renewable freshwater resources (TRWR) (MCM/year) | 2017 | 1,283,000 | 38,385 |
| Falkenmark Index - TRWR per capita (m3/year) | 2017 | 15,773 | 2,519 |
| Total renewable surface water (MCM/year) | 2017 | 1,282,000 | 36,970 |
| Total renewable groundwater (MCM/year) | 2017 | 421,000 | 7,470 |
| Total freshwater withdrawal (TFWW) (MCM/year) | 2002 | 684 | 649 |
| Total dam capacity (MCM) | 2015 | 53 | 1,777 |
| Dependency ratio (%) | 2017 | 29.85 | 22.78 |
| Interannual variability | 2013 | 1.20 | 1.55 |
| Seasonal variability | 2013 | 2.30 | 3.15 |
| Environmental Flow Requirements (MCM/year) | 2017 | 981,700 | 18,570 |
| SDG 6.4.2 Water Stress (%) | 2002 | 0.23 | 5.70 |

Source: FAO Aquastat

[iii]The International Commission on Large Dams defines a large dam as "a dam with a height of 15 meters or greater from lowest foundation to crest or a dam between 5 meters and 15 meters impounding more than 3 million cubic meters."

**FIGURE 1: MAP OF WATER RESOURCES**

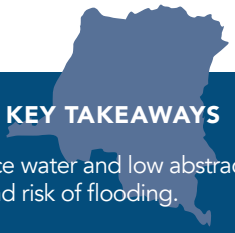



potential is 1,774 MW but they generate just 650-750 MW due to malfunctioning turbines.[12] The proposed Grand Inga Dam project would increase the number of dams to eight and raise potential capacity to 44,000 MW.[3] The project remains in the design phase but President Tshisekedi committed to seek financing for the project.[13] The government's Agency for the Development and Promotion of the Grand Inga (ADPI) announced in November 2020 that construction of the third Inga Dam (Inga III) would begin in 2021.[14] The next largest dam is the N'Seke on the Lualaba River with a 260 MW capacity[15] and in 2016, construction commenced on the 240 MW Busanga Hydropower Dam on the Lualaba River.[15]

## Groundwater

DRC is rich in groundwater, although there data on groundwater availability, yields, and aquifer size is limited.[7,16] There are five main hydrogeological units. Alluvial sedimentary aquifers are found in the Cuvette Centrale (a region of wetlands and forests in the center of the Congo Basin) and Oubangui sub-catchment in the northwest. The Cuvette Centrale also contains sandstone aquifers. Low potential Quaternary-Tertiary aquifers are located in the Batékés Plateau and Kasaï in the west and south. Sedimentary aquifers can be found in Katanga and Lubumbashi Dolomites in the south, and basement and metasedimentary aquifers underlie the eastern and western borders of the country.[4,5,7] Yields are highest in the sedimentary aquifers of the Cuvette Centrale and Oubangui where groundwater levels can reach up to 120 m.[4,5]

# Surface Water Outlook



**KEY TAKEAWAYS**

- Risk of over abstraction is low due to abundant surface water and low abstractions for agriculture and drinking. However, deforestation is increasing erosion, sedimentation, and risk of flooding.
- Annual flooding is common during seasonal inundation of Congo River tributaries. The floodplain in the central Cuvette Centrale region covers 30 percent of the Congo Basin.
- Untreated human waste near urban centers contaminate surface water and increase the risk of waterborne diseases. Uncontrolled mining, especially in the southern Copperbelt in the Lualaba and Katanga Provinces, has contaminated surface water with trace metals.

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

**Overall abstractions of surface water for drinking and agriculture are low.** Less than 10 percent of the population relies on surface water for drinking[3] and while the agricultural sector employs 71 percent of the population, irrigation is not a significant source of demand.[4] Irrigation potential ranges between four to seven million hectares, but it is estimated that only 6,800 ha are regularly irrigated, predominantly for sugar cane and rice cultivation.[3] Recurring political and violent conflict has impeded investment in large scale systems for water abstraction.[2]

**Erosion and sedimentation caused by deforestation and land use practices increase flood risk and reduce streamflow.[4]** Between 2010 and 2014, 18 million hectares were deforested.[21] Approximately 90 percent of deforestation is from small-scale clearing for crop cultivation and there is a high correlation between population growth and primary forest loss. If trends continue, primary forests could be cleared by 2100.[22] Expanding smallholder agricultural zones near urban centers, such as Kinshasa, have increased vegetation clearance and affected river flows.[4,23] Soil erosion has disrupted surface water intake at the Lukunga plant in Kinshasa[4] and reduced the generation capacity of the Inga Dams.[24] Higher runoff from altered land use also increase flood risk throughout the Congo Basin.[25] Annual flooding is common during seasonal inundation of Congo River tributaries. The floodplain in the central Cuvette Centrale region covers 30 percent of the Congo Basin.[26]

**Surface water is generally thought to be of good quality although mining and industrial runoff have resulted in localized contamination.** Intensive mining has increased levels of trace metals and toxins such as lead, copper, cobalt, chromium, cadmium, zinc, iron, arsenic, and cyanide in surface waters near active or abandoned mines in the south.[4,28] Most artisanal and industrial mines are concentrated within the southern DRC Copperbelt in the Lualaba and Katanga Provinces near the Congo River headwaters.[6,29] Sediment samples from rivers receiving mining effluent showed that copper, cobalt, and lead values exceeded recommendations set by the Sediment Quality Guidelines for the Protection of Aquatic Life by 100-1000 times.[29,30] High metal and toxin levels from mining in the Katanga Province pose risks to aquatic ecosystems,[28] but studies on local impact are limited. Many rivers and canals near Kinshasa in western DRC are also contaminated with trace metals, likely due to landfill pollution and untreated industrial effluent discharging into rivers.[31–35]

**Agricultural runoff has also polluted surface waters, threatening human health and biodiversity.** Sugarcane cultivation has increased contamination from pesticides, fungicides, and fertilizers in surface water near Kinshasa.[34] Agricultural runoff has also increased organic matter, phosphorus, and nitrogen in catchments near Lake Kivu[36,37] and near Kinshasa.[33]

**Fecal matter and untreated sewage affect surface water quality and human health, especially near urban centers.** In urban areas, 42 percent of the population uses unimproved sanitation services and none of the population uses "safely managed" sanitation services.[38] Outbreaks of waterborne diseases such as typhoid, cholera, and shigella are common throughout the country.[5,39,40] Near Kinshasa, concentrations of E.coli and enterococcus significantly exceed drinking water guidelines set by the World Health Organization.[41] Fecal contamination is high throughout the year and increases during the wet season when sanitation systems or septic tanks overflow into surface water.[42] High concentrations of pathogenic bacteria have also been recorded in the southern Katanga Province[4] and near the cities of Kikwit in the west[39] and Bukavu in the east.[44]

**Land degradation, erosion, and poor land management increase sedimentation and turbidity.** Land use degradation and deforestation have exacerbated high natural turbidity of surface water in the mountainous regions in eastern DRC.[4] Three rivers flowing into Lake Tanganyika from eastern DRC, where forested areas declined by 78 percent between 1974 and 2000, deposit 98 to 146 metric tons of sediment into the lake annually.[45] Temporary and unplanned housing settlements built by internally displaced people near Kindu in central DRC have increased sedimentation and turbidity in the Mikelenge River, which flows into the Congo River.[4]

# Groundwater Outlook

**KEY TAKEAWAYS**

- Domestic use is the largest source of demand for groundwater but insufficient abstraction limits availability.
- The risks of overexploitation in urban areas are not well understood due to limited monitoring.
- Bacteriological contamination from high rates of open defecation, poor sanitation systems, and polluted surface waters is common in both rural and urban areas.
- Effluent from agriculture and mining in the southern mining regions and near urban centers have contaminated certain groundwater resources with trace metals and nitrates.

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

**There is limited data on springs, boreholes, and wells, however, deep-drilled wells and hand-dug wells are common.[4]** An estimated 90 percent of the rural population depends on springs for drinking water.[4,7] Some provinces in the center and in the northwest have a higher dependence on unprotected wells, which makes groundwater more susceptible to contamination.[5] Demand for groundwater is highest in cities, especially Kinshasa, Lubumbashi, and Matadi, which account for 79 percent of REGIDESO's (DRC's urban public water utility) customer base.[4] Despite the abundance of groundwater, extreme poverty, rapid population growth, and recurrent conflict has limited water access and infrastructure development such that supplies of safe water do not meet demand.[47] Rapid population growth in the cities of Beni and Butembo in mountainous regions in eastern DRC has led to over-abstraction and localized water shortages.[4] Some wells in densely populated peri-urban areas in the southern Katanga region have also run dry due to over-abstraction.[48]

**Bacteriological contamination is a significant risk to groundwater quality.** E. coli contamination is common due to inadequate sanitation systems. One assessment of groundwater conducted in the rural areas of Equateur, South Kivu, and North Kivu found E. coli contamination in a majority of samples tested.[2] In Kinshasa, E. coli is present in 53 percent of samples collected from unimproved groundwater sources.[2]

**Natural variation in geological systems and pollution from fertilizers, industry, and mining contaminate groundwater with trace metals and nitrates.** In the southern Lubumbashi Dolomites, groundwater is typically alkaline.[4] Mining effluent in the Katanga Copperbelt region and artisanal gold mining in the east contaminate groundwater with trace metals.[48] Levels of lead, aluminum, iron, and cadmium in groundwater in the Copperbelt near Lubumbashi exceed WHO drinking water quality guidelines.[49] Concentrations of nitrates in excess of WHO recommendations have also been recorded in Kinshasa's groundwater, likely due to pollution from agriculture and industry.[17]

# Water Resources and Climate

## KEY TAKEAWAYS

- DRC is one of the most vulnerable countries in the world to the effects of climate change and is among the least ready to address climate change, which will exacerbate poverty, food insecurity, and political instability.
- Rainfall patterns are likely to become more variable. More intense rainfall will increase extreme floods, landslides, and runoff affecting surface water availability and quality. Drought and longer dry seasons will also become more prevalent in parts of the country.

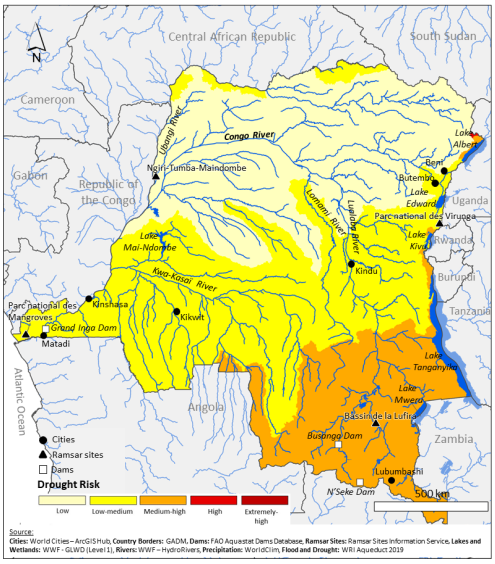
**This section covers climate variability and climate change, their impacts on water availability and water quality, and the risks they pose to local communities and their economies.**

**Climate change will increase temperatures and is likely to change rainfall patterns.** Over the past 30 years, temperatures have increased 0.17 °C per decade and are expected to increase another 1-3 °C by 2050,[53] which will alter rainfall patterns and increase evaporation.[52,54] Annual average rainfall is 1,543 mm, reaching over 2,000 mm in the north and 800 mm in the south.[3,5,6] The north and center typically experience a rainy season from February to November and a dry season from December to January. The south experiences a rainy season from September to June and a dry season between June and July, with annual fluctuations.[4,7] Overall trends suggest DRC will become slightly more wet by the 2030s, with the greatest increases projected in the northeast near the Congo River headwaters.[55,58] In the southeast, rainfall is predicted to decrease and vulnerability to drought will increase.[52,58,59] Rainfall will also likely decrease in the west.[60] Groundwater base flows will likely decline in the southeast.[56]

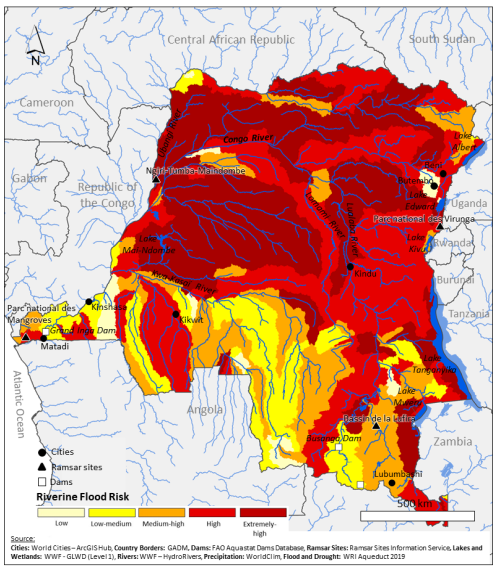
**Climate change will increase precipitation variability,[7] resulting in more intense flooding, landslides, erosion, altered hydrological regimes, and crop failure.[52,55]** Projections indicate a 33-37 percent increase in rainfall received on very wet days by the end of the century.[60] Rainfall intensity will be greater in central eastern DRC, where the rainfall on very wet days could increase by as much as 107 percent.[60] Floods are already frequent and more intense rains could lead to more extreme floods and increased sedimentation and runoff.[52,55] By 2100, runoff may increase from 23-27 percent during the wet season.[54] Climate change will exacerbate high rates of poverty, food insecurity, and political instability as there is low adaptation capacity in the DRC to address climate challenges.[2,53] According to the Ministry of Foreign Affairs of the Netherlands, DRC is the 12th most vulnerable country and the 5th least ready country to address climate change.[53]

**Decreased water availability and more frequent drought will predominantly affect the south.[60]** Projections indicate that severe droughts will occur 10 percent more frequently by 2100 and by as much 50 percent in the far south.[60] The frequency of dry spells during the rainy season in the east is projected to increase by 108 percent.

### FIGURE 2: DROUGHT RISK




### FIGURE 3. RIVERINE FLOOD RISK



# Water Policy and Governance

**KEY TAKEAWAYS**

- Fragmentation of water management responsibilities, poor coordination between water management entities, and low technical capacity and financial resources have hindered integrated water resources management.
- There is no national water quality monitoring, impeding understanding of water quality issues and effective enforcement of standards concerning contamination by wastewater or mining effluent.

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

## Water Resources Management Challenges

**The water sector is centralized but responsibilities are shared among several key entities with limited coordination.[61,62]** The CNAEHA acts as a coordinator across the sector, as responsibilities of the MERH, SNHR, DAS, and CNAEHA overlap. The institutional framework outlined in the 2015 National Water Law, including the establishment of a new Ministry of Water, has not been fully implemented due to state fragility and poor governance.[4,63] Institutions compete for limited funding, which largely comes from donors.[2] The 2015 Water Law also called for decentralizing the water sector; however, progress in delegating management responsibilities to regional and local entities has been slow.[2,61]

**Major capacity gaps at the local and regional levels have hindered implementation of plans and policies to improve IWRM.[2]** At a regional level, there are wide disparities among the 26 provincial governments in management capacity for IWRM.[2] Capacity is particularly low in newly established provinces.[iv,2] Locally, there are insufficient trained personnel in water resource management.[63] In 2016, with support from a UNEP project, the Lukaya Basin was the first area to develop an IWRM plan through their River Basin Committee and River Basin User Association.[64,65] There has been limited progress in the establishment of similar basin committees elsewhere and there is a general lack of technical capacity and access to financial resources to develop the basin plans.

**The water sector struggles with inadequate financing and donor dependance.** From 1990-2015, government funding for the water sector decreased from 5 percent to 1.2 percent.[66] Fund disbursement rates to subsectors, including rural and urban water supply as well as rural and urban sanitation and hygiene, are less than 50 percent according to the Aid and Investment Management Platform from the Ministry of Planning, which tracks donor commitments and actual disbursements.[62] Roughly 90 percent of water sector investments have been externally funded,[2] particularly by the World Bank and the African Development Bank as well as bilateral donors.[61] Financial constraints have hindered the development of water infrastructure, including piped networks and improved sources such as covered wells and protected springs.[2,62] Delays in dispersing funds have also stalled development and maintenance of water infrastructure.[62] Years of conflict have further damaged water facilities and equipment.[4]

**TABLE 2. KEY LAWS, POLICIES, AND PLANS**

| Name | Year | Purpose |
|---|---|---|
| Constitution | 2006 | Assigns responsibility for water planning, conservation of resources, and hygiene to the central government. |
| National Water Law | 2015 | Defines the legal and institutional framework of the water sector based on integrated water resource management (IWRM) principles. It delineates water management at basin or sub-basin scales. Calls for a water ministry and regulatory authority and separates asset ownership and service provision. The Law also assigns asset ownership and water service provision to provincial governments, local authorities, and user associations. |
| National Water Policy (PNSPE) | 2016 | Guides implementation of the National Water Law through six objectives which specify the responsibilities of various levels of government. Outlines drinking water service delivery for rural and urban areas, establishes financing mechanisms and drinking water management entities. |

[iii]DRC had 11 provinces until 2015, when existing provinces were split into 26 provinces to increase decentralization.

**TABLE 3: WATER MANAGEMENT ENTITIES**

| Mandate | Institution | Roles and Responsibilities |
|---|---|---|
| Transboundary | Nile Basin Initiative (NBI) | International partnership launched in 1999 consisting of 10 countries within the Nile Basin. Facilitates basin development. through a Council of Ministers, Technical Advisory Committee, and Secretariat. Strengthens institutional and technical capacity to manage water in member nations. Supports member nations in preparing for and mobilizing financial resources for investment projects within the Basin. |
| | International Commission of the Congo-Oubangui-Sangha Basin (CICOS) | Established in 1999 with five other member states (Republic of the Congo, Cameroon, Central African Republic, Gabon, and Angola) to promote improved river navigation and IWRM within the Congo Basin. |
| | Lake Tanganyika Authority | Established in 2008 between DRC, Burundi, Tanzania, and Zambia. Promotes equitable and sustainable socio-economic development and management of Lake Tanganyika's natural resources, in accordance with the protocols of the Convention on the Sustainable Management of Lake Tanganyika. |
| | Southern African Development Community | Focuses on economic development, peace and security, alleviating poverty, and enhancing quality of life in 15 member states. Aims to achieve sustainable use of natural resources and effective environmental protection. |
| National | Ministry of Energy and Hydraulic Resources (MERH) | Responsible for overall national water policy, including leading the implementation of the National Water Law, managing hydroelectricity projects, and ensuring integrated management of water resources. |
| | Directorate of Sanitation and Health (DAS) | Housed within the Ministry of Environment, Conservation of Nature and Sustainable Development (MECNDD). Responsible for safe wastewater and stormwater management, water quality monitoring, and hygiene awareness. |
| | National WASH Action Committee (CNAEHA) | Inter-ministerial agency responsible for coordinating sector planning, water supply and sanitation services, water investments, and strategy. Undergoing restructuring in response to the National Water Law. |
| Sub-national | Ministry of Rural Development - National Rural Water Service (SNHR) | Manages rural water supply and is responsible for borehole drilling and coordinating NGO stakeholders. |
| | Provincial governments | Manage water assets, investments, and service provision. Oversee provincial plans for water management based on an adaptation of the national water plan. |
| | Decentralized Territorial Entities (ETDs) | Alongside provincial governments, regulate the conservation, use and protection of water resources at a city, commune, sector, or chiefdom level within each province. Create a structure for public water services; set pricing for water services; manage drought, pollution, and flooding; and manage wastewater and stormwater. ETDs focusing on water resource management are limited. |
| | Basin Committees | Responsible for the management, development, and monitoring of water resources, including by producing basin management plans. Act as technical and advisory bodies on water resources management issues within the basin or sub-basin |

## Water Quality Monitoring

**DRC does not have a national or sub-national water quality monitoring program.[4]** Water quality data collection systems began to decline in the mid-1970s due to rising conflict. The Directorate of Hygiene within the Ministry of Public Health is now responsible for hygiene policy and setting water quality standards, while the Ministry for the Environment, Nature Conservation, and Sustainable Development (MECNDD) is responsible for water quality testing and regulation. MECNDD lacks the financial and technical capacity to fulfill its mandate.[2]

Water quality testing occurs sporadically and is usually limited to areas where mining takes place.[7] There are significant data gaps pertaining to water quality in most of DRC. Limited environmental regulation and monitoring of mining has led to contaminated and unsafe water near mines, threatening public health and biodiversity.[2] Poor enforcement of water quality standards[62] has also resulted in public health crises including cholera outbreaks and widespread diarrheal disease due to unsafe drinking water.[63]

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