



# ANNEXES FOR DELIVERABLE 2 - PHASE 2

## Findings of the Integrated Water Resources Management (IWRM) Study from the Comprehensive Review of Water Resource Issues in the CARICOM Region



### Consultancy to Develop a Regional Action Framework for Integrated Water Resources Management (IWRM) for the CARICOM Region

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# 1 ANNEX A: ANGUILLA

## 1.1 OVERVIEW

Water resource management plays a crucial role in the sustainable development of any nation, and this holds true for the small Caribbean Island of Anguilla. Anguilla is a flat, low-lying island formed mainly of coral and limestone, and as with most coral islands, fresh water is scarce. Given its limited availability of freshwater resources, the island relies on various other sources for its water supply, including rainwater catchments, groundwater aquifers, desalination, and imported water. Anguilla, however, faces numerous challenges in effectively managing and conserving its water resources due to population growth, climate change, over extraction, pollution, saltwater intrusion, and land development activities. The island's water distribution infrastructure is also in a state of disrepair, and much of the desalinated water that is produced is lost through leaks. There is also concern about the island's water quality and its potential consequences for the health and well-being of the island's residents.

Anguilla's economy is small and heavily dependent on luxury tourism, offshore banking, lobster fishing, and remittances from emigrants. Typically, with small land masses and a narrow base of livelihood options, Anguilla lacks the economic, institutional, and human-resource capacity of larger countries with broad-based economies. To sustain its population, Anguilla's government has been focusing on the development of their service sectors (tourism and non-tourism), which has exponentially increased demand for the island's limited water resources.

The increasing demand for the island's water resources is not adequately supported by a legislative and policy framework to ensure sustainable water resource use and management. While Anguilla has drafted various laws, regulations, and policies related to environmental conservation, land use planning, and sustainable development, these largely have not been enacted or, in practice, are not enforced. There are multiple government agencies responsible for different aspects of environmental and water resource management, but there is no national policy to coordinate the activities of these agencies. Consequently, the current water and environment management system in Anguilla is fragmented and lacks coordination for the efficient use of resources and a comprehensive approach to integrated water resources management (IWRM).

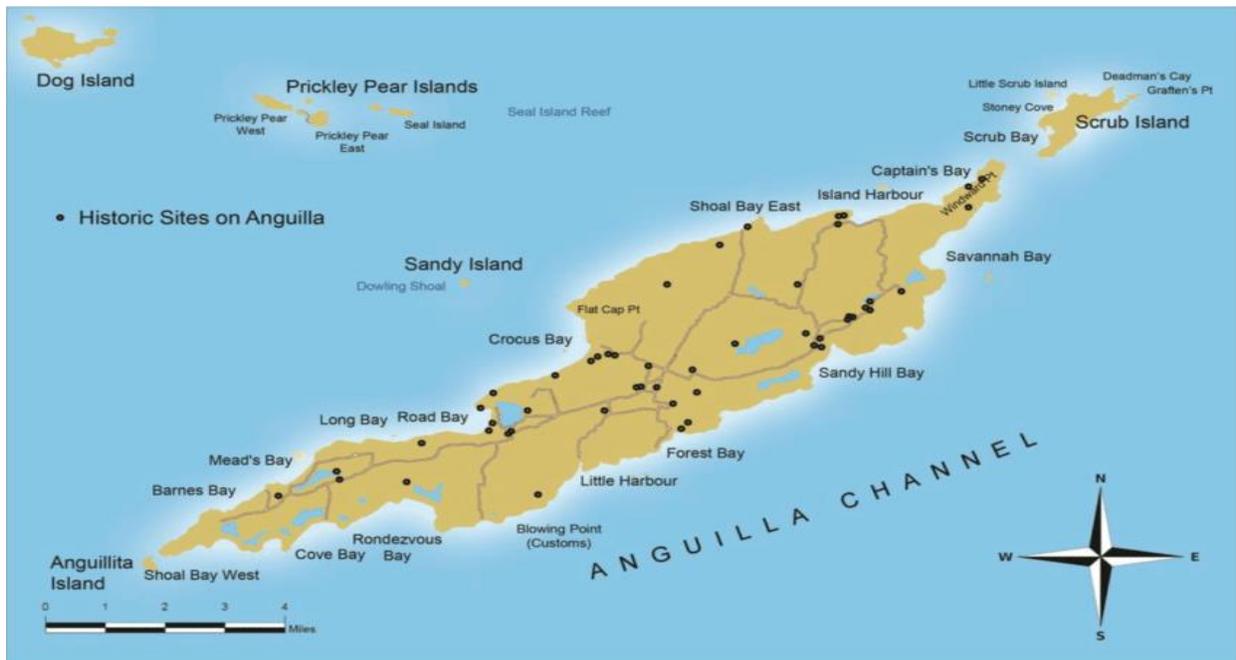
As a nation heavily dependent on tourism, the availability and quality of water resources directly impact the economy and livelihoods of its residents. The future of Anguilla depends on the reliable and reasonably priced delivery of clean water. To accomplish this, issues of rising demand, limited supply, pollution effects, distribution problems, and conservation must all be addressed. According to the UNEP, (2012) publication Integrated Water Resources Management Planning Approach for Small Island Developing States, Integrated Water Resources Management (IWRM) in the context of social, economic, and environmental objectives is key to development in SIDS, like Anguilla.

The following sections aim to evaluate the current state of water resource management in Anguilla and were compiled by reviewing online sources pertaining to the status and management of water resources in Anguilla.

## **1.2 PHYSICAL GEOGRAPHY AND SOCIO-ECONOMIC CONTEXT**

### **1.2.1 Physical Geography**

Anguilla is a British overseas island territory that includes several small uninhabited offshore islands, including Dog, Scrub, and Sombrero islands and the Prickly Pear Cays. **Figure 1** shows a map of the main island of Anguilla along with the smaller uninhabited islands, which together make up the British Overseas Island Territory (Azevedo, 2014). Located in the eastern Caribbean Sea, Anguilla is the most northerly of the Leeward Islands in the Lesser Antilles. The island lies about 12 miles (19 km) north of Saint Martin and 60 miles (100 km) northwest of Saint Kitts. The Valley is the main town in Anguilla and is considered the administrative center of the island. Anguilla has an area of 35 square miles (91 square km) with an estimated population of 15,899 (PAHO 2023).



**Figure 1: Map of Anguilla**

(Source: [https://www.researchgate.net/figure/2-Map-of-Anguilla-with-sites-marked-using-GIS\\_fig23\\_299464710](https://www.researchgate.net/figure/2-Map-of-Anguilla-with-sites-marked-using-GIS_fig23_299464710))

Anguilla is a flat, low-lying island formed mainly of coral and limestone; as with most coral islands, fresh water is scarce. The island has no rivers, but there are several surface saltwater ponds, mostly near the coast. The island is approximately 16 miles (26 km) long and 3.5 miles (6 km) wide. At its highest peak, on Crocus Hill, the island has an elevation of 64 m (210 ft.). The northern coast of the island is characterised by short slopes and steep cliffs; the southern coast has a longer and more gradual slope. The island is bordered by reefs off its' north and south coasts, but these have been subject to significant degradation from hurricane and storm activity and coastal development.

The climate is tropical, with a dry season generally from about January to April and a "wet/rainy" season from approximately May to November. Hurricanes can occur from June to November. Temperatures vary slightly throughout the year, averaging between 28°C and 31°C, and are moderated by the constant blowing of the north-east trade winds. The island's vegetation is described as predominantly small trees, low scrub inland, and sea grape along the coasts. Wildlife on Anguilla includes land reptiles, sea turtles, and lobsters.

### 1.2.2 Socioeconomic Context

Anguilla is described as a small economy heavily dependent on luxury tourism, offshore banking, lobster fishing, and remittances from emigrants.

In 2017, the island suffered a major setback, as it was hit by a Category 5 hurricane (Irma), resulting in damage estimated at 97% of the island's GDP. The island is considered highly vulnerable to external economic shocks. The Caribbean Development Bank (CDB), in its 2020 review of Anguilla, noted that the economy shrank by 27.4% - its largest contraction on record - due to the impact of the Covid-19 pandemic on tourism. Fast forward to 2022, with the full lifting of border restrictions and the recovery of the tourism industry, the CDB forecasted an 11.3% growth in Anguilla's GDP in 2023. The UN Office for the Coordination of Humanitarian Affairs (OCHA), in its 2022 profile on Anguilla, quoted the island's GDP per capita at US\$ 25,528.60. However, the profile summary cautioned that this positive statistic does not reflect Anguilla's "economic and social inequalities", referencing the impact of Hurricane Irma and the Covid-19 crisis on raising unemployment and consequently, exacerbating poverty and vulnerability among citizens.

Anguilla's total Public Debt as of March 2023 stood at \$400.66m. Total public external debt was 41.92% (\$167.95m) of total public debt, while total public domestic debt accounted for 58.08% (\$232.71m) of total public debt.

Anguilla has made several advances in health services including improving sanitation, maintaining vaccination coverage above 95% for targeted diseases, and eradicating smallpox, and measles. School is compulsory for children aged 5 to 17 and education is free in all public schools. The Anguilla Community College was established in 2009 to provide access to postsecondary and tertiary education on the island. In 2010, adult literacy was 97.7%, with males being at 97.4% and females at 98.1%.

In 2000 the total population of Anguilla was 11,047 inhabitants; by 2023, this figure had risen to 15 899, representing a 43.9% increase. The population density in Anguilla is 177 people per square kilometer. In 2023, life expectancy in Anguilla was 77.6 years, higher than the average for the Region of the Americas and 1.6 years higher than in 2000.

### 1.3 STATUS OF WATER RESOURCES MANAGEMENT IN ANGUILLA

#### 1.3.1 Sources and Distribution

Anguilla, being a small low-lying island in the Caribbean, faces challenges with its freshwater resources. The island is considered water scarce and has few renewable freshwater resources. Anguilla is dependent on rainwater catchments and ground water aquifers for its freshwater needs. However, these renewable freshwater resources are at risk due to climate change, over extraction, pollution, and saltwater intrusion.

Anguilla's climate is characterized by erratic and unpredictable rainfall patterns coupled with protracted periods of drought lasting up to 3 to 4 months. The average annual rainfall is low at only 40 inches whilst evaporation rates can reach 70 inches per year during droughts. Anguilla's low average rainfall is emphasized in **Figure 2** which shows the low median rainfall over the period 1993 – 2014, mostly <100 mm per month, except for October (Anguilla Rainfall Caribbean Regional Climate Centre).

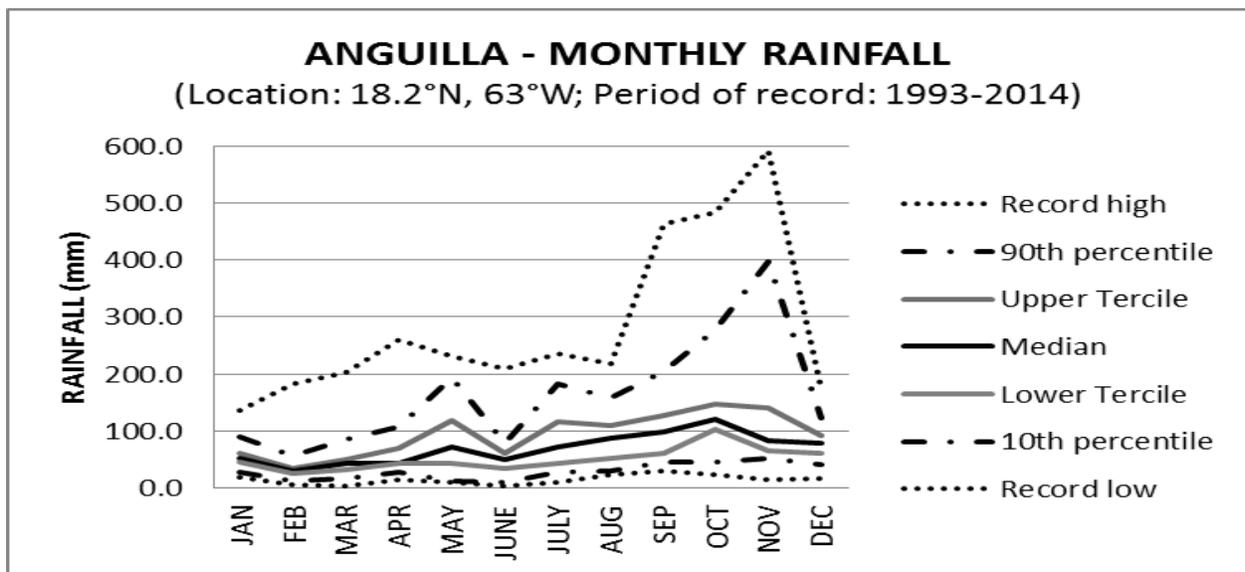


Figure 2: Monthly distribution of rainfall in Anguilla

Source: <https://rcc.cimh.edu.bb/caribbean-climatology/stations/anguilla/anguilla-rainfall/>

#### 1.3.1.1 Rainwater

Anguilla has no rivers and is dependent on rainfall as a natural source of freshwater. Rainwater is collected through various means, such as rooftop harvesting, and stored in reservoirs or cisterns. Anguilla is highly dependent on rainwater harvesting by the population. However, extended drought periods have made this an unreliable source of potable water for the island's inhabitants.

#### 1.3.1.2 Groundwater

Anguilla relies on groundwater as a source of freshwater. The island has an underground freshwater reservoir, in the “Valley area,” which has been tapped by a system of wells and boreholes, to extract freshwater. This aquifer has provided Anguilla's Water Department with 250,000 to 300,000 gallons of water per day for distribution. Anguilla is, however, low-lying, and its groundwater reservoir availability and quality are at risk from saltwater intrusion, pollution, improper waste management practices, and over-extraction. One Anguillan journalist is quoted as saying that *“as the water from the aquifer is depleted, and with very little or no rainfall to replace it, ocean water will stealthily seep into the aquifer increasing the salinity of all the underground water across the island – to the point where there is not much difference between processing water from the ocean and accessing water from the aquifer”*.

#### 1.3.1.3 Desalination

To supplement its freshwater resources, Anguilla has invested in desalination technology. In 2018 the Water Cooperation of Anguilla, the public water utility of Anguilla, entered a 10-year contract with Seven Seas Water, an operating segment of AquaVenture Holdings Limited for the production and supply of drinking water, based on reverse osmosis desalination of seawater. Water production via this contract is set at 750,000 gallons per day. However, in an Anguillan newspaper article dated August 8, 2022, entitled **“Water Problems Confronting Anguilla,”** it was stated that the Government supply of water was not always reliable, and availability was intermittent. The article also pointed to major problems with the island's water infrastructure stating that *“It is believed that over 80% of the water produced by the desalinization water plant on the island, and pumped into the water tanks for distribution, is being lost through leakage along the underground water lines, resulting in only 20% – at most – of the processed water reaching consumers”*.

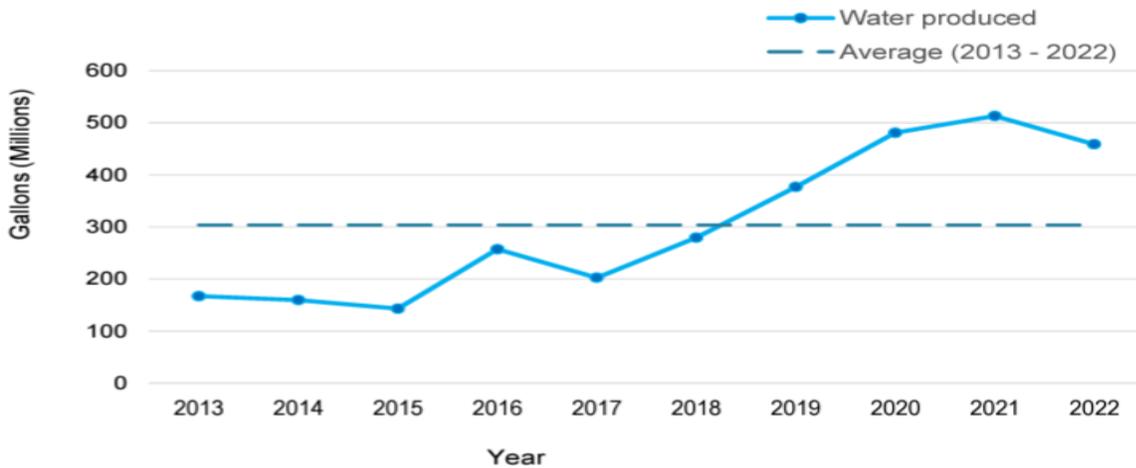
#### 1.3.1.4 Imported Water

During times of drought or increased demand, Anguilla may need to import water from neighboring islands or rely on water shipments. This dependency on external sources highlights the vulnerability of the island's water supply.

The availability of freshwater is not the only challenge but also the distribution. The little available freshwater often goes into the tourism sector with limited resources left for residential use. Tourism is the main contributor to Anguilla's economy and the industry is driving the island's economic recovery; it is also straining the island's limited water resources as tourism is a water-intensive sector that scales up the island's water demand by up to four times.

### 1.4 WATER SUPPLY DEMAND AND USAGE

The distribution of water in Anguilla is carried out by the Water Corporation of Anguilla (WCA), a government-owned utility. The WCA manages the infrastructure, including pipelines, reservoirs, and distribution networks, to deliver water to various areas of the island. While urban areas are predominantly served by piped water supply, some rural areas rely on privately-owned cisterns, wells, or other customized water sources. Four private companies supply desalinated groundwater through truck delivery. **Figure 3** shows an increasing trend in water production over the 10-year period from 2013-2022, reflective of an increasing population and economic activity. A peak production of just over 500M gallons was recorded in 2021 (Anguilla Statistics Department, March 2023).



**Figure 3: Anguilla water production for the period 2013-2022**

(Source: <http://statistics.gov.ai/PublishedDocuments/3.1.5.0%20World%20Water%20Day%202023%20Article.pdf>)

The demand for water in Anguilla is primarily driven by the needs of its residents, businesses, and agricultural activities. The specific factors influencing water demand include:

1. **Residential usage:** Water is required for various household activities such as drinking, cooking, bathing, laundry, and sanitation.
2. **Tourism industry:** As a popular tourist destination, Anguilla experiences an influx of visitors throughout the year. Hotels, resorts, restaurants, and other tourism-related businesses require a substantial amount of water to meet the needs of their guests, from providing drinking water to maintaining amenities such as pools and landscaping.
3. **Commercial and industrial usage:** Non-residential entities such as businesses, offices, and industries also have water needs for operations, including cleaning, cooling systems, manufacturing, and other processes.
4. **Agriculture:** Anguilla's agricultural sector is primarily small-scale and focuses on the cultivation of fruits, vegetables, and livestock production. Farmers require water for cultivating crops and maintaining livestock; with the island's limited freshwater resources, irrigation is crucial for agricultural production, which contributes to overall water demand.

## **1.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY AND QUANTITY)**

One of the principal "connectors" that links people, nature, land, and landscape is water. Although people use it in various life-sustaining, recreational, and service modes, it also provides convenient pollution dilution and disposal services, functioning as a solvent and vehicle for moving pollutants from one location to another (including underground). This is especially true in Anguilla for household and commercial wastewater and its relationship to groundwater.

### **1.5.1 History of IWRM in Anguilla**

The Government of Anguilla adopted the National Environmental Management Strategy and Action Plan (NEMS) in 2001, revised in 2005, a requirement of the Government to discharge its obligations under the St. George's Declaration (SGD) of Principles for Environmental Sustainability in the OECS. Anguilla's National Environmental Management Strategy (NEMS) is a comprehensive and strategic approach to environmental management and sustainable development in Anguilla. It serves as a framework for guiding the conservation, protection, and sustainable use of the island's natural resources while promoting socioeconomic development and community well-being. The NEMS is also intended to serve as a guiding framework to inform policy development, legislation, and planning processes related to environmental management.

In 2006, an Environment Department was established, and an Environmental Protection Bill was drafted, covering water and regulatory issues, but there is no consensus regarding where responsibility for regulation would be vested.

In 2008, the Water Corporation Anguilla (WCA) was established by the Water Corporation Act (2008) to deliver an economic, reliable, and sustainable piped water supply to the inhabitants of Anguilla. The corporation's mandate included harnessing and protecting the island's limited water resources using established Integrated Water Resources Management (IWRM) principles. The management of water resources is governed under the 2007 Water and Wells Act, though the regulations have yet to be drafted, leaving one to conclude that Anguilla has not adopted an IWRM approach to water resource management.

## 1.5.2 Impacts of Water Use and Wastewater Management on Ecosystems in Anguilla

A clean water supply, reliably delivered at an affordable cost, is essential to Anguilla's future. However, rising demand, limited supply, pollution effects, distribution problems, and conservation issues all make this goal more difficult to accomplish. The recent expansion of new residential areas, tourism facilities and economic development enterprises in Anguilla has elevated the demand for water and other public utility services, with a concomitant increase both in waste products and pressure on the landscape, coastal systems, and groundwater supplies.

### 1.5.2.1 Terrestrial Ecosystem

Even during fluctuating drought spells, Anguillians have managed to make the most of their irregular rainfall schedule through careful husbandry, conservation of water, and the usage of cisterns. However, as access to improved sanitation facilities has increased and tourism has flourished, the island's underground aquifer has been pushed to capacity. The pumping rates at Anguilla's wells are at their maximum. Anguilla's aquifer is being depleted, and with very little or no rainfall to replace it, saltwater intrusion is increasing the salinity of all the underground water across the island.

Nitrate concentrations are increasing in most of the production and test wells connected to the underground aquifer in Anguilla (Thelwell, "10 Facts About Sanitation in Anguilla"). There exists a chemical pollution problem in Anguilla's underground aquifer arising from a combination of agricultural fertiliser and/or animal waste, plus wastewater effluent run-off from domestic and commercial septic tanks, seeping untreated into groundwater. In Anguilla, the disposal of domestic septic waste is usually accomplished using septic tanks, pit privies, tile fields, or some type of homemade flow diffuser. Few septic tank systems in Anguilla have proper tile drain fields that discharge the septic tank effluent to the small rock and sand backfill around the buried tank itself. Commercial and public septic tanks are often too small, and they frequently overload, discharging raw sewage.

The absence of significant soil cover leaves limited opportunity for the natural filtration of pathogens, bacteria and viruses as the waste material recharges into the underlying aquifer.

Anguilla's land use planning and development controls have not been effective in reducing these and other waste disposal practices that place groundwater at risk.

#### 1.5.2.2 Aquatic Ecosystem

Anguilla's coastal zone is characterised by an interconnected system that includes coral reefs, seagrass beds, limited mangrove forests, salt ponds, and predominantly white-sanded beaches. Together, they contribute to the delicate balance that protects Anguilla's shoreline and coastal waters from excessive and damaging wave action, hurricanes, and tropical storms while also keeping the area pristine, fish-filled, and white sanded. The only true wetlands on the island are the salt ponds of Anguilla. The salt ponds of Anguilla are areas that are often inundated with brackish, salty, or fresh water.

The expansion of tourism development in Anguilla has had implications for the marine and coastal environment. Anguilla's aquatic ecosystem is at risk from chemical pollution in groundwater that spills into coastal ponds and phosphates from detergents in domestic wastewater which accelerate the growth and proliferation of unpleasant marine algae. This creates murky coastal waters and prevents coral growth. Larger concentrations of coastal tourism facilities have increased sewage discharges into nearshore waters which has resulted in the degradation of coral reefs.

#### 1.5.2.3 Agriculture and Food Production Systems

Minister of Economic Development, Commerce, IT, and Natural Resources with responsibility for Agriculture in Anguilla, the Hon. Kyle Hodge, in his address to members of the Anguilla Farmers Association in August 2020, described the state of agriculture on the island as follows: *“Anguilla is a coral-based island and virtually all the land is non-arable and largely unsuitable for agriculture. A small area of a few acres of arable farming land is located in the area around the main village, The Valley, and those lands are administered by the Department of Agriculture and leased out to local farmers who grow a limited variety of root and field crops. Several micro farms also operate on the island growing small amounts of green leaf lettuce and herbs almost all of which are ordinarily sold to the local restaurants”*.

The shortage of farmland due to degraded and infertile soil has placed constraints on agriculture and food security. Few people are engaged in hydroponics. Environmentally sound soil and water

conservation practices are generally not used in Anguilla, according to agricultural officials. Concepts of crop rotation or fallow land are not well understood. The removal of fruit trees is regulated by legislation and can only be done with the permission of the Department of Agriculture. In practice, this does not occur and fruit trees, with their deeper root systems to help prevent soil erosion, are removed without official approval.

Water is the most expensive part of farming in Anguilla; buying national water is expensive as it is limited. Farming with local water is also difficult. Water pricing does not distinguish personal use from commercial farming, so farmers use well water and cisterns to offset fees. The flat and rocky terrain and the scarcity of freshwater resources have made large-scale agricultural production challenging and restrict the amount of food that can be locally grown. Consequently, Anguilla currently imports virtually all its food supply needs and with the ever-increasing demand for tourism, the volume of fresh produce imports is approaching 3 million pounds a year.

#### 1.5.2.4 Human Health Sanitation

As of 2015, 98% of Anguilla's population gained access to improved sanitation facilities, including the use of a "flush or pour-flush sewer system. In Anguilla, the disposal of domestic septic waste is done using septic tanks, pit privies and tile fields. Although there is a recommended septic tank design for use in Anguilla, many builders deviate from this design. Tanks often malfunction, and partially treated effluent threatens the underground water supply.

Nitrate concentrations in underground water are higher than the maximum acceptable drinking water limit (Thelwell, "10 Facts About Sanitation in Anguilla"). Chronic illnesses and diseases such as high blood pressure, diabetes and cancer from which Anguillans suffer are believed to be related to the poor quality of water that they drink. Most Anguillans, at least 73% of them, still collect water from cisterns that supply water to their houses. Since cistern water is used for drinking as well as for household functions, its low quality is concerning. Rainwater captured in cisterns and other similar containers can be contaminated. They pose a health threat to those consuming the water. Very limited data exists for Anguilla on SDG 6 which seeks to ensure safe drinking water and sanitation for all, focusing on the sustainable management of water resources, wastewater, and ecosystems, and recognising the importance of an enabling environment.

#### 1.5.2.5 Finance Services

Water usage can indirectly affect financial services in small island developing states (SIDS) like Anguilla. SIDS need to invest in water infrastructure, such as dams, reservoirs, pipelines, and treatment plants, to ensure a reliable and safe water supply and sanitation services. These infrastructure projects require significant financial resources, and the financing needs can strain the government's budget. Water scarcity or poor water quality can hinder economic productivity, leading to reduced income and financial services. For instance, industries such as tourism, agriculture and energy generation heavily rely on adequate water supply for their operations. Insufficient water resources can disrupt production and result in economic losses.

The tourism industry in Anguilla also relies on its pristine coastal waters to attract visitors. Water pollution can deter tourists, leading to reduced revenues for the tourism and hospitality sectors. This, in turn, affects the financial services provided to support these industries, such as banking, investment, and loans.

#### 1.5.2.6 Socioeconomic, Security and Livelihood

Ensuring the security and resilience of the island is contingent upon the effective management of water resources, which also benefits agriculture, fishing, and tourism. Anguilla must practice sustainable water resource management to safeguard the socioeconomic well-being of its population. For instance, Anguilla's beaches, clear waters, and marine life are key attractions for tourists, contributing to the tourism industry's revenue. The sustainable use of water resources ensures the preservation of these natural attractions, supporting the socioeconomic well-being of the island. Anguilla's agricultural sector also relies on water resources for irrigation and livestock needs. Enough water resources are strongly linked to farmers' ability to generate money and their ability to feed their families.

It is worth noting that most of the socioeconomic information collected in Anguilla is centered around demographic and employment data. Very little information is available on natural resource use, which makes it difficult to develop, implement, and enforce plans of action that regulate use and work towards conservation and sustainability.

## 1.6 LEGAL POLICY AND INSTITUTIONAL FRAMEWORK

In Anguilla, freshwater management issues have gone largely unaddressed, as the government has not established regulatory measures, incentives, or related decision-making tools, although it has promoted the use of desalination and rainwater harvesting.

In 2006, the Department of the Environment was established, and an Environmental Protection Bill was drafted, which covers water and regulatory issues, but, as of yet, there is no consensus as to where responsibility for regulation would be vested. The Department of Environment has responsibilities for implementing the Government of Anguilla’s environmental policy within the island. The impetus for the development of environmental protection legislation has been directly linked to the signing of the Cartagena Convention’s Protocol for the Control of Land Based Sources of Marine Pollution (LBS Protocol), as before this there was no comprehensive environmental legislation.

The Government of Anguilla promotes and supports the sustainable use and development of the island’s natural resources through a suite of legislation and policies detailed in **Table 1** below.

**Table 1: Natural Resource Management Legislation and Policies in Anguilla**

| Legislation   | Policy  |
|---|---|
| <ul style="list-style-type: none"> <li>• Water and Wells Act (2007)</li> <li>• Environmental Protection Bill (2008) Draft</li> <li>• Land Development Control Act</li> <li>• Marine Parks Act</li> <li>• Trade in Endangered Species Act (2010)</li> <li>• Beach Control Act</li> <li>• Beach Protection Act</li> <li>• Biodiversity and Heritage Conservation Act</li> </ul> | <ul style="list-style-type: none"> <li>• Strategic Country Programme (March 2003 Revision)</li> <li>• UK White Paper on Partnership for Progress and Prosperity</li> <li>• Environment Charter- Anguilla</li> <li>• Native Plant and Animal Habitat Conservation (Biodiversity) Policy</li> <li>• National Environmental Management Strategy and Action Plan</li> <li>• The St. Georges Declaration</li> <li>• National Biodiversity Strategy and Action Plan</li> <li>• Anguilla Invasive Species Strategy</li> <li>• Anguilla Climate Change Policy</li> <li>• Anguilla National Energy Policy</li> </ul> |

The management of water resources is governed under the 2007 Water and Wells Act, though the regulations have yet to be drafted. To ensure the sustainability of groundwater yield for abstraction purposes and to safeguard groundwater quality, the act establishes controls over the abstraction and use of groundwater and includes provisions for the creation of a groundwater resource management plan that lays out policies for groundwater conservation. As of yet, there is no national water policy for Anguilla, though a draft policy has been developed.

In 2008, the Anguilla Water Corporation was established with an exclusive right to supply piped water. The corporation is charged with the responsibility to manage and operate piped water systems in such a manner that the public has a supply of potable water that is reliable, efficient, and economical. The corporation is also mandated to maintain, repair, replace, upgrade, and extend the waterworks when required. The corporation is also empowered to enter into agreements to purchase potable water; to design, construct, acquire and operate facilities to provide potable water for distribution; to abstract groundwater for treatment and distribution; among others. The Department of Health Protection is responsible for the management of waste, food hygiene, vector control, monitoring of drinking water, environmental health, occupational health, and the delivery of low-cost health services.

## **1.7 CHALLENGES FOR IWRM IN ANGUILLA**

Effective IWRM requires strong governance and institutional arrangements to coordinate and manage water resources. In Anguilla, there is a need for improved coordination and collaboration among various stakeholders, including government agencies, local communities, and private sector entities, to implement IWRM effectively.

In Anguilla, the imposition of development control measures is often resisted by the island's residents. Steps by the government to introduce regulations or guidelines to control growth or manage resources are perceived as a loss of individual rights and personal sovereignty over private property. The issues of private gain versus public cost seem to lie at the heart of many of the challenges currently faced by the Government of Anguilla. The unregulated exploitation of beach and dune sand is a classic case in point throughout the Caribbean.

### 1.7.1 Policy and Institutional Challenges

Authority and responsibility for environmental management in Anguilla are not centralised but are dispersed among several government departments. As in most small countries, a single minister in Anguilla has responsibility for several portfolios, which are not always distributed in a way that maximises administrative efficiency. The capacity of the public sector to deal with many priority issues at any one time is seriously limited. Reversals of political leadership can mean abrupt changes in those priority issues targeted by the government at any given point in time. The distinction between the political leadership of government and the civil service is blurred in Anguilla more than it is in larger countries. There is a good deal of movement of individuals between the two, as well as a relatively high proportion of appointed rather than elected membership in the legislative body. In short, the pool of available talent is relatively fixed and limited by the island's small population and by the significant number of citizens who emigrate.

There is limited institutional coordination and oversight to support IWRM in Anguilla. While there may be laws related to water resources, fragmented institutional structures, overlapping responsibilities, and limited governance frameworks have hindered the management and protection of water resources. It has also resulted in a lack of coordination and monitoring of water-related activities, creating challenges in achieving integrated and sustainable management of water resources.

Land development in Anguilla, for example, has occurred largely in an ad hoc and unregulated manner, in the absence of an official land use policy. Inadequate or ineffective development planning has had serious consequences for, the following resource issues: conserving and managing the island's limited groundwater resources; minimising the incidence and environmentally damaging effects of indiscriminate sand mining; regulating shoreline developments to decrease coastal erosion; reducing the loss of scarce agricultural land to building development.

### 1.7.2 Water Supply and Distribution Infrastructure

Anguilla's primary water management problems stem from the fact that there are limited freshwater resources to manage. The island relies heavily on rainfall for its water supply; however,

rainfall on the island is erratic and unreliable and during dry periods, water scarcity becomes a major issue. This makes it challenging to manage water resources effectively and sustainably.

Anguillans also use underground water from the island's aquifer; however, the demand for water resulting from the expansion of new residential areas and tourism facilities has devastated the groundwater supply in Anguilla. Desalinated water is used on the island, but this is expensive.

Water quality is another challenge in Anguilla. Contamination of water resources from various sources, including urban runoff, agricultural activities, and improper disposal of waste, has impacted the availability and suitability of water for various uses.

The water supply and distribution infrastructure in Anguilla is outdated and in need of repair or replacement. Aging pipes and other components have led to leaks, loss of water, and inefficiencies in water distribution. Non-revenue water has been estimated at 80% of production. There are also sectoral disparities in access to water supply and distribution infrastructure and often, tourism trumps residential needs.

### 1.7.3 Impact of Climate Variability and Change on the Water Supply

How climate change may impact the management of water resources in the Caribbean depends on several factors, including the demand for water and the ability of water utilities to supply it from both natural and artificial sources. The hydrologic cycle, which describes the movement of water from the seas to groundwater and surface water storage, has a direct impact on climate and water supplies. The amount and quality of groundwater resources are anticipated to be impacted by future climate change and climate variability. Anguilla is susceptible to the effects of climate change, which has impacted the quantity and quality of water resources as well as exacerbated water scarcity.

### 1.7.4 Freshwater Shortages/Drought

Climate change has altered the rainfall patterns in Anguilla. Reduced rainfall has resulted in lower water availability in groundwater sources, leading to reduced water supply for domestic, agricultural, and tourism uses. Climate change has created more intense drought conditions; the result has been increased evaporation rates, reduced water availability, depletion of groundwater

reserves, and increased competition for limited water resources. Rising sea levels, consequent to climate change, in combination with increased groundwater extraction have increased saltwater intrusion in Anguilla's groundwater aquifers. Saltwater intrusion into groundwater aquifers has resulted in higher treatment costs for groundwater as the supply has gone saline.

#### 1.7.5 Damage to Infrastructure

Notwithstanding the severe lack of farmland, Anguilla faces yearly threats from climate change and intense weather conditions in the form of higher temperatures, storms, and floods. Hurricane Irma, for example, destroyed many farms and the threat of future hurricanes means that fruits and vegetables must be planted early enough in the season so they can be harvested before hurricane season. Although protected structures are necessary to safeguard plants, they are not meant to be permanent. They must be disassembled and stowed as soon as a hurricane alert is issued.

Anguilla's fisheries and tourism sectors are also vulnerable to climate change hazards, including tropical storms and hurricanes passing through or near the island during the hurricane season. Between 1995 and 2010, Anguilla was hit by eight such events. These events caused significant damage to coastal resources due to strong winds, wave action, torrential rain, and floods, which have damaged the island's reefs, coastline, water supply and distribution infrastructure, and contaminated water sources, resulting in water shortages and compromised water quality. For example, in 1999, Hurricane Lenny impacted the island with torrential rains and major tidal surges. Inland areas were flooded to depths of up to 15 feet, including the capital. Many hotels were closed for a year, which affected tourism-dependent livelihoods. Again, in 2017, Hurricane Irma impacted Anguilla, causing destruction to critical infrastructure. In the fishing sector, fishermen reported significant losses or damage to fishing vessels and fish traps.

#### 1.7.6 Socioeconomic Challenges

Anguilla, like other small island developing states, is exposed to climate hazards such as rising sea levels, increased ocean acidity and increased ocean temperature. These hazards in turn have resulted in habitat alteration and loss, e.g. coral bleaching; reduced abundance and diversity of marine plants and animals; shifts in the distribution of fish species because of changes in ocean

currents and temperature; and alteration of the length and timing of spawning seasons. Consequently, Anguillans have been subject to:

- loss of livelihoods
- reduced income for fisheries and tourism dependent households
- loss of coastal lands and displacement of fishing communities
- Increased poverty
- Inadequate nutrition (notably protein intake)
- Reduced food security
- Reduced foreign exchange earnings.

#### 1.7.7 Capacity Constraints, Data Availability and Use

The management of water resources requires adequate and reliable data. Anguilla's small size and population have limited the development of a robust data infrastructure. Limited human resources and expertise in data collection, management, and analysis have hindered the availability and use of data in Anguilla. Traditional attitudes, resistance to change, a lack of awareness about the potential benefits of data availability and the absence of a data-driven culture have obstructed the effective utilisation of available data. Other than traditional climatic data, there is no continuous record or monitoring of water resources.

Physical infrastructural damage to telecommunications networks, internet connectivity, and information systems from extreme weather events on the island has also had a limiting effect. Collecting and standardising data across different sectors and organisations has also created a challenge to data availability, as a lack of coordination and discrepancies in data collection methods have led to incomplete and inconsistent data, making it difficult to compare and analyse information.

## 1.8 CONCLUSION

Anguilla faces several water-related issues due to its small size, limited freshwater availability, dependence on desalination and climate change impacts. In Anguilla, freshwater management issues have gone largely unaddressed, as the government has not established regulatory measures,

incentives, or related decision-making tools, although it has promoted the use of desalination and rainwater harvesting. Addressing these water issues requires a multi-faceted approach, including investment in sustainable water management practices, promotion of water conservation, development of infrastructure for wastewater treatment, and adaptation to the impacts of climate change and disaster risk management.

Moreover, the legislative and policy framework to support IWRM in Anguilla requires urgent attention and must be coupled with the enactment of laws and the implementation and enforcement of policies. The present-day benefits of tourism driven development must be weighed against the sustainable future of the island.

## 2 ANNEX B: THE BAHAMAS

### 2.1 OVERVIEW

The Commonwealth of the Bahamas, an archipelago comprising around 700 islands and cays, is strategically located in the North Atlantic Ocean. Encompassing a total land area of 13,880 km<sup>2</sup>, the nation extends from the eastern vicinity of Florida to the northeast of Cuba and Haiti. Divided into 31 districts, including New Providence Island, Grand Bahama, and the Family Islands, the country showcases diverse landscapes, including flat terrain, rolling hills, and unique features like extensive coral reefs and limestone formations.

With a population of approximately 407,906 inhabitants as of 2021, The Bahamas faces challenges such as economic disparities, vulnerability to climate change, and significant dependence on tourism. The economy, characterized by a reliance on tourism and agricultural activities, is susceptible to external shocks. Water resource management is a critical concern due to limited freshwater availability, relying heavily on fragile freshwater lenses within limestone aquifers.

The Bahamas employs desalination and rainfall catchment to supplement its water supply, addressing challenges like substantial water losses and brackish water sources. Additionally, industrial and commercial activities, particularly in tourism and manufacturing, contribute to increased water demand and environmental concerns. The country's overall status of Integrated Water Resources Management (IWRM) implementation indicates a medium-low level of progress, emphasizing the need for sustainable practices and improved institutional arrangements.

### 2.2 PHYSICAL GEOGRAPHY AND SOCIOECONOMIC CONTEXT

#### 2.2.1 Physical Geography

The Bahamas, officially known as the Commonwealth of the Bahamas, is an archipelago comprising approximately 700 islands and cays in the North Atlantic Ocean (see **Figure 4**).



**Figure 4: Bahamas map. (FAO 2015)**

It stretches from 80 km east of Florida to 80 km northeast of Cuba and Haiti, covering a total land area of 13,880 km<sup>2</sup>. Politically divided into 31 districts, the country is geographically classified into three main areas: New Providence Island (capital Nassau), Grand Bahama (home to Freeport), and the Family Islands (encompassing other islands and cays). The landscape features flat terrain, elevations under ten meters, rolling hills, and the highest point on Cat Island at 63 meters above sea level. Unique geographical elements include extensive coral reefs, seagrass beds, and limestone formations (USACE 2014).

### 2.2.2 Population and Social Impact

The Bahamas has a diverse population of 407,906 inhabitants as of 2021. The country's archipelagic nature poses transportation and connectivity challenges among the scattered islands. Economic growth has yet to be evenly distributed among the population. As of the 2013 Household Expenditure Survey, 13 percent lived below the national poverty line, contributing to a high Gini

index of 41.4. While official poverty indicators have not been available since 2013, improvements in the Human Development Index, particularly in education and life expectancy components, have been noted. However, vulnerability to climate change, exacerbated by events like Hurricane Dorian in 2019, poses a significant threat. The country faces an average annual loss of over 6 percent of GDP from windstorms, amounting to US\$850 million. The COVID-19 pandemic has exacerbated economic challenges, with job losses particularly impacting vulnerable populations, including low-income households, informal workers, and women (World Bank 2021).

### 2.2.3 Economy

The Bahamas portrays a diverse economy with tourism as a significant driver, attracting visitors to its beaches, marine life, and cultural attractions. New Providence and Grand Bahamas, along with Nassau and Freeport, serve as economic hubs. Agriculture, which contributes to cultivating temporary and permanent crops, is vital. Natural resources like timber, salt, and aragonite play a role. Financial vulnerabilities include dependence on tourism, susceptibility to external shocks, and the need for sustainable practices to ensure resource longevity.

## **2.3 STATUS OF WATER RESOURCES MANAGEMENT IN THE BAHAMAS**

### 2.3.1 Source

The Bahamas faces challenges in freshwater availability due to limited and vulnerable resources. With an estimated internal renewable water resource of 700 million m<sup>3</sup>/year, the country heavily relies on fragile freshwater lenses within shallow limestone aquifers. The absence of rivers or streams results from the limestone surface's low relief and high permeability, allowing rainwater to percolate quickly. Inland water bodies are typically saline or brackish, and freshwater is primarily sourced from freshwater aquifers. Desalination, producing 7.4 million m<sup>3</sup>/year in 2000, and rainfall catchment play roles in the water supply (BEST 2006).

### 2.3.2 Distribution

Water use in the Bahamas is carefully managed due to finite freshwater resources. In 2013, total municipal water withdrawal was 31 million m<sup>3</sup>/year, with significant demand driven by the tourism sector, which attracts approximately 4 million visitors annually. The primary water source

is fresh groundwater, with desalination increasing usage, particularly in regions with declining groundwater availability. Agriculture has a limited impact on New Providence but supports development in Grand Bahama and many Family Islands. Water losses are substantial, estimated at 53 percent in New Providence (UNICEF 2020).

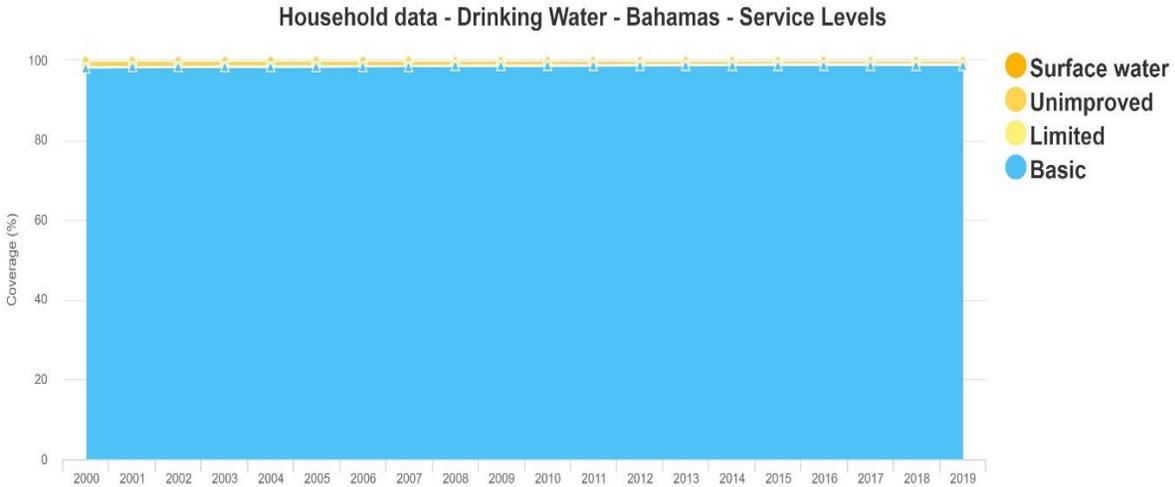
## **2.4 WATER SUPPLY DEMAND AND USAGE**

### **2.4.1 Irrigation and Drainage**

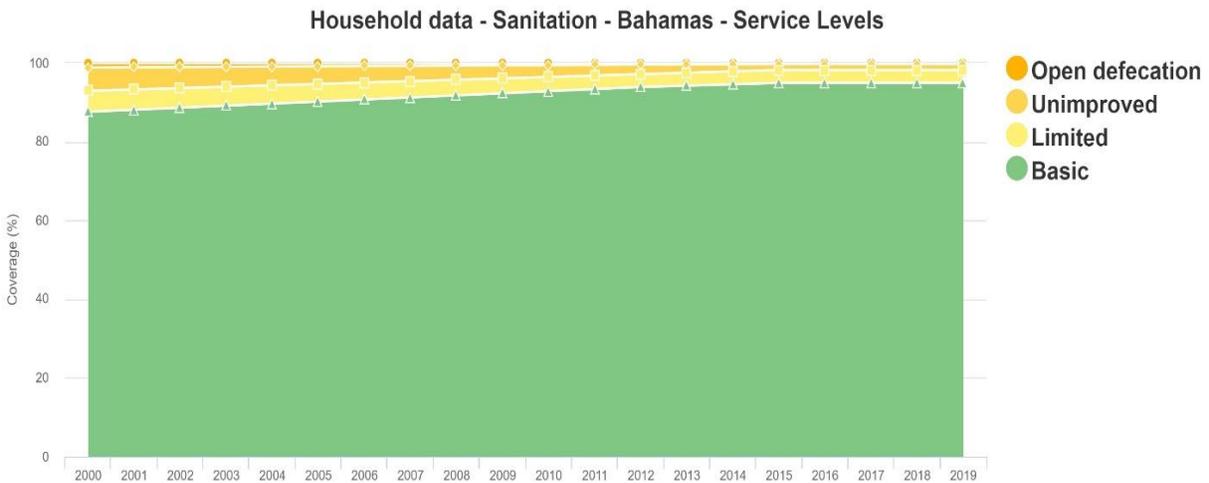
Irrigation in the Bahamas is limited, with an estimated 8 per cent of cultivated land equipped for irrigation in 2012, covering around 1,000 ha. The main crops under irrigation are vegetables and citrus. The country faces challenges in irrigation development due to its limited freshwater resources. Drainage systems are implemented to manage cultivated areas, but salinization remains a concern. The overall water management scenario includes various sources, such as large-scale groundwater supply, private wells, desalination, water trucking, and bottled water. The use of desalination is expected to increase, especially in regions with declining fresh groundwater availability (FAO 2015).

### **2.4.2 Domestic Access to Water and Sanitation**

In the Bahamas, 88% of the population benefits from a piped water supply, primarily concentrated in densely populated areas, while smaller and remote communities may face water scarcity challenges. Geographical disparities lead to variations in piped water availability, with certain islands relying on brackish water sources. Economic challenges are evident, prompting the use of alternative methods like desalination in low-density regions. Urban water supply in New Providence sees 98% of the population accessing safe water, with the Water and Sewerage Corporation playing a pivotal role, supplying half of the consumed water through wells and desalination. The burgeoning popularity of bottled water underscores concerns about the unregulated private well system, estimated at around 30,000 wells, emphasizing the need for sustainable resource management in water supply methods like desalination and water trucking.



**Figure 5: Household data, drinking water – Bahamas (JMP, 2020).**



**Figure 6: Household data, drinking water – Bahamas (JMP, 2020).**

### 2.4.3 Industrial and Commercial Uses, Needs, and Impact

In New Providence, the Government has allocated 51 hectares of land for industrial purposes, with the Soldier Road Industrial Park covering 10.5 hectares and the Agro-Industrial Park encompassing the remaining 40.5 hectares. The Bahamas Agricultural and Industrial Corporation grants permission to lease land in these parks for periods of ten or more years. Various tenants occupy the industrial land, including light manufacturing companies and small to medium-sized businesses involved in agriculture, food processing, landscaping, and construction/home improvement. The tourism industry, a significant economic driver, exerts considerable pressure on

freshwater resources, with over 3 million annual visitors consuming an estimated 400 to 1,000 litres of water per person daily (FAO 2015).

As this industry expands, there is a growing demand for additional high-quality water. Notably, industries such as Bacardi, hotels, electric companies, and private enterprises, including bottled water companies, utilize reverse osmosis (RO) to produce millions of gallons of potable water daily. The manufacturing and industrial operations in and around Freeport in Grand Bahama contribute significantly to aquifer contamination, releasing non aqueous phase liquids (NAPLs), heavy metals, and other pollutants into the groundwater. These operations involve using and disposing of fuels, lubricants, hydraulic fluids, and cleaning solvents, contributing to environmental concerns. Furthermore, new golf course constructions associated with large resorts on various islands will escalate water demands, with a planned golf course in New Providence alone projected to use 1 million gallons per day. Additionally, large volumes of non-potable water, such as seawater or saline groundwater, are extensively used for cooling purposes in New Providence's aquariums and for other industrial activities (FAO 2015).

## **2.5 LINKAGES BETWEEN IWRM AND WATER QUALITY & QUANTITY**

### **2.5.1 Challenges and Future Outlook**

The Bahamas encounters challenges related to climate change, global health risks, and economic vulnerabilities. Sea-level rise, associated with increasing temperatures, threatens the low-lying islands. Hurricane impacts, like those from Hurricane Dorian in 2019, contribute to annual losses of over 6 percent of GDP. The COVID-19 pandemic has exacerbated economic challenges, leading to job losses, particularly among vulnerable populations. Recovery and future water resource management will depend on successful vaccination efforts and financial stability in major tourism-source markets, such as the United States and Canada. Addressing water losses and enhancing water supply infrastructure is essential for building resilience in the face of ongoing challenges.

The transportation of freshwater from other islands, primarily Andros, to the main island of New Providence in the Bahamas is a crucial aspect of the country's water supply infrastructure. The dependence on inter-island water transfer highlights the challenges related to the scarcity of freshwater resources in New Providence. This practice underscores the significance of sustainable

water management strategies, as the demand for freshwater on the main island, driven by population growth and urban development, requires efficient and reliable water supply mechanisms. Additionally, the reliance on water transfer between islands underscores the vulnerability of the freshwater supply system to potential disruptions, emphasising the importance of resilience and adaptation measures in the face of climate-related events or other challenges.

**Challenges:**

- **Limited Freshwater Resources:** The Bahamas faces challenges due to its limited freshwater resources, relying on fragile freshwater lenses in shallow karstic limestone aquifers.
- **Climate Change Vulnerability:** Rising sea levels and increased temperatures threaten low-lying islands, impacting water resources and ecosystems.
- **Tourism-Induced Stress:** Heavy dependence on tourism contributes to water challenges, with significant water consumption by tourists and associated infrastructure demands.
- **Unequal Water Distribution:** Inequality in the distribution of economic benefits and water resources results in disparities in the population's access to water and sanitation services.
- **Economic Vulnerability:** The country's financial position remains vulnerable due to its small size, lack of diversification, and susceptibility to natural disasters.
- **High-Income Inequality:** The Bahamas experiences high-income inequality, reflecting disparities in consumption among different population segments.
- **Hurricane Impacts:** The severe impacts of hurricanes, exemplified by Hurricane Dorian in 2019, contribute to economic losses and affect water resources.
- **Health Risks from Climate Change:** Global health risks associated with climate change, including the potential spread of diseases, pose development challenges.

- **Job Loss from External Shocks:** Vulnerable populations, such as low-income households and informal workers, experience job losses during events like the COVID-19 pandemic, impacting human development.
- **Water Quality Concerns:** Industrial and manufacturing activities contribute to the contamination of aquifers, posing risks to terrestrial and aquatic ecosystems.
- **Non-Conventional Water Sources:** Dependence on non-conventional water sources, such as desalination, raises challenges for sustainable water supply.
- **Water Losses:** High water losses, with estimates indicating 53% loss in New Providence, pose challenges to efficient water management.
- **Over-Extraction of Groundwater:** Large-scale groundwater extraction, particularly for agriculture and tourism, raises concerns about sustainability and ecosystem impacts.
- **Wastewater Management:** Inadequate wastewater management, including the discharge of treated and untreated wastewater, contributes to pollution of terrestrial and aquatic environments.
- **Infrastructure Gaps:** Insufficient water infrastructure in rural areas and Family Islands creates challenges in providing access to safe water and sanitation services.

**Impacts:**

- **Aquifer Contamination:** Industrial and manufacturing operations contribute to the contamination of aquifers, impacting both terrestrial and aquatic ecosystems.
- **Sea-Level Rise Impact:** Rising sea levels associated with climate change jeopardize low-lying islands, affecting coastal ecosystems and freshwater resources.
- **Ecosystem Disruption:** Hurricanes and climate change events lead to ecosystem disruption, affecting biodiversity and the balance of terrestrial and aquatic ecosystems.

- **Tourism-Induced Impact:** Tourism, while a significant economic driver, puts stress on water resources, impacting aquatic ecosystems and local biodiversity.
- **Social Inequality Impact:** Economic disparities in water access contribute to social inequality, affecting vulnerable populations and exacerbating poverty.
- **Economic Vulnerability Impact:** The country's economic vulnerability affects water infrastructure development and resilience against water-related challenges.
- **Health Impact:** Climate change-related health risks and inadequate water and sanitation services impact public health and well-being.
- **Water Scarcity Impact:** Limited freshwater resources and increased water demand lead to water scarcity, affecting terrestrial and aquatic ecosystems.
- **Natural Disaster Impact:** Hurricanes and other natural disasters have severe consequences on water resources, ecosystems, and infrastructure.
- **Job Losses Impact:** Economic downturns, such as those caused by the COVID-19 pandemic, result in job losses, impact communities, and hinder water and sanitation projects.
- **Water Quality Impact:** Industrial activities contribute to water pollution, affecting surface water quality and groundwater.
- **Over-Extraction Impact:** Large-scale groundwater extraction leads to aquifer depletion, impacting ecosystems and reducing freshwater availability.
- **Non-Conventional Sources Impact:** Dependence on non-conventional water sources, like desalination, has energy and environmental implications, affecting ecosystems.
- **Water Losses Impact:** High water losses in distribution systems impact water availability, infrastructure maintenance, and overall water management.

- **Infrastructure Gaps Impact:** Inadequate water infrastructure in rural areas and Family Islands hinders access to safe water and sanitation services, impacting human health and the environment in the Bahamas.

## **2.6 LEGAL POLICY AND INSTITUTIONAL FRAMEWORK**

The water and land management landscape in The Bahamas is shaped by a complex legal and policy framework. The Bahamas Water and Sewerage Corporation Act (1976) and the Out Islands Utility Act contribute to the legal foundation for water management, emphasising water rights, protection, and regulation (Government of the Commonwealth of the Bahamas 2022). Challenges arise from outdated legislation, as current laws need more clarity and protect groundwater resources fully.

Land management responsibilities are distributed among various agencies, including the Ministry of Works and Utilities, the Ministry of Agriculture, Fisheries and Local Government, and the Department of Environmental Health Services. While legislative acts like the Town Planning Act (1961) and the Environmental Health Services Act (1987) play roles in controlling land use, a fragmented regulatory environment poses challenges. A comprehensive legislative framework for sustainable land use practices is needed, necessitating a review and update of existing laws.

Sustainable land management initiatives face hurdles due to blurred jurisdictional lines and overlapping responsibilities. The Environmental Impact Assessment (EIA), administered by the Bahamas Environment, Science and Technology (BEST) Commission, serves as a tool to evaluate projects' environmental impacts. However, the absence of a singular environmental regulatory body results in a lack of regulations controlling groundwater use and abuse, which is crucial for safeguarding water resources.

In summary, The Bahamas grapples with a legal and policy landscape that requires modernization and consolidation to address water and land management challenges. Revisiting existing legislation, streamlining responsibilities, and establishing a comprehensive regulatory framework are essential to achieving sustainable resource allocation and safeguarding the country's environmental integrity.

## 2.6.1 National Setting

**Table 2: National legal framework relating to IWRM.**

| <b>National Legislation</b>                                  |             |  |
|--|-------------|--|
| <b>Legislation</b>   | <b>Year</b> | <b>Summary</b>   |
| <b>Public Works Act</b>                                      | 1963        | Regulates construction, management, and development of public works, buildings, and roads. Empower the Minister for Public Works to make rules for property use, obstruction, alteration, and more.  |
| <b>Coastal Protection Act</b>                                | 1968        | Addresses coast protection against erosion and sea encroachment. It grants the Minister power for coast protection work, places restrictions on private work, and includes provisions for charges, compensation, and regulations.  |
| <b>Conservation and Protection of the Physical Landscape</b> | 1997        | Outlines procedures for excavation, landfill operation, and tree species removal. Aims to limit destruction of ecologically significant trees, particularly concerning water percolation rates, to mitigate climate change impacts.                                      |
| <b>National Biodiversity Strategy and Action Plan</b>        | 1999        | Focuses on biodiversity conservation, establishment of BEST Commission, National Biodiversity Task Force, and other initiatives. Some proposals, like non-implementation of data management project recommendations, still need to be completed.                         |
| <b>Bahamas National Investment Policy</b>                    | 2002        | Supports investment-friendly climate, ensures complementarity of Bahamian and overseas investments, and promotes sustainable resource exploitation. Information on investment incentives, areas for foreign and Bahamian investors, and associated benefits is provided. |
| <b>Bahamas Building Code</b>                                 | 2003        | Sets minimum standards for building design, construction, and material use. Being reviewed and updated for greater resilience to climate change impacts, particularly storm events and sea level rise.   |
| <b>National Wetlands Policy</b>                              | 2004        | Aims to protect wetlands by providing guidelines for their sustainable management.   |
| <b>Environmental Health Services Act</b>                     | 2004        | Regulates public and private waste collection, transportation, and disposal and defines duties of waste collectors. Prohibits littering and illegal dumping of waste.  |
| <b>National Environmental Management and Action Plan</b>     | 2005        | Focuses on environmental policy adoption, new legislation, the establishment of the environmental department, governance structure, and funding. It aims to improve human resources, services, training, information management, compliance, and enforcement.            |
| <b>National Policy for the Adaptation to Climate Change</b>  | 2005        | Addresses climate change impacts on various sectors defines adaptation measures and emphasizes the integration of climate considerations into planning and development.  |
| <b>Planning and Subdivision Act</b>                          | 2006        | Organizes mitigation, preparedness, response, and recovery from emergencies and disasters.   |
| <b>Roads Act</b>   | 2006        | Classifies, declares, constructs, maintains, and controls public roads. Deals with issues like water discharge, vegetation control, sand removal restrictions, and land acquisition.   |

|  |      |   |
|--|------|---|
| <b>Utility Regulation and Competition Authority Act</b>      | 2009 | Governs the electronic communications sector, covering regulatory and competition issues. Combines national communications regulator and competition authority roles into one agency, URCA.   |
| <b>Disaster Preparedness and Response Act</b>                | 2010 | Provides for land use planning, regulates subdivision of land, and aims to ensure efficient infrastructure provision and sustainable development.   |
| <b>Master Plan for The Bahamas National Protected Area</b>   | 2012 | Identifies targets for expanding protected areas for terrestrial and marine ecosystems to meet the Convention on Biological Diversity obligations.  |
| <b>Bahamas National Energy Policy</b>                        | 2013 | Aims to improve energy sector circumstances, increase awareness on energy conservation, enhance infrastructure, and reduce dependency on imported oil. Focuses on diversifying energy sources and achieving 30% renewables in the energy mix by 2030.   |
| <b>Montreal Protocol (Controlled Substances) Act</b>         | 2013 | Restricts use, manufacture, and sale of controlled substances to comply with the Montreal Protocol. Enforces licensing and quota system for controlled substances, specifically Hydro chlorofluorocarbons (HCFCs).  |
| <b>Bahamas Protected Areas Fund (BPAF) Act</b>               | 2014 | Establishes BPAF as a body corporate, defines its functions and powers, and outlines the system of protected areas in The Bahamas. Includes protection of carbon sinks.   |
| <b>Forestry Act (Amended 2014) and Forestry Regulations</b>  | 2014 | Amends Forestry Act for conservation and control of forests. Establishes Forestry Unit, regulates wood exploitation, declares, and manages forest reserves, and monitors protected trees. Forestry Regulations amended to include carbon sequestration, reforestation, and protection of designated areas vulnerable to sea-level rise. |
| <b>Bahamas Public Parks and Public Beaches Authority Act</b> | 2014 | Establishes the Public Parks and Public Beaches Authority as a body corporate. Defines its functions and powers, including control, planning, development, administration, and conservation of public parks and beaches.  |
| <b>SIDS DOCK</b>   | 2015 | Treaty establishing the SIDS Sustainable Energy and Climate Resilience Initiative, connecting the energy sector in SIDS with global markets for finance and sustainable energy technologies.  |
| <b>Electricity Act (Renewable Energy) (Amended)</b>          | 2015 | Overhauls the country's energy sector, sets policy targets for security, diversification, and access to sustainable electricity. Encourages higher capacity of renewables, reorganizes the electricity sector, promotes residential renewable energy generation, and emphasizes energy efficiency.                                      |
| <b>The Water and Sewerage Corporation Act (Amended)</b>      | 2015 | Establishes Water and Sewerage Corporation for the grant and control of water rights. Aims to protect water resources, regulate water extraction, use, and supply, and ensure proper sewage disposal. In 2017, the Government was granted a loan to enhance water sector resilience in the face of climate change.                      |
| <b>The Bahamas' National Maritime Policy</b>                 | 2015 | Developed by the Ministry of Transport and Aviation, aims to promote sustainable economic development of marine resources and activities. Includes recommendations for policies to improve climate resilience.  |
| <b>National Development Plan: Vision 2040</b>                | 2016 | Provides a roadmap for future development, highlighting the importance of protecting both natural and built environments.   |

|   |      |   |
|---|------|---|
|   |      | Incorporates comprehensive reforms for climate change adaptation and mitigation.  |
| <b>National Tourism Development Strategy 2017-2022</b>  | 2017 | Seeks to increase growth and development of the tourism sector. Includes objectives related to environmental conservation and sustainable tourism.  |
| <b>Environmental Planning and Protection Act</b>  | 2019 | Aims to protect the environment, establish a legal framework for environmental protection, promote sustainable policies, plans, and public participation, and create mechanisms for effective project implementation. Covers environmental planning, impact assessment, compliance, incidents, and emergencies. |
| <b>Environmental Protection (Control of Plastic Pollution) Act, 2019</b>  | 2019 | Prohibits single-use plastic and non-biodegradable, oxo-biodegradable, and biodegradable single-use plastic bags. Regulates compostable plastic bags and addresses the release of balloons.   |
| <b>Bahamas Power and Light (BPL) requirements for grid interconnection of small-scale renewable energy generation systems</b> | 2020 | Describes general provisions and technical requirements for connecting small-scale renewable generation systems to BPL's power system. Ensures compatibility, safety, and high standards of power quality.  |
| <b>Civil Aviation Authority Bahamas (CAAB) Environmental Regulation</b>   | 2021 | Based on ICAO model regulations, establishes environmental criteria for monitoring, reporting, verification, offsetting, and reducing CO2 emissions in the aviation sector.   |
| <b>Climate Change and Carbon Market Initiatives Act</b>   | 2022 | Draft law to support the Paris Agreement, reduce greenhouse gas emissions, and establish a carbon credits market. Aims to ensure compliance with the Paris Agreement and create incentives for emission reduction initiatives.  |
| <b>Carbon Credit Trading Act</b>  | 2022 | Draft bill for the regulatory framework of carbon credit trading. Establishes requirements for business conduct, product listings, registration, financial resources, data protection, AML/CFT measures, and defines offences, penalties, and sanctions for non-compliance.                                     |
| <b>Grand Bahama Power Company (GBPC) rules and regulations for Renewable Generation Systems (RGS)</b>                         | 2022 | Guidelines for connecting renewable generation systems to GBPC's grid. Covers safety, capacity limits, customer installations, billing, credits, and technical requirements for wind and solar-powered systems.   |
| <b>Bahamas National Trust (Preservation of Natural Parks) Bylaws</b>  | 2022 | Applies to trust property held by the Bahamas National Trust for National Parks. Covers conservation, preservation, protection, environmental regulations, and restrictions on activities in designated National Parks.   |

## 2.6.2 Regional Setting

**Table 3: Regional legal framework relating to IWRM.**

| <b>Date</b>     | <b>Agreement</b>                                      | <b>Countries Involved</b>  | <b>Region</b>                   | <b>Summary</b>  |
|-----------------|---|--|---------------------------------|---|
| <b>Jan 2014</b> | Caribbean Community Common Fisheries Policy Agreement | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Guyana, Grenada, | Latin America and the Caribbean | Establishes a common fisheries policy for sustainable development in the Caribbean, promoting cooperation |

|                 |  |  |                                 |   |
|-----------------|--|--|---------------------------------|---|
|                 |  | Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda   |                                 | among member countries.   |
| <b>Oct 2011</b> | Delimiting Line between Bahamas and Cuba Agreement   | Cuba, Bahamas  | Latin America and the Caribbean | Defines the maritime boundaries between the Bahamas and Cuba, ensuring clear demarcation and cooperation in the delimited areas.            |
| <b>Aug 2008</b> | CARIFORUM-European Community Economic Partnership Agreement  | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Guyana, Grenada, European Union, Dominican Republic, Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda   | Europe                          | Establishes an economic partnership between CARIFORUM states and the European Community, fostering trade, development, and cooperation.     |
| <b>Feb 2004</b> | Protocol to the Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean (ZTSC) | Venezuela, Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, El Salvador, Panama, Nicaragua, Mexico, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Honduras, Guyana, Guatemala, Grenada, Dominican Republic, Dominica, Cuba, Costa Rica, Colombia, Barbados, Belize, Bahamas, Antigua and Barbuda | Latin America and the Caribbean | Enhances sustainable tourism in the Caribbean, outlining guidelines and cooperation for responsible tourism development in the region.      |
| <b>Feb 2002</b> | Caribbean Regional Fisheries Mechanism Agreement   | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Guyana, Grenada, Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda  | Latin America and the Caribbean | Establishes a regional fisheries mechanism to promote effective management and conservation of fisheries resources in the Caribbean.        |
| <b>Dec 2001</b> | Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean (ZTSC)                 | Venezuela, Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, El Salvador, Panama, Nicaragua, Mexico, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Honduras, Guyana, Guatemala, Grenada, Dominican Republic, Dominica, Cuba, Costa Rica, Colombia, Barbados, Belize, Bahamas, Antigua and Barbuda | Latin America and the Caribbean | Establishes a sustainable tourism zone in the Caribbean, promoting eco-friendly tourism practices and collaboration among member countries. |

### 2.6.3 Synergies Between State, Gaps and Areas to be Harmonised

Various government agencies are crucial in managing land use, environmental health, and sustainable development. The Water & Sewerage Corporation (W&SC) serves as a legislative agency under the Department of Environmental Health Services administration. Established in

1976, the W&SC aims to control and ensure the optimal development, use, and protection of national water resources. However, challenges arise due to legal and institutional overlaps, particularly in the water and sewerage service industry. Additional regulatory bodies, such as the Ministry of Health, the Ministry of Works and Utilities, and the Department of Agriculture, share water resource management responsibilities. Efforts to address overlaps include the creation of the Joint Water Quality and Pollution Control Unit, emphasizing the importance of collaboration among stakeholders. The Bahamas Environment, Science and Technology (BEST) Commission is crucial in coordinating efforts and influencing environmental protection and resource management policies. Several legislative acts contribute to the legal framework, but gaps persist, urging the need for a comprehensive water resources management policy and regulatory instruments. Stakeholders, including the W&SC and various government bodies, are essential in shaping and implementing effective strategies to address land degradation and ensure sustainable water management in the Bahamas (UNEP 2021).

**Table 4: Institutional Framework in The Bahamas**

| <b>Government Agency</b>   | <b>Functions Affecting Land Degradation</b>   | <b>Website</b>                              |
|--|---|---|
| <b>Bahamas Environment, Science and Technology (BEST) Commission</b> | - Act as the National Focal Point for the UNCCD and CBD. - Coordinate activities related to environmental management. - Coordinate the development of environmental policy, strategy, and action programmes. - Develop EIA guidelines and procedures for various sectors. - Support efforts to combat land degradation. | <a href="#">BEST Commission</a>             |
| <b>Department of Agriculture</b>                                     | - Implement policies to achieve sustainable growth and development of the agricultural sector through optimal use of land and freshwater resources.   | Department of Agriculture                   |
| <b>Department of Environmental Health Services</b>                   | - Monitor and enforce sustainable environmental practices adopted into law. - Regulate solid waste management and land use utilization for landfills.   | Department of Environmental Health Services |
| <b>Department of Lands &amp; Surveys</b>                             | - Regulate and monitor land belonging to the Crown (land held in trust by Her Majesty Queen Elizabeth II on behalf of the Bahamian people), including the seabed. - Dispose and lease Crown Lands while protecting Crown and Government interests. - Encourage balanced use and preservation.                           | Department of Lands & Surveys               |
| <b>Department of Physical Planning</b>                               | - Regulate and monitor excavation activities to preserve the physical landscape.  | Department of Physical Planning             |

|   |   |  |
|---|---|--|
| <b>Port Department</b>  | - Regulate and monitor coastal and harbour/marina design requiring alteration to the physical landscape of the coastal zone and upland terrain.   | Port Department                                  |
| <b>Ministry of Works</b>  | - Regulate and monitor land use, construction techniques, and implementation of building codes and designs that alleviate any adverse effects of land degradation. - Utilize the best available technologies, including GIS, for urban planning and sustainable development. - Regulate public utilities. | Ministry of Works                                |
| <b>Water &amp; Sewerage Corporation</b>                         | - Manage freshwater resources. - Formulate standards for water resource development and wastewater treatment systems.   | <a href="#">Water &amp; Sewerage Corporation</a> |
| <b>BEST Commission (National Focal Point for UNCCD and CBD)</b> | - Act as the National Focal Point for the UNCCD and CBD.  | <a href="#">BEST Commission</a>                  |
| <b>Ministry of Tourism</b>                                      | - Develop policies for the sustainable growth of the tourism sector.  | Ministry of Tourism                              |
| <b>National Emergency Management Agency (NEMA)</b>              | - Coordinate disaster response and preparedness.  | NEMA   |
| <b>Bahamas National Trust</b>                                   | - Preserve and manage national parks.   | <a href="#">Bahamas National Trust</a>           |
| <b>BEST Commission (National Biodiversity Task Force)</b>       | - Coordinate the development of environmental policy, strategy, and action programmes.  | <a href="#">BEST Commission</a>                  |
| <b>Utilities Regulation and Competition Authority (URCA)</b>    | - Regulate the electronic communications sector, covering regulatory and competition issues.  | <a href="#">URCA</a>                             |

## 2.7 CHALLENGES FOR IWRM

The water-related challenges in the Bahamas have far-reaching implications across critical sectors:

### 2.7.1 Food

Hurricanes and extreme weather events have profound consequences for marine life, posing threats to fisheries and the overall biodiversity of the region. Disruptions in these ecosystems directly impact the availability and sustainability of food resources, making food security a pressing concern. For instance, hurricanes such as Joaquin (2015), Matthew (2016), Irma (2017), and Dorian (2019) have caused significant damage to marine ecosystems, leading to a decline in fishery productivity.

### 2.7.2 Health

The contamination of water resources during storm surges exacerbates health risks, particularly regarding drinking water access. Groundwater supplies are vulnerable to saltwater intrusion and contamination during extreme weather events, posing health hazards to the population and emphasising the need for resilient water infrastructure. Reports indicate that storm surges and hurricanes have led to saltwater intrusion into well fields, elevating salinity levels and threatening drinking water safety.

### 2.7.3 Finance

The nation's heavy reliance on tourism as a primary economic driver makes it particularly vulnerable to water-related crises which are intensified by climate change. The catastrophic damage caused by hurricanes severely impacts the country's GDP, highlighting the intricate link between water challenges and financial stability. Notably, hurricanes like Joaquin, Matthew, Irma, and Dorian have collectively contributed to a significant negative impact on The Bahamas' GDP, with Dorian alone causing a 1% decline.

### 2.7.4 Socio-economic

Water-related challenges intensify existing socioeconomic disparities, as vulnerable populations often lack the resources necessary for adapting to and mitigating the impacts. The disparities in access to clean water and the ability to cope with water-related disasters contribute to broader socioeconomic inequalities. Vulnerable communities facing challenges accessing clean water and adapting to climate impacts find themselves at the forefront of socioeconomic vulnerabilities (UN 2021).

### 2.7.5 Security

Security risks emerge from the potential breakdown of essential services due to water-related disasters. The interconnectedness of water with critical infrastructure and services creates vulnerabilities that, if not adequately addressed, could lead to disruptions in security and well-being. Infrastructure vulnerabilities, including those in the water sector, can compromise the overall security and resilience of the nation (BHT 2020).

### 2.7.6 Livelihoods

The multifaceted challenges related to water, including disruptions to food sources, threats to health, financial vulnerabilities, and socioeconomic disparities, collectively impact the overall livelihoods of the population. Ensuring sustainable practices and building resilience become imperative for safeguarding the nation's future against these complex challenges. With 700 islands and cays, only three have good freshwater supplies and are susceptible to overexploitation and contamination. The livelihoods of local communities, especially in the northern islands, are intricately linked to water sustainability efforts (FAO 2015).

### 2.7.7 Case Studies: Customary arrangements at the community level to enhance water resources management

#### 2.7.7.1 IWRM Planning Process: the Bahamas Experience 2011

In common with many Caribbean nations, the Bahamas transitioned from a singular focus on water management within the Water and Sewerage Corporation to adopting an Integrated Water Resource Management (IWRM) approach. Initiated in 2002 and gaining momentum in 2007, the IWRM Plan aimed to engage all stakeholders for effective water resource management. Notably, conservation and sustainability played a crucial role in decision-making, reflecting a collective commitment to protecting the environment. The IWRM process identified key areas: governance, financing, environmental concerns, stakeholder involvement, capacity building, and disaster preparedness. A vision emphasizing cooperation and coordination guided the process, and initiatives included involving various sectors, ensuring political commitment, understanding linkages between IWRM and related sectors, and instituting legal and regulatory reforms. While lessons were learned about the urgency of efficient water management in a water-scarce nation, the case study highlights the success of stakeholder participation, reflecting a shift toward collaboration and addressing critical challenges. Vulnerable groups were implicitly involved in the broader stakeholder engagement, fostering inclusivity in decision-making for sustainable water resource management in The Bahamas (GWP 2023).

#### 2.7.7.2 The NDCs

The Bahamas has outlined several adaptation actions in its updated Nationally Determined Contributions (NDC) to address the challenges posed by climate change, particularly in the context of water resources (Government of the Commonwealth of the Bahamas 2022):

1. **Technological Solutions for Drinking Water Access:** The country aims to explore new technological solutions, such as implementing a pilot project for a rainwater harvesting plant. This initiative connects the most vulnerable households to a drinking water supply system. Additionally, rainwater harvesting can serve as a backup during natural disasters, ensuring continued access to clean water.
2. **Modelling and Understanding Climate Risks:** To enhance preparedness, the Bahamas plans to model extreme precipitation, sea-level rise, and storm surge events. This effort aims to better understand the risks and consequences of these climate phenomena on water utility systems and the availability of groundwater resources.
3. **Investments in Desalination and Renewable Energy:** Acknowledging the importance of freshwater availability, especially on islands with limited resources like New Providence, the Bahamas intends to increase investments in desalination plants. This strategy aims to ensure a sustainable supply of water. Additionally, promoting on-site renewable power supplies is part of the plan, aiming to lower the operational costs of desalination plants.
4. **Climate Change Awareness for Vulnerable Populations:** Recognizing the vulnerability of specific populations, the Bahamas is committed to raising awareness about climate change and its associated health risks. This initiative is crucial for empowering communities, particularly the vulnerable ones, to adapt to changing climate conditions and protect their health.

#### 2.7.7.3 Gender Implications

In the Bahamas, women and girls face heightened vulnerability to the impacts of tropical cyclones. Among 191 countries globally, 29, home to 55.3% of the world's female population, experience high or very high exposure to these cyclones. The aftermath of cyclones extends beyond property damage, affecting both short- and long-term food production as saltwater mixes with the land, causing salt-intolerant crops to fail. Female subsistence farmers, constituting a significant portion

of the agricultural workforce, are less equipped to mitigate these shocks, leading to increased susceptibility to food insecurity, poverty, and gender-based violence. Existing disparities in access to safe drinking water and sanitation within the Bahamas exacerbate this vulnerability. As of 2022, over 4 in 10 women lack access to safely managed sanitation locally. These challenges underscore the urgent need for focused strategies to address gender-specific vulnerabilities in the Bahamas, ensuring the well-being and resilience of women and girls in the face of climatic and environmental risks.

### 3 ANNEX C: BELIZE

#### 3.1 OVERVIEW

Belize faces many challenges and opportunities shaped by its geography, population dynamics, and economic landscape. Covering 22,970 km<sup>2</sup>, the country comprises six districts, boasting diverse ecosystems, including the largest coral reef in the Americas. Socially, Belize grapples with issues such as poverty, vulnerable demographics, and human trafficking. Economically, as an upper-middle-income nation, it relies on tourism, agriculture, and crude oil. A substantial economic rebound in 2022 marked progress, yet multidimensional poverty persists. In terms of water resources, Belize manages abundant yet crucially vulnerable water sources. With an emphasis on sustainable water use, the country confronts challenges in agriculture, domestic consumption, and industrial needs. Integrated Water Resources Management (IWRM) is pivotal for addressing these challenges, ensuring sustainable development, and navigating the delicate balance between economic growth and environmental stewardship. The collaborative efforts of national and international stakeholders play a vital role in charting a resilient and inclusive future for Belize.



**Figure 7: Photo by Unknown Author is licensed under CC BY-SA**

## 3.2 PHYSICAL GEOGRAPHY AND SOCIOECONOMIC CONTEXT

### 3.2.1 Physical Geography

Belize, located in Central America and bordered by Guatemala and Mexico along the Caribbean Sea, spans 109 km in width from east to west and 274 km in length from north to south (see image below). The country comprises six administrative districts: Belize, Cayo, Corozal, Orange Walk, Stann Creek, and Toledo. Its total area is 22,970 km<sup>2</sup>, including 1,540 km<sup>2</sup> of lagoons and approximately 690 km<sup>2</sup> of around 450 small islands known as "Cayes." As of 2012, the estimated cultivated area was 110,000 hectares, with 32,000 hectares dedicated to permanent crops and 78,000 hectares to temporary crops (InforMEA 2024).



Figure 8: Country Map - Belize (FAO 2024)

### 3.2.2 Population and Social Impact

Belize's pursuit of sustainable growth and societal inclusion hinges on preserving its diverse social fabric and enhancing economic resilience. The nation's ecological richness, epitomised by the largest coral reef in the Americas and extensive mangrove ecosystems, is crucial in safeguarding its low-lying coastline from adverse climate events. The 2015 Multiple Indicator Cluster Survey reports that 96% of Belizeans use improved drinking water sources. However, a 2009 poverty study revealed that 41.3% of the population lived on or below the poverty line, with 15.8% classified as extremely poor, surviving on less than \$10.00 daily (World Bank 2022).

Education, which is compulsory for ages 6 to 14, is predominantly provided by church-operated schools, emphasising the influence of religious institutions in the country. Vulnerable groups include those in poverty, children, the elderly, and the LGBT community. Human trafficking, especially sex trafficking and forced labour, remains a pressing issue, with Belize earning a Tier 3 rating—the worst possible—from the US State Department. Migration dynamics are transforming Belize's demographic landscape, with immigrants accounting for 14.8% of the total population in 2000, mainly from neighbouring Guatemala, El Salvador, and Honduras (World Bank 2021).

In terms of health, the government underscores the importance of "universal access to affordable and high-quality healthcare." With 46% of the population aged below their teenage years and 6.5% aged 60 or older, Belize faces unique demographic challenges. The country's largest ethnic group is Mestizo (52.9%), followed by Afro-descendant Creoles (26%), Garifuna (6.1%), and the indigenous Maya (11.3%). The intercensal growth rate of 2.65% between 2000 and 2010 suggests that the population could double by 2036, posing significant implications for social services. Urbanisation is 45%, and 14.2% of Belize's population is foreign-born. Addressing social vulnerabilities and health considerations is imperative for Belize's sustainable and inclusive development (World Bank 2021).

### 3.2.3 Economy

Belize, an upper-middle-income country in Central America, maintains strong sociopolitical and economic connections with the Caribbean. With a population of around 400,000, Belize's GDP is estimated at \$2.7 billion, resulting in a per capita GDP of \$6,750. As a member of CARICOM,

Belize benefits from regional market access and trade agreements, with an export-oriented economy relying on its proximity to the United States and Mexico. Tourism, agriculture, and crude oil are significant contributors to revenue, with tourism playing a pivotal role in foreign exchange earnings.

Despite challenges, such as over a third of the population facing multidimensional poverty in 2021 and more than half struggling to afford necessities in 2018, Belize experienced a substantial economic rebound in 2022. The real GDP per capita exceeded pre-pandemic levels, driven by increased tourism arrivals and related construction activities. The unemployment rate reached a record low of 5 percent, although labour force participation remains a concern. Even after a 2021 external debt restructuring and fiscal consolidation, public debt remained high at 72.8 percent of GDP in 2022. Policy priorities focus on fiscal restraint, structural reforms, climate change mitigation, and protecting vulnerable populations. The projected medium-term economic growth rate is 2-3 percent.

Belize, having gained independence from Britain in 1981, operates under a parliamentary democracy based on the Westminster System. King Charles, representing the constitutional Head of State, is served by a Governor-General. The government maintains diplomatic ties with international organisations and focuses on sustainable development, facing challenges such as high unemployment rates and vulnerability to external shocks.

### **3.3 STATUS OF WATER RESOURCES MANAGEMENT IN BELIZE**

#### **3.3.1 Source**

Belize's water resources are shaped by a subtropical climate, featuring temperatures ranging from 22°C to 31°C on the coast and 16°C to 18°C in the mountains. With annual precipitation varying from 1,500 mm in the north to 4,000 mm in the south, the country experiences distinct dry and rainy seasons, and it is prone to hurricanes approximately once every five years. Belize's diverse population of around 332,000 inhabitants in 2013 relies on improved water sources, with 99 percent having access. The nation's economy, largely dependent on agriculture, forestry, and fisheries, faces challenges related to limited suitable land for sustained agricultural production (BEST 2006).

Belize boasts abundant water resources, both surface and groundwater. Internal renewable surface water resources are estimated at 15.258 km<sup>3</sup>/year, complemented by groundwater resources at 7.51 km<sup>3</sup>/year. The country exhibits a dependency ratio of 30 percent, reflecting a sustainable approach to water use. Noteworthy dams, such as Mollejon, Chalillo, and Vaca, contribute to hydroelectric power generation, collectively reaching a total capacity of 122 million m<sup>3</sup> in 2013. Belize engages in international collaborations, exemplified by agreements with Mexico concerning transboundary river basins. In 2000, water withdrawal reached 101 million m<sup>3</sup>, focusing predominantly on agricultural needs. Despite challenges in irrigation development due to climatic and social conditions, Belize manages an equipped irrigation area of 3,548 ha as of 2005, supporting crops like rice, bananas, papayas, and sugarcane.

### 3.3.2 Distribution

The distribution of water usage plays a crucial role in understanding the country's resource management. As of 2000, the total annual water withdrawal stood at 101 million m<sup>3</sup>, with distinct allocations across key sectors (FAO 2015).

#### AGRICULTURE

- Water consumption: approximately 68.4 million m<sup>3</sup>.
- Percentage of Total Withdrawal: 68%.
- Significance: Agriculture emerges as the primary consumer, emphasising the pivotal role of water in sustaining crops, livestock, and aquaculture.

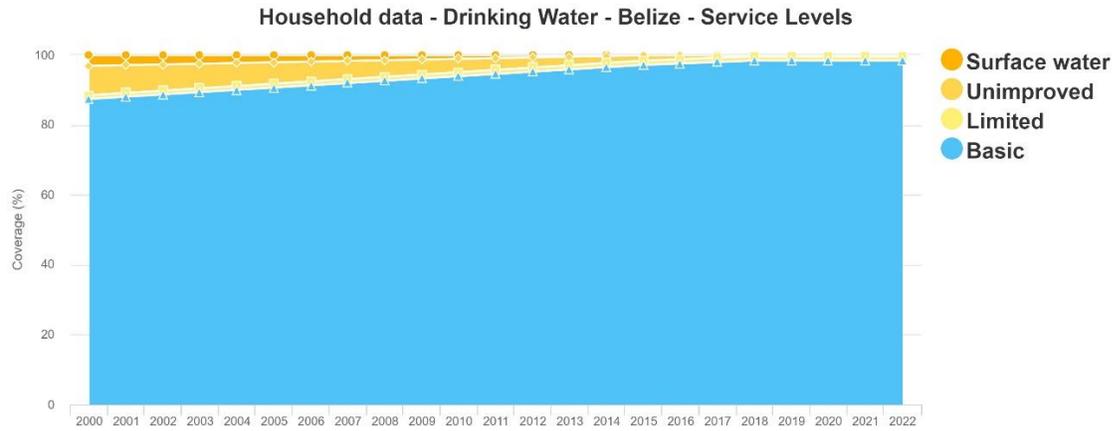
#### DOMESTIC USE

- Water consumption: 11.4 million m<sup>3</sup>.
- Percentage of Total Withdrawal: 11%.
- Urban Impact: Belize's average per capita water use is 423 m<sup>3</sup>/year. Domestic water usage encompasses various urban and town-related activities, highlighting the importance of water in sustaining communities.

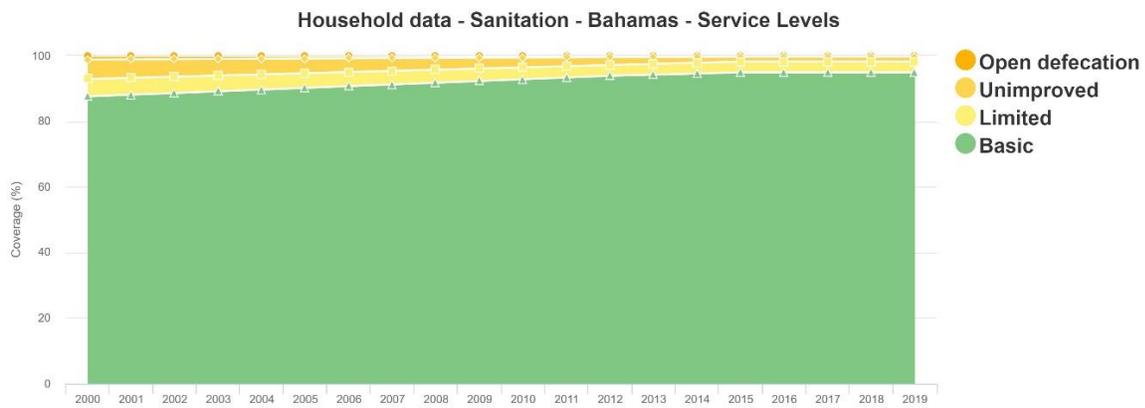
#### INDUSTRY

- Water consumption: 21.2 million m<sup>3</sup>.

- Percentage of Total Withdrawal: 21%.
- Industrial Significance: Industries heavily depend on water for manufacturing, underscoring its role in economic activities.



**Figure 9: Household Data (Access to Water) 2000 – 2022 – Belize (WHO; UNICEF 2024)**



**Figure 10: Household Data (Sanitation) 2000 – 2022 – Belize (WHO; UNICEF 2024)**

### 3.4 WATER SUPPLY DEMAND AND USAGE

Refer to sections 3.3.1 & 3.3.2

### **3.5 CHALLENGES AND FUTURE OUTLOOK**

Belize faces complex challenges and impacts associated with its water resources and Integrated Water Resources Management (IWRM). From climate variability and water scarcity to a dependency on agriculture, the country navigates a delicate balance to manage its abundant water wealth sustainably. Population growth, social vulnerabilities, and the critical intersection of water quality and vulnerable groups further compound the intricacies of water resource governance. However, effective IWRM can usher in positive impacts, enhancing economic resilience, protecting ecosystems, and addressing health considerations. Collaborative international agreements and sustainable practices are key to mitigating challenges and promoting inclusive development (FAO 2024).

#### **3.5.1 Terrestrial Ecosystem**

Challenges of Integrated Water Resources Management (IWRM) in Belize:

- **Climate variability:** Belize faces annual precipitation variations and periodic hurricanes.
- **Water Scarcity:** Despite abundant resources, water scarcity issues persist.

Impacts of IWRM in Belize:

- **Economic Resilience:** Effective IWRM contributes to economic resilience, especially in agriculture.
- **Ecosystem Protection:** IWRM safeguards diverse ecosystems, including the largest coral reef.

#### **3.5.2 Aquatic Ecosystem**

Challenges of IWRM in Belize:

- **Dependency on agriculture:** agriculture, a significant water consumer, poses challenges.
- **Population Growth:** rapid population growth raises concern about future water demand.

Impacts of IWRM in Belize:

- **Water Access and Health:** IWRM ensures universal access to healthcare and addresses health considerations.

- Migration Dynamics: IWRM aligns with addressing migration dynamics and demographic shifts.

### 3.5.3 Agriculture and Food Production Systems

#### Challenges of IWRM in Belize:

- Water Quality: Ensuring water quality is crucial for sustaining agriculture.
- Social Vulnerabilities: Vulnerable groups may face challenges related to water access.

#### Impacts of IWRM in Belize:

- Social Inclusion: IWRM contributes to social inclusion by addressing water-related challenges.
- Tourism Sector: Sustainable water practices benefit the tourism sector.

### 3.5.4 Human Health and Sanitation

#### Challenges of IWRM in Belize:

- International collaborations: collaborative water management with Mexico indicates a need for international cooperation.
- Urbanization Pressures: Urbanization increases the demand for water in urban areas.

#### Impacts of IWRM in Belize:

- Population Growth Management: IWRM becomes essential in managing the implications of population growth.
- International relations: collaborative water management strengthens international relations.

### 3.5.5 Finance Services

#### Challenges of IWRM in Belize:

- Industrial Water Use: Industries heavily depend on water for manufacturing processes.
- Limited Suitable Land: Only 16 percent of the land is suitable for sustained agricultural production.

#### Impacts of IWRM in Belize:

- Resilience to Climate Change: IWRM strategies enhance Belize's resilience.

- Sustainable Development: IWRM aligns with Belize's sustainable and inclusive development goal.

### 3.5.6 Socioeconomic, Security, and Livelihoods:

#### Challenges of IWRM in Belize:

- Social Vulnerabilities: The vulnerable population may face water-related challenges, impacting socioeconomic aspects.
- Finance Services: Industries relying on water may face financial challenges due to water-related issues.

#### Impacts of IWRM in Belize:

1. Economic Resilience: Effective IWRM contributes to economic resilience, safeguarding livelihoods.
2. Security: IWRM enhances water security, addressing potential threats to livelihoods and socioeconomic stability.

## **3.6 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK**

### 3.6.1 Overview

The chart below outlines Belize's legislative, institutional, and participatory roles related to water resources management (WRM). The complexity of arrangements involves various laws, institutions, and responsibilities in the domains of water supply, sewage services, protection and conservation, water safety, and water abstraction. The chart provides a comprehensive overview of the legal framework and the institutions with legislative responsibilities for WRM in Belize, highlighting the laws associated with each category. It also delineates institutions operating in the water resources sector, both public and private, indicating their roles and legal authority concerning WRM (Department of Environment Belize 2024).

### 3.6.2 National Setting

**Table 5: IWRM National Legislation in Belize**

| <b>Legislation</b>   | <b>Short Summary</b>   |
|--|--|
| <b>Water Industry Act</b>  | Governs water services provided by Belize Water Services.  |
| <b>Public Health Act</b>   | Regulates public health, including aspects related to water.   |
| <b>Public Utilities Commission Act</b>   | Establishes the framework for the Public Utilities Commission.                                       |
| <b>City and Town Councils Act</b>  | Specifies the role of City and Town Councils in WRM.   |
| <b>Village Council Act</b>   | Defines the responsibilities of Village Councils in WRM.   |
| <b>Forest Act</b>  | Governs aspects related to forests and their conservation.   |
| <b>Coastal Zone Management Authority Act</b>   | Establishes the Coastal Zone Management Authority.   |
| <b>Environmental Protection Act</b>  | Regulates environmental protection measures.   |
| <b>Land Utilization Authority</b>  | Defines the role of the Land Utilization Authority.  |
| <b>National Lands Act</b>  | Governs the management of national lands.  |
| <b>Solid Waste Management Authority Act</b>  | Establishes the Solid Waste Management Authority.  |
| <b>Petroleum Act</b>   | Governs activities related to petroleum.   |
| <b>Mines and Minerals Act</b>  | Regulates mining and mineral activities.   |
| <b>National Integrated Water Resources Act</b>   | Establishes the National Hydrological Service and the National Integrated Water Resources Authority. |
| <b>Ports and Harbours Act</b>  | Governs the management of ports and harbours.  |
| <b>Fisheries Act</b>   | Regulates fisheries-related activities.  |
| <b>National Climate Finance Strategy of Belize</b>   | Outlines strategies for climate finance in Belize.   |
| <b>National Trade Policy 2019-2030</b>   | Sets the trade policy framework for Belize.  |
| <b>National Implementation Plan (NIP) Update for the Stockholm Convention on Persistent Organic Pollutants (POPs) for Belize</b> | Outlines the plan for implementing the Stockholm Convention on POPs.                                 |
| <b>National Plan of Action of Belize for Reducing Incidental Catch of Seabirds in Long-Line High Seas Fisheries</b>              | Addresses incidental catch of seabirds in long-line high seas fisheries.                             |
| <b>Belize Integrated Coastal Zone Management Plan 2016</b>   | Guides the integrated management of Belize's coastal zones.  |
| <b>Growth and Sustainable Development Strategy 2016-2019</b>   | Outlines strategies for growth and sustainable development.  |
| <b>National Biodiversity Strategy and Action Plan (2016-2020), Belize</b>  | It aims to conserve Belize's biodiversity through a comprehensive strategy.                          |

|   |  |
|---|--|
| <b>National Cultural Policy 2016-2026</b>   | Sets the cultural policy framework for Belize.                       |
| <b>National Agricultural and Food Policy of Belize 2015-2030</b>  | Establishes the agricultural and food policy framework for Belize.   |
| <b>Belize's Intended Nationally Determined Contribution under the United Nations Framework Convention on Climate Change</b>       | Outlines Belize's climate goals under the UNFCCC.                    |
| <b>National Forest Policy</b>   | Establishes policies for the sustainable management of forests.      |
| <b>National Plan of Action for the Conservation and Management of Sharks on the High Seas</b>                                     | Addresses the conservation and management of sharks in high seas.    |
| <b>National Protected Areas System Plan 2015</b>  | Outlines plans for the management of national protected areas.       |
| <b>National Plan of Action to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated (IUU) Fishing on the High Seas</b> | Aims to prevent IUU fishing in high seas.                            |
| <b>2014-2024 National Environmental Policy and Strategy</b>   | Outlines environmental policies and strategies for Belize.           |
| <b>Belize's National Environmental Action Plan 2015-2020</b>  | Outlines actions for environmental conservation.                     |
| <b>National Climate Change Policy, Strategy and Action Plan to Address Climate Change In Belize</b>                               | Addresses climate change issues in Belize.                           |
| <b>Poverty Reduction Action Plan</b>  | Outlines strategies for poverty reduction in Belize.                 |
| <b>National Climate Resilience Investment Plan</b>  | Outlines strategies for climate resilience investments in Belize.    |
| <b>Política de Seguridad Alimentaria y Nutricional de Centroamérica y República Dominicana 2012-2032</b>                          | Food security policy for Central America and the Dominican Republic. |
| <b>National Sustainable Tourism Master Plan for Belize 2030</b>   | Outlines sustainable tourism strategies for Belize.                  |
| <b>Estrategia Centroamericana de Desarrollo Rural Territorial 2010 - 2030 (ECADERT)</b>   | Strategy for rural territorial development in Central America.       |
| <b>Belize Medium Term Development Strategy 2010-2013</b>  | Outlines medium-term development strategies for Belize.              |
| <b>Food And Nutrition Policy and Plan of Action for Belize 2010-2015</b>  | Addresses food and nutrition policies in Belize.                     |
| <b>Horizon 2030 National Development Framework for Belize 2010-2030</b>   | Outlines the national development framework for Belize.              |
| <b>National Poverty Elimination Strategy and Action Plan (NPESAP) 2009-2013</b>   | Strategies for poverty elimination in Belize.                        |

|  |  |
|--|--|
| <b>National Adaptation Strategy to Address Climate Change in the Water Sector in Belize</b>                      | Outlines strategies for adapting to climate change in the water sector.              |
| <b>National Integrated Water Resources Management Policy (Including Climate Change) for Belize</b>               | Establishes the national policy for integrated water resources management in Belize. |
| <b>National Plan of Action For the Control of Land-Based Sources of Marine Pollution in Belize</b>               | Addresses marine pollution from land-based sources in Belize.                        |
| <b>Política Agrícola Centroamericana 2008-2017: una agricultura competitiva e integrada para un mundo global</b> | Agricultural policy for competitive and integrated agriculture in Central America.   |
| <b>National Food and Agriculture Policy (2002-2020)</b>  | Sets policies for food and agriculture in Belize.                                    |

### 3.6.3 Institutional Framework

The landscape of Integrated Water Resources Management (IWRM) stakeholders in Belize reflects a challenging implementation status, as indicated by a low score of 21 for the 2020-21 round of data collection for SDG 6.5.1. The National Hydrological Service (NHS) is pivotal as the lead agency for IWRM, which operates under the National Integrated Water Resources Act (2010). The NHS functions as the Secretariat for the National Integrated Water Resources Authority (NIWRA), fostering cross-sector coordination through its board, which is comprised of members from various sectors.

Within the public sector, sixteen agencies, including the Ministry of Works, the Department of Agriculture, and the National Meteorological Services, contribute to water resources functions. Some operate under legislative structures, while others lack defined roles through legislation. Additionally, private sector entities like bottled water companies, well-drilling operators, and agricultural industries, as well as associations such as the Social Investment Fund, Citrus Products of Belize, Belize Sugar Industries, and the Banana Growers Association, play vital roles, despite not being explicitly governed by existing WRM legislation (UNEP 2024).

In urban areas, Belize Water Services Ltd. (BWS) is the licensed water and sanitation service provider, with a mixed ownership structure involving the government and the public. The rural water sector operates under the Village Councils Act, with village water boards overseeing water services independently. These boards, facing legislative and institutional fragmentation challenges, manage day-to-day operations, expansion, user fees, and other water-related functions. Despite progress, issues like limited resources and administrative restructuring constrain technical

coordination at the government departmental level. This fragmented landscape highlights the need for comprehensive legislative and institutional frameworks for sustainable IWRM in Belize (UN 2023).

**Table 6: Key Institutions IWRM Management in Belize**

| <b>Institution</b>  | <b>Functions in Water Management</b>                                 |
|---|--|
| <b>National Hydrological Service (NHS)</b>                        | Secretariat for NIWRA, Coordination, Water Resource Planning         |
| <b>Ministry of Works</b>  | Water Resource Functions   |
| <b>Department of Agriculture</b>                                  | Water Resource Functions   |
| <b>National Meteorological Services</b>                           | Water Resource Functions   |
| <b>Belize Water Services Ltd. (BWS)</b>                           | Licensed Water and Sanitation Service Provider in Urban Areas        |
| <b>Village Water Boards (Rural Areas)</b>                         | Day-to-day Operations, Expansion, User Fees, Water-related Functions |
| <b>Ministry of Natural Resources</b>                              | Legislative Framework, Policy Development, Oversight                 |
| <b>National Integrated Water Resources Authority (NIWRA)</b>      | Coordination, Policy Implementation                                  |
| <b>Ministry of Health</b>   | Health-related Considerations in Water Management                    |
| <b>Social Investment Fund</b>                                     | Water-related Social Investment Projects                             |
| <b>Citrus Products of Belize</b>                                  | Water Use in Agriculture, Stakeholder Engagement                     |
| <b>Belize Sugar Industries</b>                                    | Water Use in Agriculture, Stakeholder Engagement                     |
| <b>Banana Growers Association</b>                                 | Water Use in Agriculture, Stakeholder Engagement                     |
| <b>Belize Institute of Environmental Law &amp; Policy (BELPO)</b> | Environmental Advocacy, Policy Research                              |
| <b>Healthy Reefs for Healthy People</b>                           | Coral Reef Conservation, Water Quality Monitoring                    |
| <b>University of Belize</b>                                       | Water Research, Education, Capacity Building                         |

### 3.6.4 Regional Setting

**Table 7: IWRM Regional Legislation in Belize**

| <b>Date</b>            | <b>Agreement</b>   | <b>Countries Involved</b> | <b>Region</b>                   | <b>Summary</b>  |
|------------------------|--|---------------------------|---------------------------------|---|
| <b>01 January 2015</b> | Protocol to the Special Agreement between Guatemala and Belize to Submit Guatemala's Territorial, Insular, and Maritime Claim to the | Guatemala, Belize         | Latin America and the Caribbean | Protocol amending the Special Agreement between Guatemala and Belize to submit Guatemala's territorial, insular, and maritime |

|                         |   |   |                                 |  |
|-------------------------|---|---|---------------------------------|--|
|                         | International Court of Justice.   |   |                                 | claim to the International Court of Justice.   |
| <b>01 January 2014</b>  | Agreement establishing the Caribbean Community Common Fisheries Policy.   | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Guyana, Grenada, Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda   | Latin America and the Caribbean | Agreement establishing the Common Fisheries Policy for the Caribbean Community.  |
| <b>08 December 2008</b> | Special Agreement between Guatemala and Belize to submit Guatemala's territorial, insular, and maritime claim to the International Court of Justice.                | Guatemala, Belize   | Latin America and the Caribbean | Special Agreement between Guatemala and Belize to submit Guatemala's territorial, insular, and maritime claim to the International Court of Justice. |
| <b>15 August 2008</b>   | Economic Partnership Agreement between the CARIFORUM States of the one part and the European Community and its Member States of the other part.                     | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Guyana, Grenada, European Union, Dominican Republic, Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda  | Europe                          | Economic Partnership Agreement between CARIFORUM States and the European Community.  |
| <b>26 August 2005</b>   | Memorandum of Understanding for cooperation in conserving protected areas between the Republic of Guatemala, the United Mexican States, and the Republic of Belize. | Mexico, Guatemala, Belize   | Latin America and the Caribbean | Memorandum of Understanding for cooperation in conserving protected areas between Guatemala, Mexico, and Belize.                                     |
| <b>12 February 2004</b> | Protocol to the Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean (STZC).   | Venezuela (Bolivarian Republic of), Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, El Salvador, Panama, Nicaragua, Mexico, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Honduras, Guyana, Guatemala, Grenada, Dominican Republic, Dominica, Cuba, Costa Rica, Colombia, Barbados, Belize, Bahamas, Antigua and Barbuda | Latin America and the Caribbean | Protocol amending the Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean.   |

|                         |   |   |                                 |  |
|-------------------------|---|---|---------------------------------|--|
| <b>12 December 2001</b> | Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean (STZC).   | Venezuela (Bolivarian Republic of), Saint Vincent and the Grenadines, Trinidad and Tobago, Panama, Suriname, El Salvador, Nicaragua, Mexico, Saint Lucia, Saint Kitts and Nevis, Jamaica, Haiti, Honduras, Guyana, Guatemala, Grenada, Dominican Republic, Dominica, Cuba, Costa Rica, Colombia, Barbados, Belize, Bahamas, Antigua and Barbuda | Latin America and the Caribbean | Convention for the Establishment of the Sustainable Tourism Zone of the Caribbean.                   |
| <b>04 February 2002</b> | Agreement Establishing the Caribbean Regional Fisheries Mechanism.  | Saint Vincent and the Grenadines, Trinidad and Tobago, Suriname, Saint Lucia, Saint Kitts and Nevis, Jamaica, Guyana, Grenada, Dominica, Barbados, Belize, Bahamas, Antigua and Barbuda   | Latin America and the Caribbean | Agreement establishing the Caribbean Regional Fisheries Mechanism.                                   |
| <b>12 December 2001</b> | Basic Agreement of the Institute of Nutrition for Central America and Panama (INCAP).   | El Salvador, Panama, Nicaragua, Honduras, Guatemala, Belize   | Latin America and the Caribbean | Basic Agreement of the Institute of Nutrition for Central America and Panama (INCAP).                |
| <b>04 October 1995</b>  | Panama Declaration.   | Vanuatu, Venezuela (Bolivarian Republic of), United States of America, Panama, Mexico, Honduras, France, Spain, Ecuador, Costa Rica, Colombia, Belize   | Latin America and the Caribbean | Declaration of principles and commitments for the sustainable development of the countries involved. |
| <b>18 August 1992</b>   | Memorandum of Understanding for cooperation in agriculture and fisheries between the Belize Ministry of Agriculture and Fisheries and the Ministry of Agriculture of Jamaica. | Jamaica, Belize   | Latin America and the Caribbean | Memorandum of Understanding for cooperation in agriculture and fisheries between Belize and Jamaica. |

### 3.7 CHALLENGES FOR IWRM

Water-related challenges in Belize have multifaceted implications across critical sectors, exacerbating the impacts of climate change on the livelihoods of its population. As a small country with relatively minor contributions to global greenhouse gas emissions, Belize faces limited capacity to mitigate climate change. However, it is committed to transitioning to low-carbon

development while enhancing resilience to climate change, as outlined in its Nationally Determined Contribution (NDC).

### 3.7.1 Food

In Belize, hurricanes and extreme weather events profoundly affect marine life, threatening fisheries, and overall biodiversity. Disruptions to marine ecosystems directly impact the availability and sustainability of food resources, posing a significant threat to food security. Recent hurricanes, including Joaquin (2015), Matthew (2016), Irma (2017), and Dorian (2019), have caused substantial damage to marine ecosystems, leading to a decline in fishery productivity (CCCCC 2008).

### 3.7.2 Health

Contamination of water resources during storm surges exacerbates health risks, particularly in terms of drinking water access. Groundwater supplies are vulnerable to saltwater intrusion and contamination during extreme weather events, posing health hazards to the population. Storm surges and hurricanes have led to saltwater intrusion into well fields, elevating salinity levels and threatening drinking water (UNEP 2024).

### 3.7.3 Finance

Belize's heavy reliance on tourism, a primary economic driver, makes it vulnerable to water-related crises intensified by climate change. Hurricanes cause catastrophic damage, severely impacting the country's GDP. Hurricanes like Joaquin, Matthew, Irma, and Dorian collectively significantly negatively impacted Belize's GDP, with Dorian alone causing a 1% decline.

### 3.7.4 Socioeconomic

Water-related challenges intensify socioeconomic disparities in Belize, as vulnerable populations lack resources for adapting to and mitigating impacts. Disparities in access to clean water and coping with water-related disasters contribute to broader socioeconomic inequalities. Vulnerable communities facing challenges accessing clean water and adapting to climate impacts find themselves at the forefront of socioeconomic vulnerabilities.

### 3.7.5 Security

Security risks emerge from the potential breakdown of essential services due to water-related disasters. The interconnectedness of water with critical infrastructure creates vulnerabilities that, if not addressed, could disrupt security and well-being.

### 3.7.6 Livelihoods

The multifaceted challenges related to water, including disruptions to food sources, threats to health, financial vulnerabilities, and socioeconomic disparities, collectively impact the overall livelihoods of Belize's population. Sustainable practices and resilience-building become imperative for safeguarding the nation's future against these complex challenges (IPCC 2022).

With Belize's vulnerability to climate change impacts, particularly in the agriculture and fisheries sectors, the nation faces substantial economic and environmental risks. Adapting to these challenges, enhancing water infrastructure resilience, and pursuing sustainable development practices are crucial for Belize's future.

## **3.8 SYNERGIES BETWEEN STATE, GAPS AND AREAS TO BE HARMONISED**

Belize confronts multifaceted challenges linked to vulnerable populations, where economic inequalities and persistent gender-based violence issues underscore societal disparities. Despite strides in the Human Development Index, gender inequality and domestic violence remain as pressing concerns. To counter these issues, the Women's Department diligently works towards fostering gender equality, promoting economic development, and preventing gender-based violence. The implementation of the Revised National Gender Policy signifies a commitment to addressing existing disparities comprehensively (IDB 2023).

However, these ongoing challenges could potentially impede stakeholder participation in Belize's Integrated Water Resources Management (IWRM). Vulnerable populations grappling with economic disadvantages and health-related issues may encounter barriers to accessing decision-making processes related to water resource management. The necessity of addressing fundamental societal concerns might divert attention and resources away from active engagement in crucial water management discussions.

Moreover, the uneven distribution of healthcare professionals and limited coordination within the health system may pose challenges to integrating health considerations into water management strategies. This lack of integration could disproportionately affect vulnerable communities, exacerbating existing disparities in access to healthcare and compounding the challenges faced by marginalised groups. Addressing these interconnected issues requires a holistic approach to ensure sustainable development and the well-being of all Belizeans.

Belize's involvement in the PAHO Commission on Equity and Health Inequalities is a body that looks at various variables influencing health outcomes for different groups. Even if health is the focus, social justice and equitable themes may apply to other, more general topics, such as water management—particulars regarding the involvement of stakeholders in water management (SECAP 2019).

Belize is advancing water infrastructure with the support of two Inter-American Development Bank programmes totalling \$10.64 million. Aimed at delivering safe drinking water to rural and peri-urban areas, the initiatives will benefit over 20,000 households, particularly vulnerable populations. The programmes focus on water quality, energy efficiency, and renovation, strengthening Belize's water sector. Efforts include increasing women's representation on water boards and integrating gender considerations into service delivery. The programs strive for sustainable and inclusive water management practices through innovative technologies and behaviour change campaigns.

The National Determined Contributions (NDCs) in Belize are expected to enhance stakeholder engagement for Integrated Water Resources Management (IWRM) through various measures. The NDCs may include provisions for increased transparency, public consultation, and participation in decision-making processes related to water resource management. Stakeholders, including local communities, indigenous groups, and civil society organizations, could be involved in developing, implementing, and monitoring water-related policies. Additionally, the NDCs might emphasize the importance of building capacity and awareness among stakeholders; and fostering collaboration between government agencies, non-governmental organizations, and the private sector. Overall, the NDCs can serve as a framework for promoting inclusive and sustainable practices in IWRM, ensuring that diverse perspectives and interests are considered in the decision-

making processes related to water resources in Belize (National Adaptation and Planning for Integrated Water Resources Management in Belize Ministry of Economic Development).

### 3.8.1 Best Practices and Opportunities for Replication and Scaling Up.

Belize is renowned for its dedication to protecting the environment, especially when it comes to its vast network of barrier reefs, which is recognized as a UNESCO World Heritage Site. The nation has been dealing with illicit fishing, deforestation, and other practices that can endanger biodiversity.

Belize, like many other nations, faces the difficulty of making sure that the use of natural resources, particularly genetic resources, is equitable regarding access and benefit-sharing (ABS). To ensure that the benefits of using these resources are distributed fairly, rules and regulations are frequently established. This may be especially pertinent when considering traditional biodiversity - related knowledge (PAHO 2017).

## 4 ANNEX D: BRITISH VIRGIN ISLANDS

### 4.1 OVERVIEW

Although the Virgin Islands (commonly referred to as the British Virgin Islands (BVI)) is a British overseas territory, it experiences the same vulnerabilities as small island developing states (SIDS). It is a low-lying coastal country with limited land size and a small population. The territory is extremely susceptible to external shocks and natural disasters. Due to its limited resources, there is an excessive dependence on international trade.

Surface water sources on the islands are seasonal and do not provide a viable or dependable water source to suit the needs of the inhabitants and the hundreds of thousands of tourists that visit the islands each year. Water is obtained through reverse-osmosis desalination, rainwater harvesting and groundwater aquifers, which are threatened by sea level rise and possible saltwater intrusion.

Integrated water resource management (IWRM) has been a priority of the BVI for over two decades. Regional and international commitments have been made towards the development of IWRM plans and increasing water use efficacy. The BVI is a member of the Global Water Partnership Caribbean (GWP-C). The BVI is a party to many regional agreements, but there is growing concern over its ability to meet the ambitious goals set for IWRM without jeopardising economic growth while continuing to face the impacts of climate change.

In 2018, the National Physical Development Plan was proposed and provides wide-ranging policies in a single plan to help achieve a sustainable future. It addresses growth, economic development and tourism, environmental protection, urbanisation and development, climate change, disaster risk management, security and resilience, good design, heritage, community development and services, recreation, infrastructure, energy conservation, coastal zone protection, utilities, telecommunication, and waste management.

This report seeks to summarize the activities and policies that the BVI has established towards achieving IWRM and identify the gaps and challenges faced when pursuing this goal.

## 4.2 PHYSICAL GEOGRAPHY AND SOCIOECONOMIC CONTEXT

### 4.2.1 Physical Geography

The British Virgin Islands (BVI) is an archipelagic territory in the Caribbean. It lies between the Caribbean Sea and the North Atlantic Ocean, east of Puerto Rico. Its geographic coordinates are 18°30'N, 64°30'W. In total, the area amounts to 151 km<sup>2</sup> consisting of 36 islands, of which 16 are inhabited. Tortola, Anegada, Virgin Gorda and Jost van Dyke are the main islands of habitation.

There are no permanent natural bodies of fresh water on the islands, a few seasonal streams and springs do appear on Tortola during the rainy season. No land boundaries exist. There is 80 km of coastline. Maritime claims include 3 nmi (5.6 km; 3.5 mi) of territorial sea and an exclusive 200 nmi (370.4 km; 230.2 mi) fishing zone. Its terrain consists of coral islands and is relatively flat. It consists of volcanic islands with steep and hilly terrain. The lowest point is the Caribbean Sea, and its highest point is Mount Sage, on the island of Tortola, at 521 metres (1,709 ft.) above sea level. Natural resources are negligible.

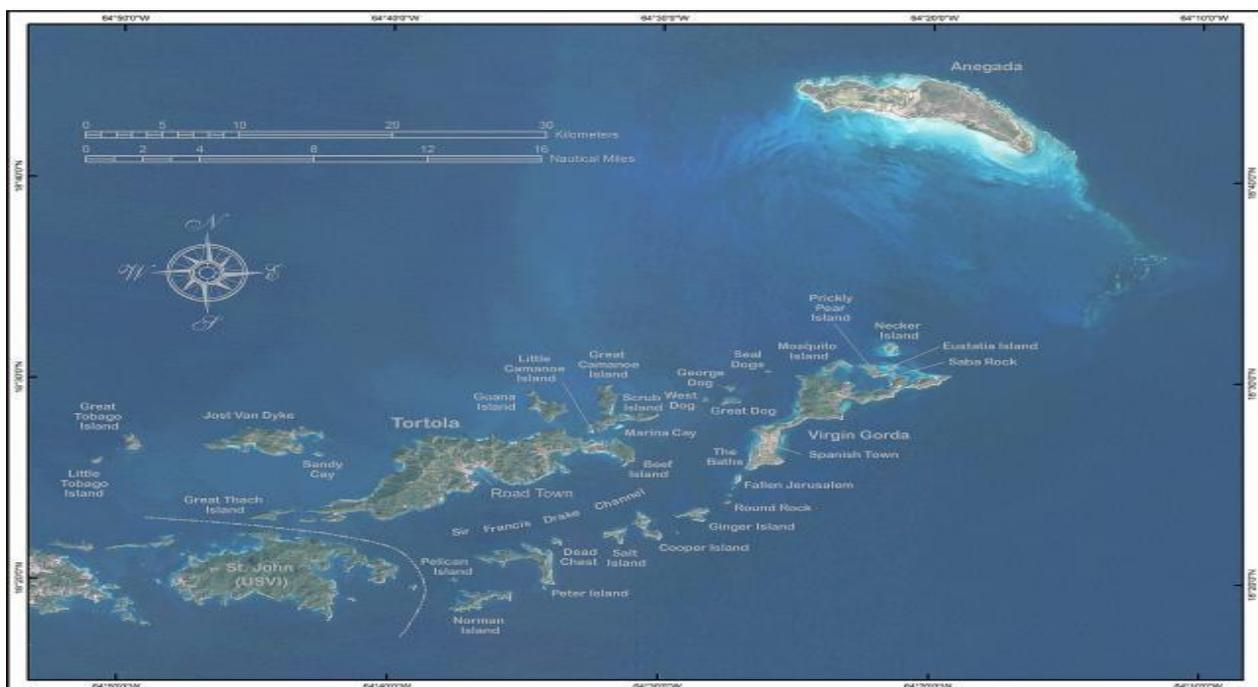


Figure 11: Map of the British Virgin Islands

The British Virgin Islands are described by a tropical climate, moderated by trade winds. Variations in temperature throughout the year are minor. Road Town, the capital city, experiences a daily maximum of around 32 °C in the summer and 29 °C in the winter. Typical daily minimums are around 24 °C in the summer and 21 °C in the winter. Rainfall averages about 1,150 mm (45.3 in) per year, higher in the hills and lower on the coast. Rainfall can be quite variable, but the wettest and driest months on average are September to November and February and March, respectively. Hurricanes occasionally hit the islands, with the hurricane season running from June to November.

#### 4.2.2 Watersheds

Literature on the watersheds of the BVI is scarce but the Department of Town and Country Planning has generated maps and listed watersheds for Tortola, Virgin Gorda and Beef Island which are described in Table 8 below.

**Table 8: Watershed in Tortola, Virgin Gorda and Beef Island**

| Watershed Name            | Island       | Area (ha) | Area (ac) |
|---------------------------|--------------|-----------|-----------|
| Belmont Pond              | Tortola      | 157       | 388       |
| Carrot Bay                | Tortola      | 288       | 712       |
| Cane Garden Bay           | Tortola      | 403       | 997       |
| Brewer's Bay              | Tortola      | 368       | 909       |
| Cooper Bay                | Tortola      | 410       | 1013      |
| Josiah's Bay - Lamber Bay | Tortola      | 516       | 1274      |
| Lloyds                    | Tortola      | 157       | 389       |
| Fat Hogs Bay              | Tortola      | 291       | 718       |
| Paraquita Bay             | Tortola      | 476       | 1175      |
| Road Town                 | Tortola      | 1062      | 2625      |
| Sea Cow's Bay             | Tortola      | 800       | 1978      |
| Pockwood Pond             | Tortola      | 473       | 1168      |
| West End                  | Tortola      | 304       | 750       |
| Long Bay - Trellis Bay    | Beef Island  | 167       | 412       |
| Mount Alma                | Beef Island  | 70        | 172       |
| Hans Creek - Bluff Bay    | Beef Island  | 14        | 36        |
| Berchers Bay              | Virgin Gorda | 67        | 166       |
| Blunder Bay               | Virgin Gorda | 196       | 484       |
| Crooks Bay                | Virgin Gorda | 69        | 170       |
| Eustatia Sound            | Virgin Gorda | 152       | 376       |
| Fanny Hill                | Virgin Gorda | 91        | 225       |

|                |              |     |     |
|----------------|--------------|-----|-----|
| Joe Bay        | Virgin Gorda | 75  | 185 |
| Little Dix Bay | Virgin Gorda | 65  | 161 |
| Long Bay       | Virgin Gorda | 190 | 470 |
| North Sound    | Virgin Gorda | 211 | 521 |
| Savannah Bay   | Virgin Gorda | 185 | 457 |
| Soldier Bay    | Virgin Gorda | 148 | 366 |
| South Sound    | Virgin Gorda | 282 | 697 |
| St. Thomas Bay | Virgin Gorda | 220 | 544 |
| Taylors Bay    | Virgin Gorda | 136 | 336 |
| Trunk Bay      | Virgin Gorda | 90  | 222 |

#### 4.2.3 Socioeconomic Context

A census was conducted in the BVI in 2023, but the report has yet to be published. As of the 2010 census, the population was recorded to be 28,054. Tortola was the most inhabited island with 23,419 people living there or 83% of the population. 3,930 people resided on Virgin Gorda (about 14% of the population). The islands of Anegada and Jost Van Dyke both accounted for 1% of the population, with the remaining 1% living on yachts and other smaller islands. The overall population percentage of males was 49.3% and females were 50.7%.

The economy of the BVI is comprised of two main sectors: tourism and international business and finance accounts. Agriculture accounts for less than 1% of the GDP, attributed to the poor soil quality and steep slopes found on the islands. Approximately 850 tonnes of agricultural products are produced per year, mainly beef, sheep, goat, pork, bananas, sweet potatoes, and cassava.

In 2018, the BVI had an estimated gross domestic product of US\$1.38 billion. This, leading to the \$34,200 GDP per capita as of 2017, has made the BVI one of the most prosperous nations in the Caribbean.

Tourism accounts for approximately one in every four jobs held by citizens of the BVI. Per year, the BVI accommodates more than 900,000 tourists. In 2015, 922,372 people entered the country, with the majority visiting the country via cruise ships (529,354). Overnight visitors accounted for the remaining portion. The COVID-19 pandemic significantly impacted the tourism sector and a 17% GDP decline was seen in 2020. During this time 41% of the population reported a loss of

income or jobs during this time. The Minister of Tourism indicated in October 2023 that the number of tourists visiting the islands is on the rise and that the sector is stabilising.

In the 1980s, the government began offering offshore registration to companies wishing to incorporate in the islands. These incorporation fees now account for 51.4% of government revenues. As of June 2012, official statistics specified that 447,801 companies were active in the BVI. The BVI has become one of the world’s leading offshore financial centres.

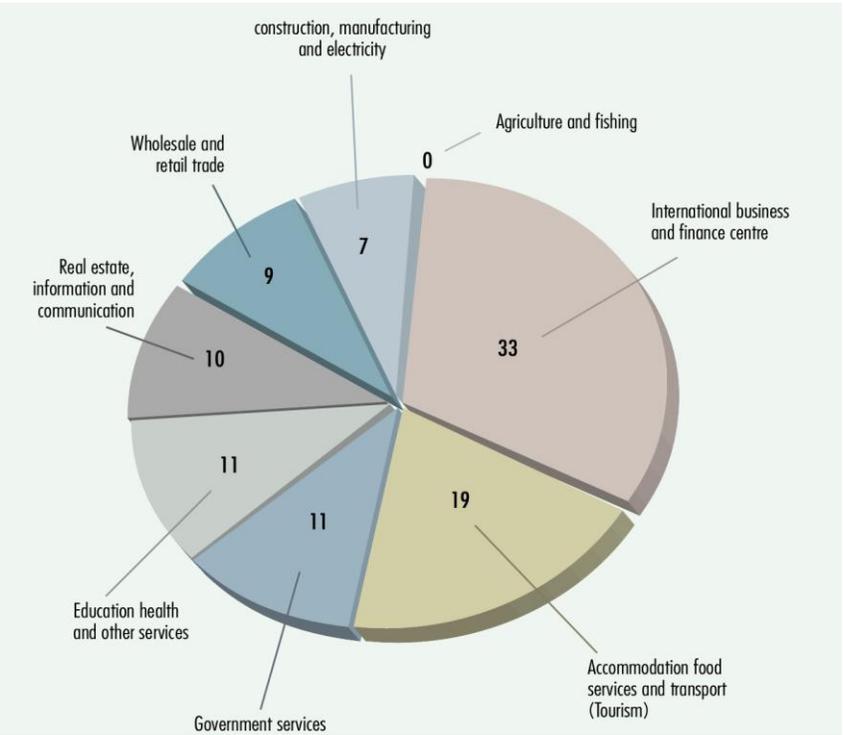


Figure 12: Pie chart of the components (showing percentage) of the BVI Economy

### 4.3 STATUS OF WATER RESOURCES MANAGEMENT IN THE BVI

#### 4.3.1 Sources and Distribution

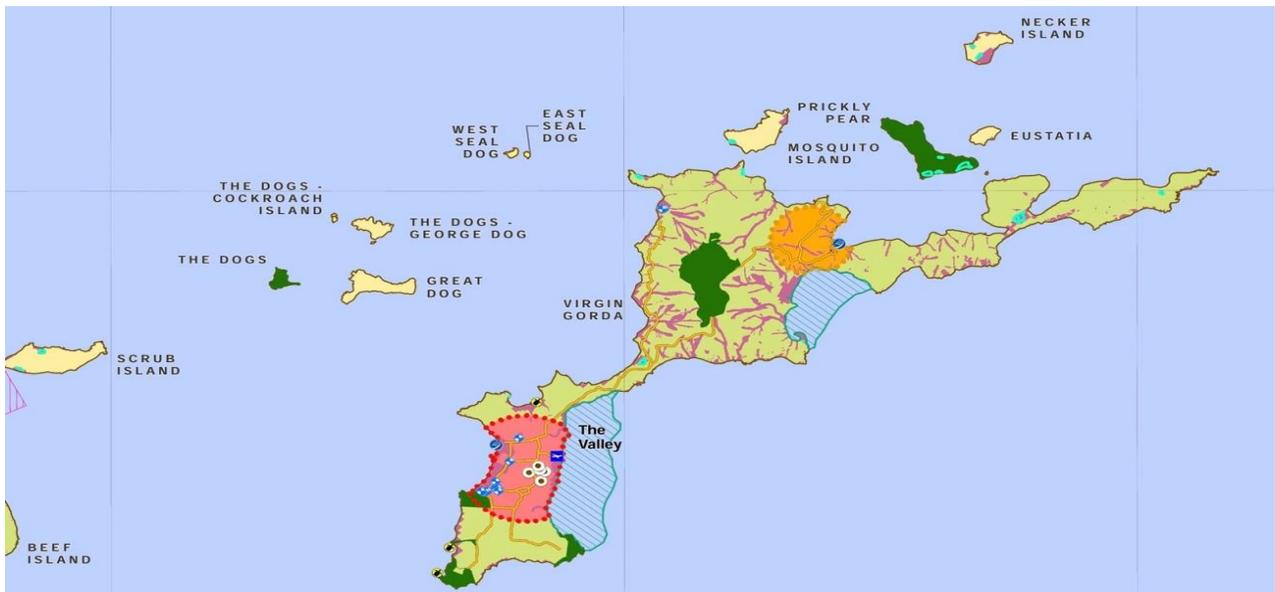
There are gaps in important metrics reported by the BVI and presently, the total renewable water resources, municipal water withdrawal, total water withdrawal per capita, or total renewable water per capita have not been stated. Given the low rainfall averages of 1,150 mm/year, lack of permanent water sources and reliance on desalination techniques, it can be inferred that the BVI is a water scarce territory. Water is obtained in three ways; rainwater harvesting, wells and aquifers.

### 4.3.2 Wells

There are numerous wells scattered throughout the islands that provide water for domestic use. The quantity of water abstracted by these wells is unknown, but data referring to household use is shown in **Table 9** below. **Figures 13-16** below show the distribution of wells throughout the islands through this symbol:



**Figure 13: Well locations on Tortola.**



**Figure 14: Well locations on Virgin Gorda**



**Figure 15: Well locations on Jost Van Dyke**



**Figure 16: Well locations on Anegada**

#### 4.3.3 Rainwater Harvesting

Many households depend on private cisterns that use rainwater for recharging. This practice is particularly important on the less developed islands of Jost Van Dyke and Anegada. On Virgin Gorda, 19.9% of households use private water cisterns either in conjunction with piped water from the government or as their sole source of water. This number is significantly higher in Tortola, as 54.3% of households use private water cisterns.

#### 4.3.4 Desalination Plants

Two privately owned companies operate reverse-osmosis plants across the four main islands of the BVI. This water is sold to the government and then redistributed to the population. This accounts for most of the water issued across Tortola and Virgin Gorda. Several hotels operate their own seawater desalination plants.

### 4.4 WATER SUPPLY AND DEMAND

Precise data regarding water demand across sectors is not currently available. The quantity of water used daily for each of the islands is unknown. The Water and Sewerage Department does have an intricate system of pipes throughout the four main islands that distributes water purchased from desalinization plants to households. Domestic and commercial water is metered, and a rate is paid per gallon. **Table 9** indicates the sources of water for the major islands as well as yachts that are permanently based in the territory. For the islands of Anegada, Jost Van Dyke, Tortola, Virgin Gorda and yachts based in the BVI, publicly piped water accounts for the highest percentage of water supplied to most households. On the smaller islands of Cooper Island and Great Camanoe Island, where public piping is not widespread, all households obtain their water through private cisterns.

**Table 9: Main source of water supply for each island as a percentage**

| Main Source of Water Supply               | Name of Island |               |                      |               |         |              |        |
|---|----------------|---------------|----------------------|---------------|---------|--------------|--------|
|   | Anegada        | Cooper Island | Great Camanoe Island | Jost Van Dyke | Tortola | Virgin Gorda | Yachts |
| Public Piped into dwelling (street water) | 58.9           | 0             | 0                    | 59.2          | 42.5    | 80.1         | 50     |
| Public standpipe outside the unit         | 0.9            | 0             | 0                    | 0             | 0.2     | 0.1          | 0      |
| Public piped into yard                    | 0              | 0             | 0                    | 2.5           | 0.3     | 0.4          | 25     |
| Private Piped into dwelling (cistern)     | 22.3           | 100           | 100                  | 20            | 35.6    | 13.2         | 0      |
| Public and Private piped into dwelling    | 2.7            | 0             | 0                    | 10            | 18.7    | 2.9          | 0      |
| Truck borne (not piped into dwelling)     | 0              | 0             | 0                    | 0             | 0.1     | 0            | 0      |
| Private Catchments, not piped             | 4.5            | 0             | 0                    | 5             | 1.2     | 0.6          | 0      |
| Spring/Well                               | 10.7           | 0             | 0                    | 1.7           | 0.9     | 0.6          | 0      |
| Other                                     | 0              | 0             | 0                    | 1.7           | 0.4     | 2.2          | 25     |

For the purposes of agriculture, the Department of Agriculture has created small ponds or minidams for use by farmers. With a capacity of 14,000 cubic metres these ponds have also improved the hydrology and microclimate of the immediate area.

There are only two major irrigation systems in the BIV: one on Tortola, where the department is located, and the other on Virgin Gorda. These supply the department and 48 farmers on Tortola on 12 ha. The project on Virgin Gorda serves 14 farmers on 5.6 ha. The project on Tortola is fed by public water and well water. The project in Virgin Gorda is fed by wells and spring water. Other farmers are supplied with public, surface and well water.

Of the delineation systems reported on the islands, Jost Van Dyke is home to one desalination plant with a capacity of 60,000 US gallons per day. This plant was commissioned in 2003 and was expanded in 2010 to accommodate the increase in tourism on the island.

Both Tortola and Virgin Gorda house various desalination plants and have been commissioning the construction of these plants since the 1980s. As recently as 2015, the government approved expansions to desalination plants on both islands to meet the growing demand for water. The new facility on Tortola provides 10,450 cubic metres of water per day, year-round, to add to the water supplied by existing plants.

Although specific values for the quantity of water demanded in the BVI are not reported, it is understood that water demand is seasonal with the influx of tourism. Peak travel to the islands is seen between the months of November to March. This can be visualized in **Table 10** below, which shows a significant increase (2-3-fold) in the number of tourists during the winter period, contributing to the demand for water.

**Table 10: Tourist entries in 2019**

| Month        | Cruise Ship    | Overnight      | Day Trippers  | TOTAL          |
|--------------|----------------|----------------|---------------|----------------|
| January      | 109,061        | 27,955         | 1,196         | 137,312        |
| February     | 79,270         | 26,948         | 1,095         | 107,313        |
| March        | 88,424         | 33,960         | 1,403         | 123,787        |
| April        | 29,225         | 39,862         | 1,735         | 60,822         |
| May          | 19,331         | 25,051         | 1,749         | 46,131         |
| June         | 27,457         | 29,900         | 1,406         | 58,763         |
| July         | 11,553         | 30,931         | 1,794         | 44,278         |
| August       | 11,781         | 20,478         | 2,326         | 34,585         |
| September    | 14,676         | 7,564          | 865           | 23,105         |
| October      | 20,315         | 13,323         | 1,096         | 34,734         |
| November     | 57,513         | 23,601         | 1,304         | 82,418         |
| December     | 106,528        | 33,826         | 1,389         | 141,743        |
| <b>TOTAL</b> | <b>575,134</b> | <b>302,499</b> | <b>17,358</b> | <b>894,991</b> |

Residential customers across the islands have very low confidence in piped water, whether from public or private sources, and the most abundance source of drinking water throughout the territory is bottled water. Almost 84% of households in Virgin Gorda and 80.9% of households in Tortola used bottled water as their main source of drinking water. Such was also the case for 75.8% and 51.8% of households in Jost Van Dyke and Anegada respectively.

#### **4.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY & QUANTITY)**

While the quantity of water produced and utilized in the BVI is difficult to ascertain, in part due to the high incidence of private water cisterns and the use of wells. There is a robust system for

testing the quality of the water on the islands. The Environmental Health Division of the Ministry of Health is responsible for water quality surveillance and investigations of complaints such as septic tank problems, among other environmental parameters.

#### 4.5.1 Sewage Treatment

Sewage is managed in the territory via the Public Health Ordinance and the Public Health Regulation (Nuisances). Both acts leave gaps and need to be amended to regulate the use of holding tanks in yachts and the discharge of sewage effluents from ships and yachts. The responsibility for this disposal is left in the hands of the Water and Sewerage Department. While there is a national sewage system, it is underutilised, and much of the population uses septic tanks. In both Jost Van Dyke and Virgin Gorda, around 92% of all households had toilet facilities linked to septic tanks. In Tortola, 70.8% of households used septic tanks, while 28.6% were linked to the public sewer. In Anegada, 12.5% of households were linked to the public sewer system, but this was the case for only about 6% of households in Jost Van Dyke and Virgin Gorda.

The sewage collected is treated at various wastewater treatment plants, and a sewerage system currently serves Road Town, with waste being collected and pumped through an outfall located on Tortola. Cane Garden Bay, on Tortola's western end, is also served by two sewerage systems that include a secondary treatment plant. In addition, some hotels have sewage treatment plants that produce water for garden irrigation. The high dependence on septic tanks has led to some environmental concerns, as poor soil percolation has led to sewage disposal problems in the East End Long Look community on Tortola in the past. The vulnerability to natural disasters has also caused concern for sewage treatment, as Hurricane Irma in 2017 rendered the Burt Point Wastewater Treatment Plant non-functional, and since then, the territory has continued to flush raw sewage directly into the ocean off Slaney Point.

In October 2023, the Government of the Virgin Islands entered into two contracts for the wastewater treatment plant at Paraquita Bay. The first contract signed is for the management and operation of the wastewater treatment plant, and the second is for the repair and commission of the wastewater plant and the design and construction of a sludge treatment facility.

#### 4.5.2 Climate Change

As climate change continues to threaten the Caribbean region, small island territories are particularly vulnerable to any variation in weather patterns. Dry seasons are expected to be particularly harsh, and most climate models predict a reduction in rainfall across the region during the wet season. This would act as a blow to the BVI, as a large percentage of the population relies on rainwater harvesting as their main source of domestic water. According to RCP 4.5, temperatures will continue to rise this century, leading to more intense hurricanes and a global sea level rise of 0.5–0.6 m.

#### 4.5.3 Water Quality Testing

The Environmental Health Division administers a water quality surveillance and institutional hygiene programme designed to protect residents and tourists from water-borne disease outbreaks and ensure that public institutions adhere to a basic standard of sanitation. The inspection of schools and water supply systems is a major component of the program. In 2003, 105 samples were taken and analysed; 25 of them were contaminated and subsequently treated with chlorine. If citizens desire water quality testing to be done, the government offers this service upon completion of a form.

In December 2022, the Ministry of Natural Resources and Labour received a grant from the European Union valued at €927,980 to improve the water quality testing capabilities in the BVI. Limitations in the Territory’s water quality monitoring programme are to be addressed in the new “Resilience, Sustainable Energy and Marine Biodiversity Programme” (RESEMBID), funded by this grant. Institutional strengthening, capacity building, equipment, hardware and software acquisition, and the establishment of a baseline for new priority areas and water quality parameters are the areas to be strengthened.

### **4.6 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK**

The British Virgin Islands have developed various laws and policies designed to improve the management of water resources. The government of the BVI has employed measures to improve the quality and supply of water, such as upgrading infrastructure in water reservoirs, improving

detection of water leaks, improving metering technologies, and promoting environmental education and public awareness.

#### 4.6.1 Regional Setting

The British Virgin Islands are privy to various Multilateral Environmental Agreements (MEAs), which provide direction and focus on approaches understood to promote inclusive and sustainable development of local land and water resources. The BVI is also part of major regional communities such as the Caribbean Community (CARICOM) and the Organisation of Eastern Caribbean States (OECS), which actively provide technical support and formulate policies aimed at furthering the development of their individual member states. Apart from assisting in the development of member states, these regional entities aim to promote regional integration and cooperation through their activities. **Table 11** below lists various MEAs of which the British Virgin Islands are members or associate members and various guiding regional documents produced by CARICOM and the OECS.

**Table 11: Key MEAs and Regional Guidance Documents**

| <b>Multilateral Environmental Agreements (MEAs)</b>  | <b>Regional Guidance Documents</b>  |
|--|---|
| Montreal Protocol (Accession)<br>Vienna Convention (Accession)<br>Convention of Biological Diversity (Ratification)<br>Convention on Migratory Species of Wild Animals (Ratification)<br>Cartagena Convention (SPAW and LBS Protocol) (Ratification)<br>Ramsar Convention (Ratification)<br>World Heritage Convention (Ratification)<br>Convention on the International Trade in Endangered Species of Wild Flora and Fauna (Ratification)<br>United Nations Convention to Combat Desertification (Ratification)<br>United Nations Convention on the Law of the Sea (Ratification) | Organisation of Eastern Caribbean States (OECS) Biodiversity and Ecosystems Management Framework 2020-2035<br>OECS Regional Green-Blue Economy Strategy and Action Plan (2020 Draft)<br>St. Georges’ Declaration of Principles for Environmental Sustainability in the OECS<br>Revised OECS Regional Plan of Action for Agriculture 2012 – 2022<br>Eastern Caribbean Climate Change Implementation Plan – Final Report<br>OECS Model Water Policy |

#### 4.6.2 National Setting

The regulatory framework in the British Virgin Islands consists of various policy documents and legislature which have been continuously developed over the last century. Mandates associated with water resource management are carried out by several authorities. The Department of Agriculture is mandated to manage and protect watersheds however the responsibilities for the management of non-watershed water sources are distributed among other agencies. **Table 12** below gives an overview of the major legislature and policy documents associated with the management of watersheds and other water resources.

**Table 12: Key Legislative and Policy Documents for the Water Sector**

| <b>Legislation</b>  | <b>Policy/Guidance Document</b>                            |
|---|--|
| <b>Protection of Tress and Conservation of Soil and Water Ordinance (1954/1965)</b> | Parks and Protected Areas System Plans (1981 & 1986)       |
| <b>Salt Ponds Ordinance (1959)</b>  | British Virgin Islands Environment Charter (2001)          |
| <b>Public Health Ordinance (1967)</b>   | National Integrated. Development Plan (1999-2003)          |
| <b>Beach protection Act (1985)</b>  | National Environmental Action Plan (2004)                  |
| <b>The Marine Parks and Prohibited Areas Regulations (1991)</b>                     | Virgin Islands Climate Change Green Paper (2010)           |
| <b>Fisheries Act (1997)</b>   | The Virgin Islands Climate Change Adaptation Policy (2012) |
| <b>Fisheries Regulation (2003)</b>  | BVI Protected Areas System Plan (2007-2017)                |
| <b>National Parks Act (2006)</b>  | National Physical Development Plan (2018)                  |
| <b>Water and Sewerage Act (2007)</b>  |  |
| <b>National Parks Regulations (2008)</b>  |  |
| <b>Litter Abatement Act (2009)</b>  |  |

#### 4.6.3 Institutional Framework

There is a plethora of agencies associated with the management of watersheds and other water resources which are detailed in **Table 13** below.

**Table 13: Overview of Agencies Associated with Watersheds and Water Resource Management**

| <b>Agency</b>   | <b>Responsibility</b>   |
|---|---|
| Ministry of Natural Resources and Labour                  | Responsible for upholding environmental policies and international environmental agreements.<br><br>Responsible for the management of crown land and the seabed.  |
| Ministry of Communications and Works                      | Responsible for the assessment of water reservoirs.<br><br>Responsible for improving the supply of water through infrastructural upgrades.  |
| Division of Environmental Health (The Ministry of Health) | Monitors water quality in schools and water supply systems to prevent the outbreak of water borne diseases.<br><br>Responsible for the control of environmental pollution under the Public Health Ordinance.  |
| Water and Sewerage Department                             | Responsible for the management and disposal of public sewage.<br><br>Responsible for the provision of potable water to residents.<br><br>Supplies data and advice to the governments on matters involving water and sewage.<br><br>Responsible for planning of water and sewerage infrastructure. |
| National Parks Trust                                      | Responsible for the management of protected areas and designated parks.<br><br>Oversees the identification and incorporation of new sites in the Protected Areas System of the British Virgin Islands.  |
| Department of Town and Country Planning                   | Responsible for the assessment of environmental impacts for proposed projects.<br><br>Authorized to designate Environmental Protection Areas in developmental plans.  |
| Department of Agriculture                                 | Responsible for the prevention of deforestation.<br><br>Responsible with designating, managing, and protecting watershed areas and water sources.   |
| Department of Conservation and Fisheries                  | Responsible for biodiversity conservation and research, involving environmental monitoring and the maintenance of fisheries.<br><br>Promotion of fisheries development.   |

## **4.7 CHALLENGES FOR IWRM**

### **4.7.1 Policy and Institutional Challenges**

Responsibilities related to improving IWRM in the BVI are currently spread over different departments of government. The need for coordination in operations in this field is evident and has been recognised by the relevant authorities. The current disjointed system allows for gaps in operation and in 2021, the “Water and Sewerage Authority Act” was proposed for the

establishment of one authority to resolve these issues. Under the Act, the authority will have exclusive rights to supply, distribute, maintain, and sell water in the BVI, as well as give written permission to any person to do the same. The authority has the power to do anything or enter into any transaction to facilitate carrying out its functions. The authority will also oversee the disposal and treatment of sewerage. To date, this act has yet to be enacted. When this act is passed, it can be considered a step in the right direction, but it is not fully understood what change the authority would make to address the management of water resources when compared to what is currently done by the various agencies.

Regionally, many policies have been developed with the goal of developing IWRM across the Caribbean. The concern for the BVI lies with the ambitious nature of the goals relative to the country's capacities and developmental direction. Nationally, no new policies have been developed to address issues related to IWRM.

Various institutions are hampered in their ability to carry out their relevant functions due to outdated ordinances, poor manifestation of regulations authorised in past legislation, and a lack of relevant standard operating procedures. For example, the Division of Environmental Health has faced difficulty in their task to manage environmental pollution due to the archaic ordinance of 1967 and the failed enactment of authorised regulations. On the other hand, the Department of Conservation and Fisheries has faced challenges in monitoring coastal waters due to a lack of approved water quality standards.

#### 4.7.2 Impact of Climate Variability and Change on the Water Supply

As a result of its location, size, and socioeconomic reality, the BVI is prone to vulnerabilities because of natural hazards and external shocks. As climate models predict a continuously warming climate, these shocks and hazards are expected to magnify with time. Reductions in rainfall and drought are major concerns. Significant portions of the population rely solely on harvested rainwater as their primary source of fresh water. With a predicted reduction in rainfall over the course of the 21<sup>st</sup> century, measures must be applied to safeguard the potable water of vulnerable households. Sea level rise is another source of concern for the territory's freshwater resources. Notwithstanding the socioeconomic effect that a higher sea level will have on the territory, as most

of the population lives near low-lying areas and the tourism sector is heavily dependent on the coast, groundwater resources would be at risk of saltwater intrusion.

Hurricanes have already damaged existing infrastructure, such as Hurricane Irma, which in 2017 devastated the capacity of Tortola to adequately dispose of wastewater. As storms of this level and stronger are projected to become a more common occurrence, this threatens the ability of the BVI to achieve IWRM goals.

#### 4.7.3 Data Availability and Use

Very few scientific studies have been undertaken in the BVI with respect to water quality, quantity, and distribution. Important information such as demand and usage has yet to be ascertained, mainly due to the reliance on private water catchments. Should a drought occur, it is unsure whether current water production would meet the needs of existing citizens.

#### 4.7.4 Capacity Constraints

The Department of Agriculture is mandated to manage areas for the protection of watersheds and water sources. To date, seven areas are currently protected under the authority of the department. Issues arise as the Department of Agriculture does not have staff dedicated to the management of these protected areas. This means that responsibilities for water conservation and the like are not being adequately addressed by officials and staff within the department.

### 4.8 CONCLUSION

The British Virgin Islands (BVI) have limited freshwater resources, and as a result, they depend heavily on water purification processes. Furthermore, the occurrences of drought, hurricanes and saltwater intrusion serve as constant threats to water supplies and availability in the BVI. Climate change and economic development may also place pressure on limited water resources by compounding the issues. Therefore, there is a fervent need to ensure proper management of water sources to strengthen the availability, affordability, and quality of water.

Over the last century the BVI has made efforts to improve their water resource management through the activities of various agencies and the establishment of relevant policies. However, outdated water policies limit the efficacy of relevant agencies in carrying out their designated roles,

and there has been little progress in the implementation of new policies and legislation with the potential to positively impact water resource management.

## 5 ANNEX E: DOMINICA

### 5.1 OVERVIEW

With an average annual rainfall of 2083 mm and a significant withdrawal of water resources per capita, Dominica primarily depends on its network of rivers and streams for water supply. However, challenges like leakage, inconsistent metering, and inadequate wastewater treatment persist. The Dominica Water and Sewerage Company Limited (DOWASCO) plays a pivotal role in water management, but institutional and regulatory frameworks need enhancement to ensure effective Integrated Water Resources Management (IWRM).

Despite the existence of laws governing water usage and management, enforcement remains inadequate, leading to intermittent water availability and compromised quality. The island's susceptibility to climate change exacerbates these challenges, necessitating proactive measures and comprehensive strategies for conservation and resilience.

### 5.2 GEOGRAPHICAL CONTEXT

Dominica is a tropical island positioned strategically within the Lesser Antilles of the Eastern Caribbean and occupies a pivotal geographical location south of Guadeloupe and north of Martinique. As one of the largest and northernmost islands in the Windward Archipelago, Dominica features a tropical rainforest climate characterized by elevated temperatures and substantial rainfall, influenced by the northeast trade winds. Dominica's climate falls under the classification of humid tropical marine, characterized by minimal seasonal or diurnal fluctuations. The island experiences a dry season extending from January to June, followed by a wet season from July to December. Annual rainfall exhibits variation, ranging from approximately 300 inches at the central peaks to an average of 50 inches along the typically drier central part of the west coast. Temperature-wise, annual averages span from 21°C at the highest elevations to 27°C on the coast, with seasonal temperature fluctuations generally remaining below 2°C (CEPAL 2007). However, its geographical positioning renders it susceptible to hurricanes, being situated in the hurricane belt (UWI-SRC 2024).

Encompassing a land area of 751 km<sup>2</sup>, Dominica, with a volcanic origin, presents diverse

topography, showcasing mountainous landscapes adorned with rivers, streams, waterfalls, and springs, including the renowned Boiling Lake. The Morne Trois Pitons, standing at an elevation of 1,342m, signifies a prominent volcanic feature on the island (Nations Online Project 2023). Dominica has a coastline spanning 148 km, and the island's resources include timber, hydropower, and arable land, that contribute to its geographical richness. Dominica's land use comprises agricultural land, arable land, permanent crops, permanent pasture, forest, and others, with agricultural land emerging as the predominant land use (The World Factbook 2018).

Dominica's demographic profile, with a population of approximately 72,000 people as of 2014 and a growth rate of 0.02% (The World Factbook 2023), is characterized by its largest city, Roseau, which serves as a hub of cultural diversity. Dominica's air connectivity is facilitated by two airports, Douglas-Charles, and Canefield Airport, while the populace predominantly resides along the coast, with a substantial portion concentrated in the parish of St. George around Roseau. In contrast, the volcanic interior remains sparsely populated (the World Factbook 2024). An extensive transportation network spanning 1,512 km, of which 762 km are paved and 750 km are unpaved, is complemented by major ports located in Portsmouth and Roseau.

Administratively, Dominica is compartmentalized into ten parishes, Saint Andrew, Saint David, Saint George, Saint John, Saint Joseph, Saint Luke, Saint Mark, Saint Patrick, Saint Paul, and Saint Peter Parish, as seen in **Figure 17**.

The environmental landscape of Dominica is not without challenges, grappling with issues such as water shortages, pollution from agrochemicals and untreated sewage, encroachments on forests due to agricultural expansion, soil erosion, and coastal pollution by agricultural and industrial chemicals. Economically, Dominica has a highly agrarian economy within the Organisation of Eastern Caribbean States (OECS) island framework, coupled with its Eastern Caribbean Currency Union (ECCU) membership. It stands as a prominent banana exporter, overseen by an evolving citizenship-by-investment program, and emerging industries in ecotourism, information and communications, and education (The World Factbook 2024).

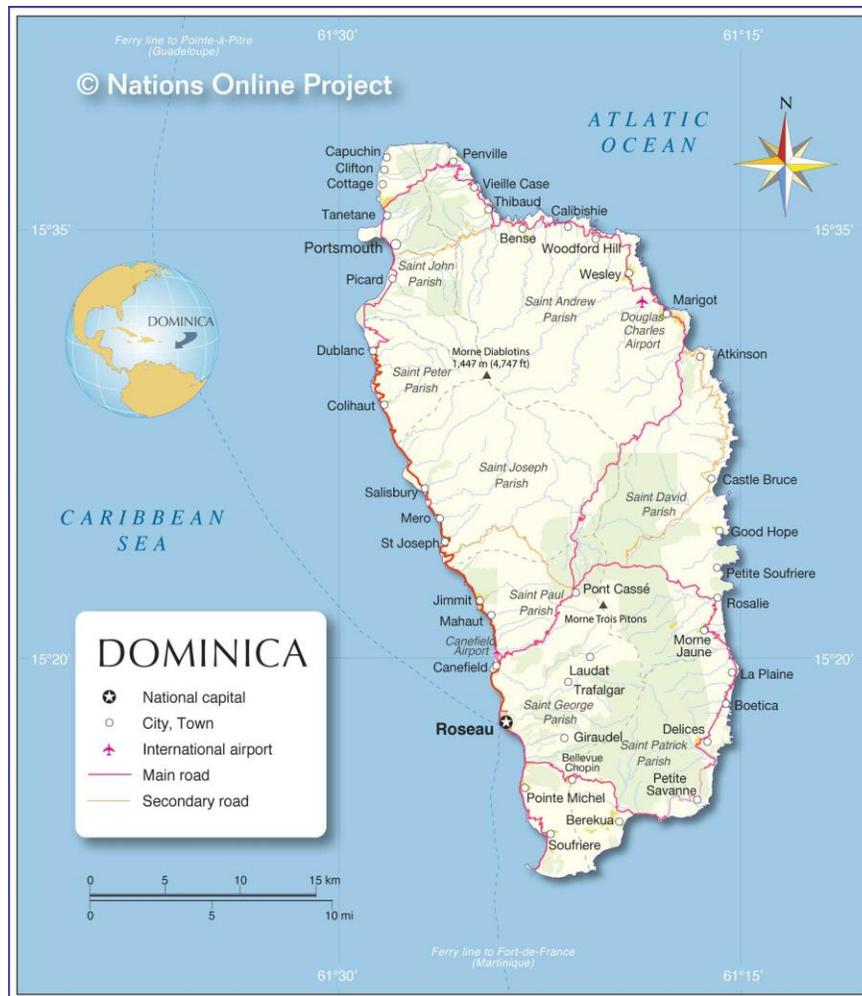


Figure 17: Map of Dominica, highlighting parishes, main cities, and roads (NOP 2023)

## 5.3 STATUS OF WATER RESOURCES MANAGEMENT IN DOMINICA

### 5.3.1 Source

Dominica, experiences an average annual rainfall of 2083 mm, contributing to a total water withdrawal per capita of 244.10 cubic meters per capita per year (see **Table 14**). DOWASCO (Dominica Water and Sewerage Company Limited) and the government of Dominica have identified ten major rivers crucial for water supply which can be found in **Figure 18**: Indian, Picard, Layou, Roseau, Blenheim, Hampstead, Clyde, Pagua, Castle Bruce, and Rosalie. These rivers play a significant role in the water infrastructure of the region (CIJN 2023).



**Figure 18: Map of Dominica Highlighting Parishes and Main Rivers**

Dominica is abundantly supplied with water resources, predominantly sourced from its extensive network of rivers and streams, obviating the need for in-depth exploration of groundwater reservoirs. DOWASCO relies exclusively on surface water for its potable water supply, utilizing strategically constructed dams along rivers for water storage and subsequent extraction. Notably, surface water constitutes the primary source, while rainwater harvesting is a customary practice in isolated regions (CEPAL 2007).

The reliance on surface water persists in Dominica, where DOWASCO harnesses approximately 45 million litres of potable water daily from rivers.

Rainwater harvesting is prevalent in remote areas, and small communities with populations below 200, underserved by DOWASCO, access water through diminutive systems established by non-governmental organizations. Furthermore, groundwater extracted from surface water and a restricted number of springs is harnessed for potable water supply to specific communities and for the commercial production of bottled water (IWCAM 2011).

Selected groundwater sources are commercially leveraged for bottling purposes, primarily acquired from natural springs. DOWASCO allocates a total of 3.24 million gallons per day (imgd) for public water supply, with 2.5 imgd designated for cruise ship water supply and 6.0 imgd as bulk water. The estimated leakage or unaccounted-for water stands at approximately 20 percent (DOWASCO 2007). It is imperative to note that the quantification of water released into the distribution system lacks consistency, and not all customers are equipped with metering devices.

**Table 14: Water Resources for Dominica (GWP 2014).**

| Country  | Land area km2 | Total average annual rainfall (mm) | Total renewable water resources (mm3/year) | Municipal water withdrawal (mm3/year) | Total water withdrawal per capita (m3/capita/year) | Total Renewable water per capita (m3/capita/year) |
|----------|---------------|------------------------------------|--|---------------------------------------|--|---|
| Dominica | 751           | 2,083                              | Not Stated                                 | Not Stated                            | 244.10   | Not Stated  |

The island's topography delineates six distinct hydrological basins, characterized by radial stream patterns originating from volcanic mountain peaks and descending downslope. Virtually all streams, major and minor alike, maintain consistent flow throughout the year, with certain unnamed streams in the southeast providing limited to moderate water volumes. Dominica relies exclusively on these streams for its water supply, although their mouths are subject to periodic inundation by brackish to saline water from the Caribbean Sea or Atlantic Ocean (USACE 2004).

Below are the descriptions of the individual basins:

- Basin I: The Lamothe Basin is situated in the far northwestern corner of the island, receiving an average annual rainfall ranging from 1,270 to 3,810 mm (50 to 150 inches). Its primary watercourse, the Lamothe River, originates from Morne Aux Diabes, a volcanic peak. The streams within this basin, with an average length of 2 kilometers (1.2 miles), pose accessibility challenges due to limited road infrastructure, dense vegetation, and steep terrain.
- Basin II: The Northwest Basin, positioned in the northwestern region, experiences variable average annual rainfall, ranging from less than 2540 mm (100 inches) to as much as 7,620 mm (300 inches). With a local relief of 1,587 meters (5,207 feet), it is fed by major rivers like Picard, Dublanc, Batali, and Macoucheri, originating from the volcanic summit Morne Diablotins. Streams extending over 8 kilometers (5 miles) offer limited freshwater resources year-round, with challenging access due to steep slopes and limited road networks.
- Basin III: The Layou Basin, located in the west-central part of the island, receives average annual rainfall spanning from 1,270 to 7,620 mm (50 to 300 inches). It has a local relief of

approximately 1,390 meters (4,560 feet). The Layou River, one of Dominica's largest, originates from Morne Trois Pitons and Morne Diablotins. A significant landslide in 2002 formed a reservoir behind debris, raising concerns about potential flooding if the dam were to breach. Access to upper basin areas requires specialized vehicles or on-foot travel.

- The Castle Bruce Basin (V) encompasses the eastern and southeastern regions of the island. Annual precipitation in this area varies from 1,270 to 7,620 mm (50 to 300 inches) per year. The topographical relief is comparable to that of the Roseau Basin (IV). Key rivers within this basin include Belle Fille, Clarke's, Geneva, La Rivere Blanche, and Ouayaneri Rivers. These rivers originate from volcanic peaks such as Morne Cola Anglais, Watt Mountain, Morne Trois Pitons, and Morne Fraser. During the high flow period from June to October, small seasonal streams north of Grand Bay yield limited to moderate amounts of freshwater. The drainage from two freshwater lakes, Boeri Lake and Fresh Water Lake, located in Basin (V), is redirected to the Roseau Basin (IV) via treated wood stave pipes, contributing to the operation of hydroelectric power plants along the Roseau River.
- The Melville Hall Basin (VI) is situated in the northeast section of the island. Annual rainfall in this area ranges from 1,270 to 7,620 mm (50 to 300 inches). The local terrain rises to an elevation of 1,587 meters (5,207 feet). Key rivers within the basin include the Beauplan, Hampstead, Mamelabou, Toulaman, Melville Hall, Canal, Saint Marie, and Pagua Rivers, all of which originate from the Morne Diablotins. While most streams offer minimal water flow, small seasonal streams in the northern portion of the basin provide modest amounts of freshwater during the high flow season from June to October. Agricultural activities such as coconut, citrus, vegetable, and coffee cultivation are prevalent, leading to widespread herbicide use. However, recent water quality assessments regarding the impact of herbicide application on drinking water quality are lacking. Open dumping of garbage is also observed in rural areas, further compromising water quality. Moreover, significant landslides have occurred in the upper reaches of many rivers, potentially affecting water clarity. Accessing the headwaters of these rivers is challenging due to steep inclines, dense vegetation, and inadequate road infrastructure.

### 5.3.2 Distribution

The Water and Sewerage Act of 1991 in Dominica designates DOWASCO with the responsibility for potable water supply in the country. Users supplied with potable water include domestic, tourism, commercial, industrial, agricultural, and bulk water exports with different assigned tariffs (**Figure 19**). Prioritization is given to potable water supplies for domestic, commercial, and industrial users. However, large-scale agricultural activities abstract a substantial volume of water directly from rivers and streams, with no recorded quantity. Additionally, individuals and communities living near water sources directly abstract water for a variety of purposes. Some industries also utilize water from adjacent watercourses for various processing activities. While a license is legally required to abstract water, enforcement is not always consistent.

DOWASCO manages more than 40 water systems across Dominica, organized into zones—North, South, East, and West—each featuring multiple treatment plants for water treatment services. The primary focus of water treatment is bacterial mitigation, achieved through one of three chlorination methods. DOWASCO ensures that its water quality standards conform to international benchmarks established by the World Health Organization (WHO) (DOWASCO 2024).

Currently, over 90% of DOWASCO's clientele have meters installed. Recently, two pilot initiatives have been launched to assess ultrasonic meters and remote reading systems, aiming to gather more data on water usage and losses for improved management. Recommendations include installing additional bulk meters and establishing "district metered areas." While DOWASCO has introduced its initial Supervisory Control and Data Acquisition (SCADA) system and installed numerous pressure reducing valves on pipelines, further measures such as enhanced pressure management, leak detection systems, and pipeline replacement programs are advised to mitigate water loss and enhance control over water supply and distribution. A Cost of Service and Tariff Study has been recently concluded, proposing revised tariff structures to encourage water use efficiency. Additionally, DOWASCO enforces limits on water abstraction from all sources (UNEP 2020).

In terms of sewage disposal, Roseau, the capital, is served by a sizable, centralized sewerage system, while Cane Field and Jimmit have two smaller sewerage systems. The Roseau system undergoes minimal treatment, and the smaller systems lack any treatment. In these sewerage

systems, sewage is discharged through marine outfalls situated approximately 1,000 feet away from the shoreline (IWCAM 2011).

Sewerage services are provided in Roseau, Goodwill, Stockfarm, Bath Estate, Newtown, Canefield, and Jimmit areas. The sewerage treatment plant, situated in Baytown, processes raw sewage by removing floatables and then pumps the treated effluent into the open sea, away from the coastline (DOWASCO 2024).

For potable water supply, surface water undergoes chlorination treatment. During the dry season, river and stream flows diminish significantly, occasionally plummeting to as low as 30 percent of average flows during the wet season, accompanied by a noticeable escalation in turbidity during heavy precipitation. While the water supply generally meets user demands, regions of elevated terrain may experience insufficient in flow during the dry season.

The primary users of water are DOWASCO for potable water supply and Dominica Electricity Services (DOMLEC) for hydropower generation, abstracting over 6 million gallons per day from surface sources on average.

In communities without access to a potable water system, individual cistern systems for water collection and storage are employed. DOWASCO provides water to approximately 80 percent of the total population on a 24/7 basis through connections to its water supply system and existing standpipes that serve communities with populations exceeding 200 persons. Small communities not served by DOWASCO are assisted through small water supply systems established by non-governmental organizations.

Approximately 98 percent of the urban populace and 58 percent of rural residents are integrated into Dominica's water distribution network. However, communities such as Bells, Morpo, and Deux Bras in rural areas lack access to potable water. The average water withdrawal per person stands at 240 cubic meters (m<sup>3</sup>), predominantly allocated for domestic use. A network of 43 catchment areas captures surface water, a portion of which undergoes filtration, and all is subject to chlorination. Despite these measures, occasional excessive turbidity poses a significant quality concern, exacerbated by the presence of agricultural runoff containing fertilizers, pesticides, and insecticides, especially in rural locales (USACE 2004).

Apart from delivering potable water and sewerage services, DOWASCO holds a legal mandate for overseeing the management of the country's water resources. Consequently, the Minister of Communication and Works granted DOWASCO an exclusive 25-year license in 1989 to abstract and utilize the nation's water resources. DOWASCO allocates potable water to various users based on their needs but has implemented a licensing system for those who wish to directly abstract water from surface sources and distribute it. It's important to note that DOWASCO is not obligated to supply water for agricultural irrigation (ECLAC 2007).

| <b><u>METERED SUPPLY</u></b>              |                        |
|---|------------------------|
| <b><u>Domestic</u></b>                    |                        |
| • Fixed service charge per month          | <b>ECS</b><br>\$10.00  |
| • For 0 – 1000 gallons per month          | 8.80                   |
| • For more than 1000 gallons per month    | 8.80 per 1000 gallons  |
| <b><u>Commercial &amp; Industrial</u></b> |                        |
| • Fixed service charge per month          | \$20.00                |
| • For 0 – 1000 gallons per month          | 11.80                  |
| • For more than 1000 gallons per month    | 11.80 per 1000 gallons |
| <b><u>Stand Pipes</u></b>                 |                        |
| • Fixed service charge per month          | \$ 20.00               |
| • Flat rate per stand pipe per month      | 270.00                 |
| <b><u>Bulk Water Shipment</u></b>         |                        |
| • Water delivered to ships                | \$20.00/1000 gallons   |
| • Water delivered to bulk carriers        | 10.00/1000 gallons     |
| <b><u>UNMETERED SUPPLY</u></b>            |                        |
| • For property with one fixture           | \$25.00 per month      |
| • For property with more than one fixture | 42.00 per month        |
| <b><u>SEWERAGE</u></b>                    |                        |
| • Flat Rate                               | \$10.60 per month      |

Figure 19: DOWASCO Tariff Structure (USACE 2004)

| Catchment  | Population Served | Number of Standpipes | Basin Encompassed <sup>1</sup>           |
|--|-------------------|----------------------|--|
| Roseau/Loubiere/Snug Corner Estate/Pointe Michel   | 10,888            | 112                  | Northwest (II), Layou (III), Roseau (IV) |
| Saint Joseph to Potters Ville/Goodwill/Bath Estate | 16,978            | 20                   | Layou (III), Roseau (IV)                 |
| Salisbury  | 1,700             | 3                    | Northwest (II)                           |
| Coulibistri/Morne Raquette                         | 900               | 10                   | Northwest (II)                           |
| Colihaut   | 900               | 10                   | Northwest (II)                           |
| Dublanc/Bioche                                     | 700               | 7                    | Northwest (II)                           |
| Picard/Portsmouth/Glanvillia                       | 3,500             | 41                   | Northwest (II), Melville Hall (VI)       |
| Guillet/Tanetane/Toucari                           | 294               | 9                    | Lamothe (I)                              |
| Cottage  | 186               | 5                    | Lamothe (I)                              |
| Clifton  | 1,000             | 19                   | Lamothe (I)                              |
| Capucin  | 186               | 5                    | Lamothe (I)                              |
| Peineville   | 1,000             | 20                   | Melville Hall (VI)                       |
| Vieille Case                                       | 1,100             | 16                   | Melville Hall (VI)                       |
| Moore Park   | 300               | 4                    | Melville Hall (VI)                       |
| Thibaud/Paix Bouche/Dos D' Ane/Bornes              | 1,756             | 33                   | Melville Hall (VI)                       |
| Hampstead/Bense/Anse Du Me                         | 780               | 12                   | Melville Hall (VI)                       |
| Calibishie   | 1,000             | 19                   | Melville Hall (VI)                       |
| Woodford Hill/Wesley                               | 3,303             | 15                   | Castle Bruce (V), Melville Hall (VI)     |
| Castle Bruce                                       | 1,864             | 20                   | Castle Bruce (V)                         |
| Marigot  | 3,554             | 21                   | Melville Hall (VI)                       |
| Good Hope/Saint Sauveur/Petite Soufriere           | 594               | 8                    | Castle Bruce (V)                         |
| Grand Fond   | 750               | 9                    | Castle Bruce (V)                         |
| Morne Jaune  | 260               | 8                    | Castle Bruce (V)                         |
| Riviere Cyriques                                   | 475               | 9                    | Castle Bruce (V)                         |
| La Plaine  | 1,299             | 27                   | Castle Bruce (V)                         |
| Delices  | 700               | 16                   | Castle Bruce (V)                         |
| Petite Savane                                      | 750               | 6                    | Castle Bruce (V)                         |
| Bagatelle Estate/Fond Saint Jean/Stowe             | 880               | 12                   | Castle Bruce (V)                         |
| Dubuc  | 90                | 4                    | Castle Bruce (V)                         |
| Grand Bay/Tete Morne/Pichelin                      | 4,500             | 25                   | Castle Bruce (V)                         |
| Soufriere/Scotts Head Village/Galion               | 1,700             | 10                   | Roseau (IV)                              |
| Bellevue Chopin                                    | 433               | 6                    | Roseau (IV)                              |
| Giraudet/Eggleston                                 | 482               | 5                    | Roseau (IV)                              |
| Morne Prosper                                      | 500               | 5                    | Roseau (IV)                              |
| Wotten Waven                                       | 200               | 4                    | Roseau (IV)                              |
| Trafalgar  | 700               | 6                    | Roseau (IV)                              |
| Laudat   | 300               | 3                    | Roseau (IV)                              |
| Cochrane   | 280               | 7                    | Roseau (IV)                              |
| Des Por area                                       | 90                | 4                    | Roseau (IV)                              |
| Campbell   | 500               | 9                    | Roseau (IV)                              |
| Warner   | 450               | 2                    | Layou (III)                              |
| Carib Reserve                                      | 2,539             | No information       | Castle Bruce (V), Melville Hall (VI)     |
| Boetica  | 267               | No information       | Castle Bruce (V)                         |

Figure 20: Table highlighting Catchment Areas in Dominica and the population served (USACE 2004).

| Distribution                   | 1995           | 1996           | 1997           | 1998           | 1999           | 2000           |
|--------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Domestic:</b>               |                |                |                |                |                |                |
| Metered (# connections)        | 4,391          | 5,095          | 6,387          | --             | 8,072          | 8,405          |
| Non-metered (# connections)    | 6,605          | 6,318          | 5,717          | --             | 6,189          | 5,231          |
| Consumption (gal)              | 210,768        | 244,560        | 306,672        | 369,600        | 342,000        | 336,071        |
| <b>Industrial:</b>             |                |                |                |                |                |                |
| Metered (# connections)        | 66             | 72             | 74             | --             | 69             | 65             |
| Consumption (gal)              | 39,600         | 43,200         | 44,400         | 48,000         | 54,060         | 35,648         |
| <b>Commercial:</b>             |                |                |                |                |                |                |
| Metered (# connections)        | 464            | 562            | 604            | --             | 498            | 449            |
| Consumption (gal)              | 83,520         | 100,800        | 108,220        | 110,700        | 104,940        | 60,343         |
| <b>Government:</b>             |                |                |                |                |                |                |
| Metered (# connections)        | 140            | 145            | 153            | --             | 176            | 193            |
| Consumption (gal)              | 84,266         | 87,276         | 92,076         | 92,076         | 90,000         | 69,158         |
| <b>Standpipes (#)</b>          |                |                |                |                |                |                |
|                                | 591            | 592            | 596            | 598            | 599            | 600            |
| Consumption (gal)              | 164,006        | 164,294        | 165,127        | 166,237        | 165,324        | 123,993        |
| <b>Total Consumption (gal)</b> | <b>582,160</b> | <b>640,130</b> | <b>716,495</b> | <b>786,613</b> | <b>756,324</b> | <b>625,213</b> |

Source: Dominica Water and Sewerage Company  
-- = information not available  
# = number

Figure 21: Table illustrating potable water consumption and distribution (1995-2000), gallons (USACE 2004).

Water supply in Dominica operates via a catchment system, wherein stream water is captured through small concrete weirs. DOWASCO manages a network of forty-three catchment areas, with at least five sourced from springs. Despite being essential for water provision, these catchment areas are not delineated on surface water maps due to technical constraints. The water undergoes chlorination; however, turbidity remains uncontrolled, particularly following rainfall, leading to muddy water due to sediment disturbance. Some catchments employ rapid sand filtration systems, although there is a need for additional sand filtration setups, along with the potential adoption of slow sand filtration methods to enhance solid particle removal.

DOWASCO extracts over 10 million gallons per day (mgd) from 43 river intakes to cater to domestic, commercial, and industrial water demands. This suffices to meet the country's water requirements, barring the dry season, when urban and rural areas experience a drop in daily per capita consumption to around 60 and 45 gallons, respectively. DOWASCO serves over 90 percent of the population through 16,000 customer connections, excluding agricultural water supply. Dry season water shortages, typically from January to May, intensify due to increased usage for

landscaping and bathing, with the main water consumers being DOWASCO for domestic use and export and the Dominica Electricity Services for hydropower generation (USACE 2011).

**Figure 21**, presents potable water consumption and distribution data from 1995 to 2000, highlighting a notable 91.4 percent rise in metered households during this period despite a decrease in consumption. Sewage treatment remains a critical issue, with only Roseau having a sewer network, albeit outdated and poorly maintained, discharging sewage directly into the sea through eight coastal outfalls. The Roseau Water and Sanitation Project, initiated in 2000, aims to overhaul the urban sewer and water infrastructure, along with improving disposal and treatment methods. Elsewhere on the island, sanitation facilities include soakaways, pit latrines, and septic tanks, with septic tanks more prevalent in urban areas and latrines in rural regions. PAHO's Regional Report on the Global Assessment 2000 indicates that 86 percent of urban and 75 percent of rural populations had access to sanitation services. Distribution losses, estimated at 40 percent in 1985, persist as a challenge, mirroring trends in Latin America and the Caribbean (USACE 2004).

#### **5.4 WATER SUPPLY, DEMAND AND USAGE**

DOWASCO provides water to an estimated 80% of the total population continuously, 24 hours a day, seven days a week through its water supply system and standpipes. Notably, the water released into the distribution system is not metered, and not all customers have meters.

In terms of sewage disposal, there is a centralized sewerage system serving the capital, Roseau, and two smaller systems catering to the areas of Cane Field and Jimmit. While minimal treatment is applied in the Roseau sewerage system, there is none in the two smaller systems. Sewage from these systems is discharged via marine outfalls located approximately 1,000 feet from the shore. In most areas, wastewater disposal primarily relies on septic tank/soakaway systems, posing potential challenges for water resource management when these systems malfunction (Environmental Advisors Inc. 2011).

##### **5.4.1 Source Sustainability, Protection, Access and Benefit Sharing**

Dominica stands out among its regional counterparts for its abundant rivers and water resources, which have earned it recognition from other Caribbean nations as a reliable alternative water

source during times of scarcity. Beyond serving various sectors such as bottled water production, agriculture, tourism, hydropower, and domestic consumption, the Dominican government strategically positions itself as a bulk water exporter. IWCAM (2011) underscores the government's proactive stance in acknowledging the long-term importance of Dominica's water supply amidst challenges like climate change and drought, viewing it as a potential driver of economic development. They emphasize the critical role of integrated water resources management in safeguarding water resources for equitable access by the Dominican populace, thereby addressing regional water needs and challenges effectively.

DOWASCO manages a sewerage treatment facility responsible for processing over half a million gallons of wastewater daily. This facility handles the conveyance of raw sewage from various sources to the treatment plant, supported by lift stations and a gravity system. DOWASCO's sanitation division addresses emergencies, conducts preventive maintenance, and oversees repairs, replacements, and expansions of the sewerage collection system. The Roseau Water and Sanitation Project launched in 2003 aimed to enhance the living conditions of Roseau residents and Dominicans at large. This initiative, with a total cost of 62 million dollars EC, improved public health and environmental protection by constructing a primary sewerage treatment plant, installing a submarine outfall line, and upgrading existing sewer and water infrastructure in Roseau.

In Dominica, individuals seeking to extract and sell water must obtain licenses, paying royalties and fees based on their intended use. The tariff structure for water supply and sewerage prioritizes affordability, ensuring access to potable water through public standpipes and facilities without direct charges to the public, with the government compensating DOWASCO for this service.

## **5.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY & QUANTITY)**

Since water is the inextricable link in the environment and almost everything depends on it, the responsibility of the water sector must be shared with other key stakeholder departments. Hence, sectoral policies and plans must be consistent with the National Water Resources Management Policy (ECLAC 2007).

### 5.5.1 History of IWRM in Dominica

An official survey was conducted for Dominica to report on Sustainable Development Goal (SDG) 6.5.1: “Degree of integrated water resources management implementation (0-100)” which is used to measure progress towards target 6.5. The tool serves as an instrumental diagnostic tool used to identify the strengths and weaknesses of the various aspects in IWRM implementation and focuses on 4 crucial dimensions of SDG 6.5.1. The survey was conducted in 2017 and 2020 for Dominica and shows an increase in the Final SDG Score indicating a Medium-Low score for both years (**Table 15** and **Table 16**).

**Table 15: Illustrates the degree of implementation (0-100) for various key dimensions of SDG 6.5.1 for Dominica (2017)**

| Key Dimensions           | Enabling Environment | Institution and Participation | Management Instruments | Financing | SDG 6.5.1 Score |
|--------------------------|----------------------|-------------------------------|------------------------|-----------|-----------------|
| Degree of Implementation | 18                   | 61                            | 56                     | 25        | 40              |

In 2017, laws and policies remained outdated, as exemplified by the Draft Integrated Water Resources Management (IWRM) policy, initiated in 2011 under the IWCAM project, still pending government approval and undergoing review. Moreover, existing legislation, such as the Water Sewerage Act (1989), assigning water resource management responsibility to DOWASCO, and the Forestry and Wildlife Act (1990), containing some water resource management components, also remain outdated. Despite these challenges, progress towards an IWRM plan was evident, with the preparation of Terms of Reference (TOR) for a Water Resources Master Plan, although details on this initiative were scarce. Additionally, CARPHA conducted Water Safety Plan training sessions for stakeholders in a bid to establish a pilot water safety plan.

In 2020, the IWRM survey highlighted a pivotal advancement: the initiation of an ongoing consultancy funded by the Department for International Development (DFID), aimed at formulating a Water Sector Strategic Development Plan (WSSDP). This strategic endeavour encompasses the revision of existing policy frameworks and legislative structures within the water sector, with a particular focus on refining the draft Integrated Water Resources Management (IWRM) policy.

**Table 16: Illustrates the degree of implementation (0-100) for various key dimensions of SDG 6.5.1 for Dominica (2020)**

| Key Dimensions           | Enabling Environment | Institution and Participation | Management Instruments | Financing | SDG 6.5.1 Score |
|--------------------------|----------------------|-------------------------------|------------------------|-----------|-----------------|
| Degree of Implementation | 25                   | 61                            | 55                     | 48        | 47              |

Following this, the formal commencement of the Water Sector Strategic Development Project occurred in 2022, with an allocated budget of US\$ 30.319 million. This project is designed to fortify Dominica's water supply network and wastewater infrastructure, bolstering its resilience against various natural hazards and the impacts of climate change. Its core objective is to optimize the management of water resources, ensuring their availability, quality, and quantity for both residential and commercial applications (CDB 2023).

An estimated population of 71,000 residents of Dominica stands to benefit from this initiative, which aims to enhance access to safe drinking water and sanitation facilities. Detailed targets and output indicators associated with the project's implementation are elucidated in **Figure 22**, providing a comprehensive overview of the anticipated outcomes and milestones.

| Output Indicator   | Target              | RSAP |
|--|---------------------|------|
| 1.1 <b>New District Meter Areas (DMAs) established (#)</b>                                 | 5;<br>12/31/2023    | 4.2  |
| 1.3 Water production capacity installed (m3/hr)  | 265<br>12/31/2023   |      |
| 1.3 Water storage capacity installed (m3)  | 7,040<br>12/31/2023 |      |
| 1.4 <b>Water supply mains laid/upgraded (km)</b>   | 42<br>12/31/2023    |      |
| 2.1 SCADA system operational (Yes/No)  | Yes<br>12/31/2023   | 4.4  |
| 4.1 RE generating capacity installed (hydro turbines) (MW)                                 | 0.146<br>12/31/2023 | 4.3  |
| 5.1 <b>DOWASCO Employees trained in systems and software (#)</b>                           | 50;<br>3/31/2024    | 4.4  |
| 5.2 Recommended management systems implemented in DOWASCO (Yes/No)                         | Yes;<br>3/31/2024   |      |
| 5.3 Strategic Water Sector Framework accepted by GOCD (Yes/No)                             | Yes;<br>3/31/2024   | 1.1  |
| 5.4 Gender-responsive and Socially Inclusive Comms Plan developed and implemented (Yes/No) | Yes;<br>3/31/2024   | 5.3  |
| 5.5 Baseline and follow up Customer Survey implemented (Yes/No)                            | Yes;<br>3/31/2024   | 4.4  |

**Figure 22: Output Indicator and Targets for the Water Sector Strategic Development Project 2022 (CDB 2023)**

### 5.5.2 Impact of Climate Variability and Change on Water Supply

There is compelling evidence indicating a changing climate in Dominica, with recent increases observed in both maximum and minimum temperatures. This warming trend is anticipated to persist, projecting a temperature rise of up to 1.3°C by the 2050s and between 2 and 3 degrees by the century's end. The winter months are expected to experience slightly larger temperature increases than the summer months. The frequency of very hot days and nights is foreseen to rise, accompanied by a reduction in very cool days and nights. The overall climate is likely to become drier, with projections suggesting up to a 20% decrease by mid-century and up to 50% by 2100. Specifically, July-August is expected to be drier. Although the seasonality of Dominica will remain largely unchanged, with cooler early months and wetter late months prevailing, there are concerns about an increase in hurricane intensity, indicated by stronger peak winds and heightened rainfall, even though hurricane frequency may not necessarily increase. Additionally, Caribbean Sea levels are projected to rise by up to 0.24 meters by mid-century, and sea surface temperatures in the region are expected to warm by approximately 2°C by the century's end. The impact of the El Niño-Southern Oscillation (ENSO) on Dominican rainfall, particularly in early and late seasons, is likely to persist based on projections of the phenomenon's continued occurrence in the future (UNFCCC 2012).

Based on the increase in temperature, expected drying trends were expected which could potentially result in a reduction in flow volumes in streams and rivers due to the longer drier period. This is already a seasonal phenomenon in Dominica in the dry season and will likely be exacerbated by higher seasonal temperatures and increasing drought conditions (UNFCCC 2012).

Climate change is poised to exert a multifaceted impact on the sector, primarily through temperature fluctuations. This includes influencing the distribution of species, altering water flow in watersheds, reducing food resources for wildlife, and amplifying the prevalence of forest pests, diseases, and vulnerability to extreme climatic events. The anticipated changes underscore the need for adaptive measures to sustain ecosystems, protect biodiversity, and mitigate potential disruptions to the delicate balance of Dominica's natural habitats.

A substantial threat arises from the impending sea level rise, particularly to coastal habitats such as freshwater ponds, brackish water systems, mangroves, and arable floodplains. This elevation

poses challenges like increased pressure on forest reserves due to the loss of coastal agricultural lands to salinization. Coastal forests face depletion from inundation and intensified storm events, potentially resulting in the migration or loss of wildlife species from their accustomed habitats. Managing these coastal vulnerabilities is paramount to safeguarding the resilience of ecosystems and the communities reliant on their services.

The Caribbean region confronts an escalated risk of more frequent and intense storms due to climate change. This heightened storm activity increases the likelihood of landfall, severely impacting terrestrial ecosystems. Simultaneously, coastal ecosystems grapple with additional stresses, including beach erosion and inundation. Elevated sea temperatures pose a further threat to Dominica's coral reefs, leading to bleaching. Studies conducted by the Fisheries Development Division in 1998 revealed that approximately 15% of the coral exhibited signs of bleaching. As sea levels rise, the destruction of mangroves may further compromise the availability of fresh water, disrupting the delicate salinity balance. The freshwater supply of Dominica is also vulnerable to major hurricane impacts, resulting in compromised water quality through landslides, gully erosion, and flooding. Addressing these climate-induced challenges requires comprehensive strategies for conservation, resilience, and sustainable resource management. Given the island's topography and global positioning, a notable challenge revolves around mitigating vulnerabilities to disasters, particularly concerning critical infrastructure such as water supply systems, which remain susceptible to the impacts of climate change. Illustratively, Hurricane Maria in 2017 not only caused substantial economic and infrastructural damage but also led to a significant disruption in the water supply. The uprooting of pipes resulted in a widespread shortage of water across the entire island (UNFCCC 2020).

Profound global shifts are underway, directly impacting hydrological processes and consequently influencing both water supply and demand. Any changes in the climate or its variability pose challenges to the design and management of water resource projects. Given its vulnerability to climate-related extreme events like droughts, floods, and hurricanes, Dominica, as a small island developing state, must strategize to mitigate negative impacts and enhance resilience to protect and optimize its water resources for supply, especially under adverse conditions (IWCAM 2011).

In 2001, Dominica faced its severest drought in three decades. Towns like Cabrits, Carholm, and Delices received a mere 0.48 percent, 1.42 percent, and 2.52 percent, respectively, of their total annual rainfall by May 2001. This drought led to numerous fires in lower altitude scrublands and rainforests during April and May, with May emerging as the driest month. Forests along the southern and eastern coasts experienced heavy leaf fall due to the pronounced lack of precipitation. The north-central coast, with an average annual rainfall of less than 1,270 mm (50 inches), remains the most susceptible area to drought on the island (USACE 2004).

### 5.5.3 Impact of Water Use and Wastewater Management on Ecosystems in Dominica

Emissions from the waste sector stem from the handling and disposal of municipal or industrial solid waste, as well as the treatment and disposal of wastewater from domestic and industrial sources. Methods for treating solid waste encompass landfill disposal, incineration, and utilization in waste-to-energy plants. These processes predominantly release CH<sup>4</sup> and CO<sup>2</sup>, with landfill sites emitting methane and carbon dioxide, and incineration contributing various pollutants. Wastewater treatment can result in the release of CH<sub>4</sub> in anaerobic systems and CO<sub>2</sub> in aerobic systems.

In Dominica, there are two solid waste disposal sites, one of which ceased operations in 2005. The sewage system in Roseau serves to transport sewage from residences and businesses in Roseau and adjacent communities to a primary treatment facility before discharging it through a submarine outfall (UNFCCC 2020). Additionally, there are no municipal or industrial wastewater treatment facilities in Dominica, and as such, domestic sewerage in rural areas is treated in individual septic pits or latrines.

Emissions from the waste sector arise from the treatment and disposal of municipal or industrial solid waste and from the treatment and disposal of wastewater from domestic and industrial sources. CH<sup>4</sup> emissions from the sector for the period 2006-2017 ranged from 0.905 to 0.907 Gg. Total N<sup>2</sup>O emissions for the same period remained constant at 0.0054 Gg with 2017 declining to 0.0048 Gg due mainly to changes in wastewater handling (UNFCCC 2020).

### 5.5.4 Terrestrial ecosystem

Dominica maintains an operational system of protected areas, primarily comprising national parks and forest reserves, governed by the National Parks and Protected Areas Act of 1975. The primary

focus of this legislation is to safeguard watersheds, control soil erosion, and preserve biodiversity. While some catchments supplying water for hydroelectricity generators fall within these protected areas, the Department of Physical Planning engages in land-use management based on a policy, despite the absence of specific land-use legislation. Several policies and regulations indirectly impact watershed management, leading to conflicts arising from inadequate enforcement. Instances include permitting agricultural activities that may detrimentally affect water supply, even in violation of the rules for the Stewart Hall Catchment (ECLAC 2007)

In Dominica, improper disposal of solid waste and effluent from commercial and industrial ventures, coupled with suboptimal land management and agricultural practices, significantly impact watersheds and coastal areas. There is a need for enhanced data collection to inform proper watershed management, covering aspects like erosion levels, deforestation, marine environments, and coastal status (ECLAC 2007)

Despite having a Natural Disaster Preparedness Plan that prioritizes hurricane preparedness, Dominica faces potential disruptions to the hydrological cycle due to watershed damage, as exemplified by the impacts of Hurricane Dean in August 2007. This underscores the relevance of addressing global warming and climate change, particularly given their potential adverse effects on watersheds, coastal areas, and water supply, especially for a small island nation like Dominica (ECLAC 2007).

#### 5.5.5 Aquatic Ecosystem

In January 1990, the Consortium for International Crop Protection (CICP) undertook limited sampling for specific pesticides such as paraquat, glyphosate, carbamates, organochlorides, and organophosphates across selected rivers. While the results from this sampling did not detect any pesticide residues, concerns were raised by CICP investigators regarding the concentrations of organochlorides in wildlife (USACE 2004).

#### 5.5.6 Agriculture and Food Production Systems

Most of the agricultural activities in Dominica rely on rainfall for irrigation, with minimal existing infrastructure for artificial irrigation. Nonetheless, the potential benefits of implementing irrigation systems are significant, promising a substantial boost in agricultural output. Presently, small-scale

irrigation systems, utilizing surface water sources, are employed by farmers for cultivating vegetables. Plans are underway to expand irrigation coverage to approximately 1,000 acres, primarily targeting banana and vegetable crops. The proposed irrigation scheme will utilize gravity-fed systems or water pumped from rivers and streams, as outlined in USACE's 2004 report.

#### 5.5.7 Human Health and Sanitation

The disposal of solid and industrial wastes in rural areas, including communities like Marigot, Castle Bruce and La Plaine, among others, adds to the contamination of streams. These rural areas lack a centralized waste collection system, leading to household garbage often being discarded into nearby streams. Furthermore, industrial facilities such as rum distilleries, auto repair shops, and furniture manufacturers dispose of their waste and by-products directly into the streams adjacent to their operations (USACE 2004).

#### 5.5.8 Finance Services

In 2020, following a survey, UNEP highlighted that following Hurricane Maria, funding was allocated to support reforestation efforts in affected basins and to undertake various activities related to slope stabilization and soil conservation. This funding was channelled through the national budget, specifically to the Forestry Division, to invest in water resource infrastructure and cover both initial investment and ongoing costs. Additionally, a £25 million grant from the Department for International Development and the United Kingdom Caribbean Infrastructure Partnership Fund (DFID UKCIF) was earmarked for the ongoing comprehensive consultancy of the Water Sector Strategic Development Plan (WSSDP) and to facilitate recommended interventions for Integrated Water Resources Management (IWRM). Recurrent budget allocations were also made available to support IWRM initiatives under the responsibility of the Forestry Division.

At the subnational or basin level, budgetary planning typically commences at the national level before being adapted and scaled down to the basin level. Moreover, revenues for IWRM elements are sourced from various avenues. A portion of DOWASCO's revenue from tariffs is allocated to IWRM efforts, and part of the government's allocation to agencies like the Forestry Division is also directed towards IWRM initiatives. Additionally, revenue generated from site passes required

for accessing eco-tourism sites contributes a percentage towards IWRM activities. Grant funding from the UKCIF may be utilized for IWRM endeavours, including groundwork for the establishment of a water resources authority under the WSSDP.

#### 5.5.9 Socioeconomic, Security, and Livelihood

The wealth of water resources in Dominica offers ample opportunities for recreational pursuits. The island has an array of natural attractions, including waterfalls, pools, lakes, national parks, rivers, and sulphur springs. Morne Trois Pitons, established as a National Park in 1975, occupies the site of a former volcano characterized by fumaroles, hot springs, mud pots, and sulphur vents nestled within the Valley of Desolation. Boiling Lake, shrouded in steam clouds, presents a remarkable sight with its fluctuating water levels and hues, influenced by varying temperatures. The Valley of Desolation feeds into the Pointe Mulatre River, eventually emptying into the Atlantic Ocean. Other notable water features in the vicinity include Emerald Pool, Middleham Falls, and the Boeri and Freshwater Lakes, with Fresh Water Lake being the largest and second deepest among Dominica's lakes. Morne Trois Pitons serves as a significant source of electrical power for the island, particularly near Fresh Water Lake. Emerald Pool and Boiling Lake are renowned for their popularity as hiking and leisure destinations (USACE, 2004).

## 5.6 LEGAL POLICY AND INSTITUTIONAL FRAMEWORK

### 5.6.1 Regional Setting

The following table highlights organisations and agreements that provide a framework for collaboration, knowledge exchange, and capacity building in water resources management for Dominica (**Table 17**).

**Table 17: Regional Organisations and Agreement that Provide a Framework for IWRM in Dominica.**

| <i>Organisation/Agreement</i>                                 | <i>Description</i>  |
|---|---|
| <i>Organisation of Eastern Caribbean States (OECS)</i>        | Dominica is part of the OECS, which fosters cooperation among its member states in various sectors, including water resources management. The OECS provides a platform for sharing best practices, technical expertise, and resources related to water management.        |
| <i>Eastern Caribbean Currency Union (ECCU)</i>                | As a member of the ECCU, Dominica collaborates with other Eastern Caribbean countries on economic and financial matters, which can indirectly impact water management initiatives through funding mechanisms and economic policies.                                       |
| <i>Caribbean Community (CARICOM)</i>                          | Dominica's involvement in CARICOM allows it to participate in regional discussions and initiatives related to sustainable development, environmental protection, and disaster risk management, all of which are relevant to water resources management.                   |
| <i>Caribbean Regional Environmental Programme (CREP)</i>      | CREP facilitates regional cooperation on environmental issues, including water quality, biodiversity conservation, and climate change adaptation. Dominica's engagement with CREP contributes to the development of regional strategies for IWRM.                         |
| <i>Caribbean Development Bank (CDB)</i>                       | Dominica accesses funding and technical assistance from the CDB for water infrastructure projects and capacity-building initiatives. The bank's policies and guidelines influence Dominica's approach to water resources management.                                      |
| <i>Caribbean Community Climate Change Centre (CCCC)</i>       | Given Dominica's vulnerability to climate change, its collaboration with the CCCCC is critical for integrating climate resilience into water management strategies. The CCCCC provides support for climate change adaptation and mitigation measures in the water sector. |
| <i>Caribbean Public Health Agency (CARPHA)</i>                | CARPHA plays a role in monitoring water quality and ensuring public health standards in the region. Dominica's adherence to CARPHA guidelines influences its water quality monitoring and treatment practices.  |
| <i>Caribbean Disaster Emergency Management Agency (CDEMA)</i> | Dominica's participation in CDEMA facilitates coordination of disaster preparedness and response efforts related to water-related hazards such as hurricanes and flooding.  |

### 5.6.2 National Setting

According to the IWCAM (2011), which remains the same to this date, the Water and Sewerage Act of 1991, governs water resources management and gives DOWASCO, the purview of supply and distribution of potable water, wastewater services and management of water resources. Several other laws and institutions are pertinent to water resources in Dominica; these include the Physical Planning Act (no.5 of 2002), the Development and Planning Corporation Act (1972), the Agricultural Small Tenancies Ordinance (1953), the Pesticides Control Act and Regulations, the

Crown Lands Ordinance, the Forestry Act, the Health Act, and the National Development Corporation Act (1988).

The Forestry Division, established in 1949, has a sound record of safeguarding Dominica's pristine environment since the early 1950s. Primarily tasked with managing forests, wildlife, and watersheds, this division plays a pivotal role in preserving the island's natural heritage (UNFCCC 2020).

Under the purview of the Ministry of Health and Environment, the Environmental Health Division carries out a multifaceted array of responsibilities. These include monitoring water supply systems, overseeing liquid and solid waste disposal, ensuring compliance with building regulations, investigating communicable diseases, implementing food safety measures and disaster preparedness initiatives, enforcing health and safety protocols, and establishing institutional and recreational hygiene standards. Additionally, it is entrusted with the development of occupational health regulations (UNFCCC 2020).

The Dominica Water and Sewage Company (DOWASCO), operating as a statutory body, bears the mandate for water and sewage infrastructure development. DOWASCO has successfully implemented reliable, safe, and sustainable water facilities across major communities and population centres. Moreover, it has overseen the creation of small reservoirs and water catchment areas throughout the island. Notably, in Roseau, the capital, a modern sewer system has recently been completed and put into operation (UNFCCC 2020).

In Dominica, DOWASCO is tasked with monitoring, assessing, and managing the country's water resources. However, the necessary institutional and legal framework for effective Integrated Water Resources Management (IWRM) is currently absent. Dominica lacks an IWRM policy, legislation, strategy, and plan. The current approach to water management is fragmented and uncoordinated, with DOWASCO, under the Water and Sewerage Act, having statutory responsibilities for both water resources management and supplying water, as well as waste collection and disposal. Nevertheless, DOWASCO functions solely as a provider of potable water and wastewater services, focusing its water resource monitoring on delivering a potable water supply (ECLAC 2007).

Several other organizations share responsibilities related to water management in Dominica,

including the Ministry of Health, the Ministry of Agriculture (Forestry and Wildlife Division, Lands and Surveys, and Pesticide Control Board), the Ministry of Finance and Economic Development (Physical Planning Division and Development and Planning Corporation), the Ministry of Community Development and Gender Affairs (Cultural Division, Local Government, and Community Division), the Solid Waste Management Authority, and various non-governmental organizations, as outlined in **Figure 23** and **Figure 24** (ECLAC 2007).

While some informal cooperation and collaboration among organizations occur on a case-by-case basis, there is no coordinating organization or mechanism for IWRM. As a result, IWRM operations remain fragmented and sectoral, occasionally leading to overlaps and duplications of responsibility (ECLAC 2007).

The process of formulating water policy in Dominica was initiated through two European Union (EU)-backed initiatives. In 2005, a policy statement was drafted but remained pending ratification. Subsequently, in 2008, DOWASCO underwent a comprehensive institutional assessment aimed at enhancing its management and operational framework, legislative structure, infrastructure, and resource protection. Despite the thorough review and its recommendations, formal ratification by the government did not materialize.

The GEF-IWCAM project identified the Roseau catchment, the capital's primary water source, as a critical area requiring an integrated water management approach. Key issues identified included shifting land use patterns, unregulated land-based activities leading to pollution, and a lack of adequate legislation and policies for water resource management.

In 2011, consultations were carried out, drawing heavily from two previous EU-sponsored sector reform studies focused on a national Integrated Water Resources Management (IWRM) policy and guidance paper for Cabinet ratification of the LBS Protocol. Despite receiving support from water sector technocrats and the responsible minister, these proposals have yet to receive official ratification by the cabinet (CEHI, 2013) (GWP 2014).

An informal hydromet committee, comprising representatives from DOWASCO, Dominica Meteorological Services, the Environmental Coordinating Unit, Environmental Health Department, Forestry Division, the Division of Agriculture, DOMLEC, the Independent

Regulatory Commission, and the Office of Disaster Management, has historically existed but has been inactive recently. However, most members are also part of the Technical Working Group under the DVRP’s ongoing Hydromet Project, providing guidance for the development of a comprehensive water resources monitoring system. Collaboration has been extensive during the development of the CDB-funded study "Planning for the Integration of Climate Resilience in the Water Sector in the Caribbean (CREAD)" and the ongoing WSSDP study mentioned previously, focusing on IWRM. The Ministry of Finance and CREAD are key stakeholders in the process, and inter-ministerial cooperation occurs at the Permanent Secretary level regarding water use planning (UNEP 2020).

|   |  |  |
|---|--|--|
| <p><b>Pesticide Control Board</b></p> <p>Ministry of Agriculture, Fisheries and the Environment</p>   | <ul style="list-style-type: none"> <li>Enforcement of the Pesticides and Control Act and Regulations</li> </ul>  | <ul style="list-style-type: none"> <li>Pesticides Control Act</li> <li>Licensing and Registration of Pesticides</li> </ul> |
| <p><b>Ministry of Agriculture</b></p>   | <ul style="list-style-type: none"> <li>Soil and water conservation</li> </ul>  |  |
| <p><b>Physical Planning Division</b></p> <p>Ministry of Housing, Lands, Telecommunications, Energy and Port – Lands and Surveys</p>           | <ul style="list-style-type: none"> <li>Development Control and Physical Planning</li> <li>Administers removal permits</li> </ul>                                 | <ul style="list-style-type: none"> <li>Town and Country Planning Act</li> </ul>  |
| <p><b>Development and Planning Corporation</b></p> <p>Ministry of Housing, Lands, Telecommunications, Energy and Port – Lands and Surveys</p> | <ul style="list-style-type: none"> <li>Decision-making for Planning and Development Control</li> </ul>   |  |
| <p><b>Cultural Division</b></p> <p>Ministry of Community Development and Gender Affairs</p>   | <ul style="list-style-type: none"> <li>Within their jurisdictions, responsibility for sanitation, waste removal, nuisance abatement and beach control</li> </ul> |  |
| <p><b>Local Government and Community Development Division</b></p> <p>Ministry of Community Development and Gender Affairs</p>                 | <ul style="list-style-type: none"> <li>Assist in areas of responsibilities such as disaster preparedness</li> </ul>  |  |

Figure 23: Table Illustrating Organisations and responsibilities as it relates to National Water Resources Management

| ORGANIZATION  | ROLES/RESPONSIBILITIES   | LEGISLATION   |
|---|--|---|
| <b>DOWASCO</b><br>Ministry of Communication and Works (MOCW)                                    | <ul style="list-style-type: none"> <li>Water resources monitoring and assessment as well as planning and organizing for water resources management</li> <li>Collect and dispose wastewater</li> <li>Exclusive licence to supply water</li> <li>Catchment Protection Control</li> </ul> | <ul style="list-style-type: none"> <li>Water and Sewerage Act <i>Chap.43:04</i></li> <li>Water and Sewerage Act Section 13</li> </ul> |
| <b>Ministry of Health</b>   | <ul style="list-style-type: none"> <li>Establish water quality and treatment standards</li> <li>Monitor source protection, water quality and water treatment throughout the island</li> <li>Environmental Health</li> </ul>  |   |
| <b>Forestry and Wildlife Division</b><br>Ministry of Agriculture, Fisheries and the Environment | <ul style="list-style-type: none"> <li>Demarcate and protect water catchments</li> <li>Water shed management and protection</li> <li>Regulate activities within the forest reserves and national parks</li> </ul>  | <ul style="list-style-type: none"> <li>Forestry Act <i>Section 5</i></li> </ul>   |
| <b>Lands and Surveys</b><br>Ministry of Housing, Lands, Telecommunications, Energy and Ports    | <ul style="list-style-type: none"> <li>Survey and administration of government lands</li> <li>Preserving and protection lands</li> </ul>   | <ul style="list-style-type: none"> <li>Crown Lands Ordinance</li> </ul>   |

**Figure 24: Organisations and responsibilities as it relates to National Water Resources Management continued.**

### 5.6.3 Community level

No customary water resource management arrangements were identified at the community level. However, public participation in water resource policy, planning, and management at the local level occurs through local government/village councils and community meetings preceding significant developments. Residents can also raise concerns with their parliamentary representatives, who can then convey them to relevant authorities. Vulnerable groups are also represented in these meetings (UNEP 2020).

## 5.7 CHALLENGES FOR IWRM

Within the context of Dominica, in the formal management framework, the customary exclusion of policies and formal arrangements arises due to the absence of established mechanisms that mandate coordination, collaboration, and cooperation among relevant institutions. Consequently, entities such as DOWASCO assume a leadership role in water resources management for the nation, while other significant contributions remain unincorporated in the framework. This deficiency leads to a less comprehensive approach to water resources management within the country (IWCAM 2011).

| <b>Physical</b>   | <b>Institutional</b>   | <b>Capacity</b>   |
|---|--|---|
| Water Supply: Degradation of watersheds due to high rates of deforestation                | Weak institutional framework for managing water resources  | Poor irrigation supply network leading to underdevelopment of agricultural sector. Poor and aging water distribution and sanitary system networks leading to contaminated discharges into waterways and coastal areas |
| Limited access to water and sanitation  | Limited stakeholder involvement and public participation in decisions affecting water;   | Little wastewater and sewage treatment and proper waste disposal affecting water quality  |
| Extensive environmental damage due to agricultural and human encroachment into watersheds | Unplanned growth in the tourism and developing housing areas placing additional stress on water supply and sanitation services and resources | Inadequate monitoring and assessment to make informed decisions   |

**Figure 25: Summary of Challenges and Issues which IWRM can improve (IWCAM 2011)**

### 5.7.1 Policy Challenges

Since the information presented in 2011, concerns about the sustainability of Dominica's extensive river network have been on the rise. Despite the Water and Sewage Act (Cap 43:40) serving as a comprehensive legal framework for water usage and management, the lack of enforcement by various authorities on policies related to water conservation, management, financing, and monitoring has impacted the supply of water. This has led to intermittent water availability in various communities, compromised water quality, and limited access to piped water (CIJN 2023).

The Dominica Water and Sewerage (Catchment Area) Regulations (No. 13 of 1995) define the areas along rivers, streams, and lakes designated as water catchment areas, imposing restrictions on activities within these zones. However, certain operations, such as timber extraction and logging, are permitted in protected areas under specific conditions. DOWASCO, the exclusive distributor of potable water in Dominica, has internal policies governing its operations. Although the company is currently implementing aspects of its Water Sector Strategic Development Plan, additional efforts are needed to ensure the preservation of its water reservoirs at full capacity (CIJN 2023).

The water treatment facilities located in the secure, concrete sheds of Dublanc and Platt Ma Pierre have prompted security concerns among residents, mirroring apprehensions regarding the protection of treated water. Bernard Etinoffe, the General Manager of DOWASCO, addressed these apprehensions by emphasizing the company's unwavering commitment to maintaining water quality. He elucidated that the implementation of advanced technology and stringent protocols enables continuous monitoring of water quality, with a dedicated standby team prepared to promptly shut down intakes, conduct rigorous tests, and administer appropriate treatment in the event of contamination.

Etinoffe underscored the company's proactive approach to quality assurance, noting daily testing across all intakes facilitated by a state-of-the-art water lab. Despite occasional reports of water contaminants, he assured the public that thorough investigations consistently refute such claims. Additionally, Etinoffe disclosed that DOWASCO has encountered threats from criminal elements with intentions to contaminate specific water intakes in Dominica. Reassuring the public, he conveyed that the company has successfully thwarted and reported such incidents to law enforcement in the past and remains steadfast in its commitment to ensuring water security and public safety (CIJN 2023).

#### 5.7.2 Challenges for Water Security

Concerns about the sustained availability of freshwater in the region have persisted for at least three decades (CEHI, 2002). With escalating demands and anticipated shifts in rainfall patterns

due to climate change, even a minor decrease in precipitation could lead to significant repercussions (GWP 2014). Based on climate change expectations, demand can exceed supply during the dry season because of reduced stream flows (USACE, 2004 as seen in GWP 2014). The availability and security of water are other challenges for the effective management of water resources. Urbanization in upper-level watershed areas leads to elevated peak flows, downstream flooding, and a general decline in base stream flows accompanied by increased sediment flows. These effects are usually noticeable during the dry season, resulting in a notable reduction of approximately 50% in water availability, particularly in Dominica (GWP 2014).

In many areas, wastewater disposal primarily relies on septic tank/soakaway systems, which can present significant challenges for water resource management when these systems malfunction. Agriculture, constituting approximately 25% of the gross domestic product (GDP), raises concerns regarding social and economic development, food security, economic costs, and environmental impacts. Commercial-scale agriculture extracts a considerable volume of water directly from rivers, although the exact quantity remains unquantified. It's important to note that DOWASCO bears no legal obligation to supply water for agricultural purposes. Irrigated land represents less than 1% of the total farmland acreage. Regular hydrological monitoring and assessment are not conducted as frequently as necessary, potentially compromising the reliability of water availability assessments. A survey conducted by DOWASCO in 1987 revealed that very few of the 43 watersheds then in use were devoid of human activity (IWCAM 2011).

Ongoing water quality monitoring suggests that chemical fertilizers and pesticides have not yet posed a significant threat to human health through water contamination. However, as economic development activities increase, this issue is expected to escalate. To address these concerns, DOWASCO has proposed declaring all catchment areas on the island as "Water Quality Control Areas." Water allocation for various users currently depends on water availability rather than any assessment-based allocation mechanism. Additionally, there's a lack of demand management mechanisms, as the water rate structure does not adjust with changes in water usage volume (IWCAM 2011).

Efforts toward water resource protection are minimal, with actions related to watershed management falling short of optimal effectiveness due to significant sources of pollution from

solid waste, agricultural waste, and industrial discharge. As a leader in water resources management on the island, DOWASCO continues to work on improving coordination among stakeholders and interests in water, including land use management (IWCAM 2011).

Governance of the country's water resources in a holistic manner is generally lacking as there is no WRM policy, strategy, plan or overarching legislative framework in place. With the growing demand for water, the inadequate institutional structure, ineffective land-use management, limited public understanding of IWRM, a lack of data and information to support decisions, legislation that needs updating, and a lack of adequate human and financial resources, it seems almost mandatory that appropriate actions are urgently undertaken. As with the rest of the Caribbean region the looming threats associated with climate change will place added stress on the resource and place greater challenges for sustainable management of the resource. Integrated Water Resources Management (IWRM) offers the framework within which these challenges and inefficiencies may be more effectively addressed (IWCAM 2011).

However, certain critical responsibilities are lacking within some governmental units, necessitating their establishment and adoption. These include:

1. The development of National Land Use Plans, which should be spearheaded by the Planning Department in collaboration with other stakeholders.
2. Integrated Watershed Management, which should be a primary responsibility of the Forestry Unit within the Department of Agriculture, is carried out in partnership with other stakeholders. This involves the development and implementation of watershed management plans.
3. National Irrigation Management, which should be a central activity of the Agriculture Department to ensure the fulfilment of water demands for the advancement of the agricultural sector. Consequently, National Irrigation Plans must be formulated, with actionable steps taken for their implementation.

### 5.7.3 Capacity Constraints

As mentioned earlier, DOWASCO, as outlined in the Water and Sewerage Act, is tasked with the

responsibility for water resources management. However, its primary emphasis lies in serving as a provider of potable water and wastewater services. Considering that a provider of potable water is essentially a user of the resource, the arrangement where the manager of water resources is under the control of a resource user appears unsuitable and contradictory. Therefore, it is more advisable for Integrated Water Resources Management (IWRM) to be conducted by a distinct organization or unit (ECLAC 2007).

The organizational structure of DOWASCO comprises four departments. Two of these departments, namely Engineering and Technical Services (inclusive of the water quality laboratory), are dedicated to the fundamental technical aspects of water and wastewater services. The remaining two departments focus on finance, and customer service along with human resources. The organization is fully staffed, consisting of 13 professionals, including three mechanical engineers, one civil engineer, one water engineer specialized in industrial engineering, and two information systems officers in the technical professional staff. Additionally, there are seven technicians in the technical support staff. Although there is a robust technical foundation for developing the expertise and skills necessary for Integrated Water Resources Management (IWRM) core functions, there is currently no surplus human resource capacity (ECLAC 2007).

Several other organizations, identified as key stakeholders with responsibilities related to water resources management, include the Lands and Surveys Department, the Physical Planning Unit, the Meteorological Services Unit, and the Disaster Coordination Unit of the Ministry of Housing, Lands, Telecommunications, Energy, and Ports, all of which engage in activities associated with water management (ECLAC 2007).

The Land and Surveys Department has the responsibility to administer state lands, preserve and protect lands, map and upkeep a GIS database and coordinate with other agencies. The department is not fully staffed and has lost several surveyors through attrition. There is, however, a shortage of surveyors. The department also has no land use plan. Land is becoming scarce, and the management of the information needs to be addressed but is hindered by a lack of human resource capacity. Training to address gaps is not consistent. The department requires several new staff members. The Forestry and Wildlife Division of the Ministry of Agriculture, Fisheries, and the Environment is responsible for watershed protection, management, and regulation of activities

within the forest reserves and national parks. This division is governed by the Forest Act, 1958, the Forest Rules and Regulations 1972 which support the Act and the National Parks and Protected Areas Act, 1975. The division is staffed with a director who has a master's degree, a Forester 2 with an MSc degree, a forest officer for research, monitoring and environmental education with a Bachelor of Science degree, an assistant forest officer of national parks with a BSc degree and five other assistant forest officers with diploma level qualifications. The remaining staff have high school qualifications. The established monthly paid staff has 24 positions, whereas the total staff including daily paid workers is 100. The vacant positions include a forest officer and human resource manager. The forest officer is required to have a BSc or associate degree with five years' experience. This person will be responsible for silviculture. However, there is a need for a forest planner and someone who can provide technical assistance in landscape planning. Training is undertaken through an in-service training programme in forestry and national parks in the division plus local and international training. Information obtained indicated that there is a need for more support staff and professional training for in-house personnel. Lack of professional expertise within the division is reflected in the need for greater detail in special reports. In addition, there is a need for larger office accommodations and adequate equipment (ECLAC 2007).

Financial struggles have ensued at DOWASCO due to operating in deficit for many years through the absorption of costs to facilitate community wide access to pipe borne water, relying on financial support from the central government and donor agencies. These constraints have affected maintenance operations on distribution networks and security for the various watersheds, affecting operational efficiency and long-term sustainability. DOWASCO has heavily relied on the Central Government and donor agencies to sustain its operations, highlighting the reliance of the company on external funding to address financial shortcomings.

#### 5.7.4 Data Availability and Use

The lack of proper data and information to manage the finite water resources of Dominica for sustainable use is due to inadequate hydrological monitoring and assessment among other issues. This deficiency in data and information has been recognized as an international problem and declared so by the World Water Council. Among the data needs are hydrological and socioeconomic data on groundwater, stream flows, watersheds, fresh and coastal water quality,

water use, precipitation, evaporation, and other parameters to enable water managers to understand past and present scenarios and to anticipate future needs. This data and information are not only needed by water managers but by many sectors. In this respect, the government has an essential role to undertake in educating the population about water management (IWCAM 2011).

## **5.8 SYNERGIES BETWEEN STATE, GAPS AND AREAS TO BE HARMONISED**

In 2011, the IWCAM acknowledged the essential prerequisites for the successful implementation of Integrated Water Resources Management (IWRM) in Dominica. These prerequisites encompassed factors such as political commitment, an enhanced governance structure, integrated planning and management of water resources, clearly articulated and adaptable legal frameworks, recognized appreciation of the economic value of water, capacity development, and a thorough system of monitoring and evaluation.

One of the ongoing initiatives which works towards one of the priority investments for support under Dominica's SPRC is the formulation of a Water Resources Inventory (surface and groundwater resources), conducting a water balance assessment, consistently monitoring water resources, and implementing hydro-meteorological and coastal monitoring stations—equipped with automatic hydro-met and coastal monitoring tools—are integral steps to facilitate the development of community early-warning systems. Additionally, the formulation of an Integrated Natural Resource Management Plan is essential. This plan will guide various aspects, including water conservation, extraction practices, and overall utilization strategies (UNFCCC 2020).

A second initiative is the development of Land Use Capability, and Integrated Natural Resources Management Plan and supporting legislation that works towards achieving the regulation of development in both coastal and watershed area, and to regulate the extraction, conservation of water and determination of sustainable irrigation levels (UNFCCC 2020).

## **5.9 CONCLUSION**

In conclusion, Dominica's water resources management faces multifaceted challenges stemming from environmental, economic, and climatic factors. Addressing these challenges requires a concerted effort to strengthen policies, enhance institutional capacity, and invest in infrastructure

and technology. Public participation, gender-inclusive practices, and community engagement are vital for fostering sustainable water management practices.

Moving forward, prioritizing water safety, pollution control, and groundwater management alongside resource mobilization efforts will be essential. Leveraging external funding, engaging the private sector, and implementing innovative solutions are crucial steps towards achieving water security and resilience in Dominica.

Despite the hurdles, Dominica's commitment to IWRM and sustainable development is evident through ongoing initiatives and partnerships. With strategic planning, robust governance, and stakeholder collaboration, Dominica can navigate the challenges posed by climate change and emerge as a beacon of water resilience in the Caribbean region.

## 6 ANNEX F: GUYANA

### 6.1 OVERVIEW

Guyana, nestled along South America's northern coast, possesses a diverse landscape, spanning from coastal lowlands to rugged highlands. With its strategic location and abundant water resources, the country faces both opportunities and challenges in managing its water effectively.

The coastal region, where most of the population resides, is prone to flooding due to its low-lying terrain. Man-made structures and drainage systems help mitigate flood risks, but challenges persist, particularly during the wet seasons. The interior plains, western highlands, and southern uplands contribute to the country's water resources, with rivers like the Essequibo playing a significant role.

Guyana experiences distinct rainy seasons, leading to high precipitation levels. However, this abundance of water is not evenly distributed, resulting in challenges such as droughts and floods. Surface water management, through conservancies and dams, helps regulate water supply, although droughts can still lead to shortages.

Climate change has significantly affected water supply in Guyana, primarily by altering precipitation patterns and causing sea levels to rise. These changes have led to fluctuations in water availability across different regions, with some areas experiencing more intense and frequent rainfall, while others endure prolonged droughts. Additionally, rising sea levels pose a threat to coastal regions, leading to the intrusion of saline water into freshwater sources and exacerbating water scarcity issues.

Water usage in Guyana is primarily for agriculture, industry, and domestic purposes. Groundwater is vital for both rural and urban communities, although issues such as pollution and limited infrastructure affect water quality and availability. Policy frameworks exist, but implementation challenges persist, including fragmented regulations and capacity constraints.

Customary arrangements at the community level play a crucial role in water management, reflecting local traditions and governance structures. However, these arrangements need to be integrated into broader policy frameworks to ensure sustainability and inclusivity.

Challenges such as fragmented policies, water security concerns, capacity constraints, and limited data availability require concerted efforts from various stakeholders. Initiatives focusing on data collection, infrastructure enhancement, pollution control, and resource mobilization are essential for improving water management in Guyana.

In conclusion, Guyana's water resources hold immense potential for supporting sustainable development. Addressing existing challenges and strengthening governance frameworks are crucial steps towards achieving effective water management and ensuring water security for all Guyanese citizens.

## **6.2 GEOGRAPHICAL CONTEXT**

Guyana, located along South America's northern coast, has a coastline spanning 285 miles from Punta Playa in the northwest to the Corentyne River in the east. The coastal region, characterized by its flat and often swampy terrain, lies approximately 5 ½ feet below sea level during high tide. To mitigate floods, man-made structures like concrete walls and earthen barriers are strategically positioned along the coast, alongside canals equipped with sluice gates to facilitate drainage. This coastal strip, extending from the Pomeroon to the Corentyne Rivers, accommodates most of the population and agricultural activities in the country. Guyana is divided into ten regions, namely Barima-Waini (Region 1), Pomeroon-Supenaam (Region 2), Essequibo Islands-West Demerara (Region 3), Demerara-Mahaica (Region 4), Mahaica-Berbice (Region 5), East Berbice-Corentyne (Region 6), Cuyuni-Mazaruni (Region 7), Potaro-Siparuni (Region 8), Upper Takutu-Upper Essequibo (Region 9), and Upper Demerara-Berbice (Region 10) (**Figure 26**).

Moving inland, the mountainous terrain includes the Pakaraima Range, featuring a sandstone plateau over 22 miles long and towering more than 9,000 feet above sea level. Additionally, the Kanaku Mountains near the Rupununi River border with Brazil add to the rugged landscape (Country Reports 2024).

The intermediate region, the largest among the three areas, lies east and south of the coastal and mountainous zones. Predominantly covered by tropical forests and jungles, this area includes the Rupununi savanna along the southwestern border with Brazil. Large rivers and their tributaries traverse the region, although navigation and development face obstacles due to rapids and falls

along major rivers. Key rivers such as the Essequibo, Demerara, Berbice, and Corentyne, along with significant tributaries like the Cuyuni, Mazaruni, and Rupununi, shape the landscape (Country Reports 2024).



**Figure 26: Map of Guyana and its major cities.**

Guyana experiences a typical tropical climate characterized by fluctuating humidity levels and consistent temperatures. Georgetown, situated on the coast, maintains steady minimum temperatures between 22-26°C (71-80°F) year-round, with maximum temperatures ranging from 28-32°C (83-90°F). The coastal area benefits from sea breezes, particularly the east-northeast trade winds, providing relief from the heat. Precipitation patterns in the coastal region exhibit two primary wet seasons, from May to mid-August and December to mid-January, contributing to the annual average of 90 inches of rainfall. In contrast, the interior experiences a wider range of rainfall, from 60 to 150 inches annually (Country Reports 2024).

The population of Guyana, totalling 746,955 according to the 2012 census (BOS 2012), is concentrated primarily in the coastal plain, with over 90% residing in this narrow band.

Georgetown serves as the capital and primary port, with other smaller population centres including New Amsterdam and Linden (USCAE 1994).

Agriculture and mining are the cornerstone sectors of Guyana's economy, contributing significantly to export earnings. Agriculture, which is primarily focused on sugar and rice production, faces challenges due to frequent floods in the coastal plain. Meanwhile, mining, particularly bauxite and gold extraction, has emerged as a valuable export sector. The recent privatization of government-owned industries has stimulated economic growth, leveraging the country's abundant natural resources (USCAE 1994).

### 6.3 STATUS OF WATER RESOURCES MANAGEMENT IN GUYANA

#### 6.3.1 Source

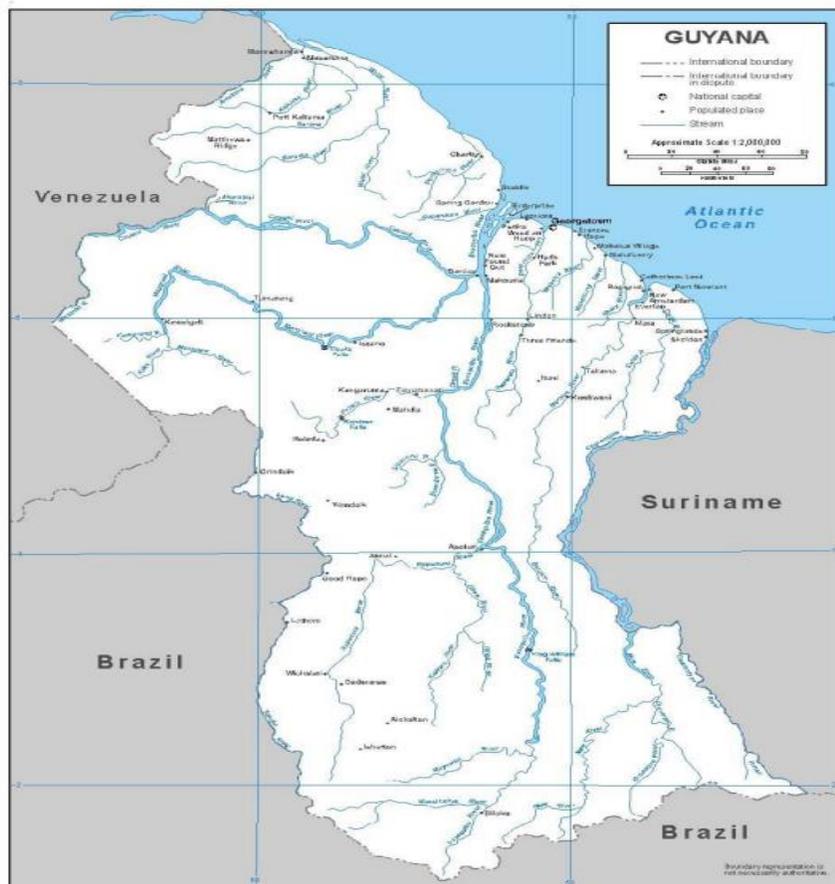


Figure 27: Country map of Guyana (USACE 1994)

Guyana is segmented into five prominent geographical regions: the coastal lowlands, interior plains, western highlands, southern uplands, and southwest savannah. The coastal lowlands, which host approximately 90% of Guyana's total population, occupy a mere 10% of the country's land. Stretching from 8 to 65 kilometres in width, this region primarily lies below sea level, making it susceptible to flooding, particularly during the wet seasons from April to August and November to January, as well as high tides. Elevations are notably low, with some areas even below sea level, while others have been artificially elevated to protect against sea invasion. These low-lying plains, formed by the deposition of alluvial sediments from rivers flowing into the Atlantic Ocean, constitute a vital agricultural hub. To safeguard against flooding, an intricate system of sea defences, along with irrigation and drainage canals, is essential (USCAE 1994)

The interior plains region, constituting around 35% of the country, extends east to west immediately south of the coastal lowlands. Characterized by undulating expanses of white and brown sands adorned with scrublands and hardwood forests, this area rises to elevations of approximately 120 meters. It serves as a crucial source of groundwater recharge for the coastal lowlands and is crisscrossed by rivers and perennial streams flowing from the uplands and highlands. Covering roughly 15% of the country, the western highlands region is situated along the borders with Brazil and Venezuela. This area boasts rugged igneous and metamorphic mountains, that are densely forested and challenging to access. Marked by steep tabular hills and mountains cut by deep gorges, its rivers flow rapidly, forming deep gorges and waterfalls (USCAE 1994).

In the southern uplands region, which encompasses about 30% of the country and borders Brazil and Suriname, four mountain ranges with elevations ranging from 300 to over 1,200 meters dominate the landscape. Access to these forested ranges is notably restricted (USCAE 1994).

Guyana boasts four primary rivers—Berbice, Corentyne, Demerara, and Essequibo—alongside numerous smaller waterways like creeks and streams. Of these, the Essequibo River, draining over half the country, holds significant international recognition. Groundwater is sourced from three aquifers, with the shallowest "upper" sand layer ranging from depths of 30 to 60m and thicknesses of 15 to 120m, although it remains unused for water supply due to its high iron content and salinity. Potable water is primarily extracted from the deeper "A" sand layer at 200 to 300m and the "B"

sand layer at 300 to 400m (Water Action Hub 2020).

Annual precipitation averages about 2,300mm in Guyana, varying from 1,800mm in savannahs to over 4,300mm in rainforest regions. Rainfall occurs predominantly during two distinct rainy seasons: November to February and May to August, except for the savannahs, which experience a single rainy season from May to August (Water Action Hub 2020).

To manage surface water runoff, Guyana employs "conservancies," large shallow dams formed by earth embankments, strategically located in upper stream catchment areas. These conservancies, such as Tapakuma Conservancy (Region 2), Boerasirie (West Demerara, Region 3), East Demerara (Region 4), and MMA (Region 5), ensure water supply throughout the year. However, droughts during the secondary November-January wet season may lead to water shortages (Water Action Hub 2020).

Erratic rainfall distribution throughout the year leads to droughts and floods in Guyana. Heavy rainfall from April to August often results in extensive flooding in southern regions, while some creeks dry up before the rainy season (Water Action Hub 2020). Groundwater serves as the primary water source in the coastal zone, with distinct layers of sand housing aquifers for domestic and industrial use (Water Action Hub 2020).

Official records regarding water withdrawal are not readily available, although estimates have been provided by World Resources. The demand for water, particularly for irrigation purposes, is substantial. Approximately 90% of the population resides in the coastal region, relying entirely on groundwater sources to fulfil their domestic water requirements. However, there is an exception in the Georgetown area, where approximately 30% of the water supply is sourced from the East-Demerara conservancy's surface water. Nationally, water supply infrastructure comprises approximately 178 groundwater wells and eight surface water sources (Water Action Hub 2020).

### 6.3.2 Distribution

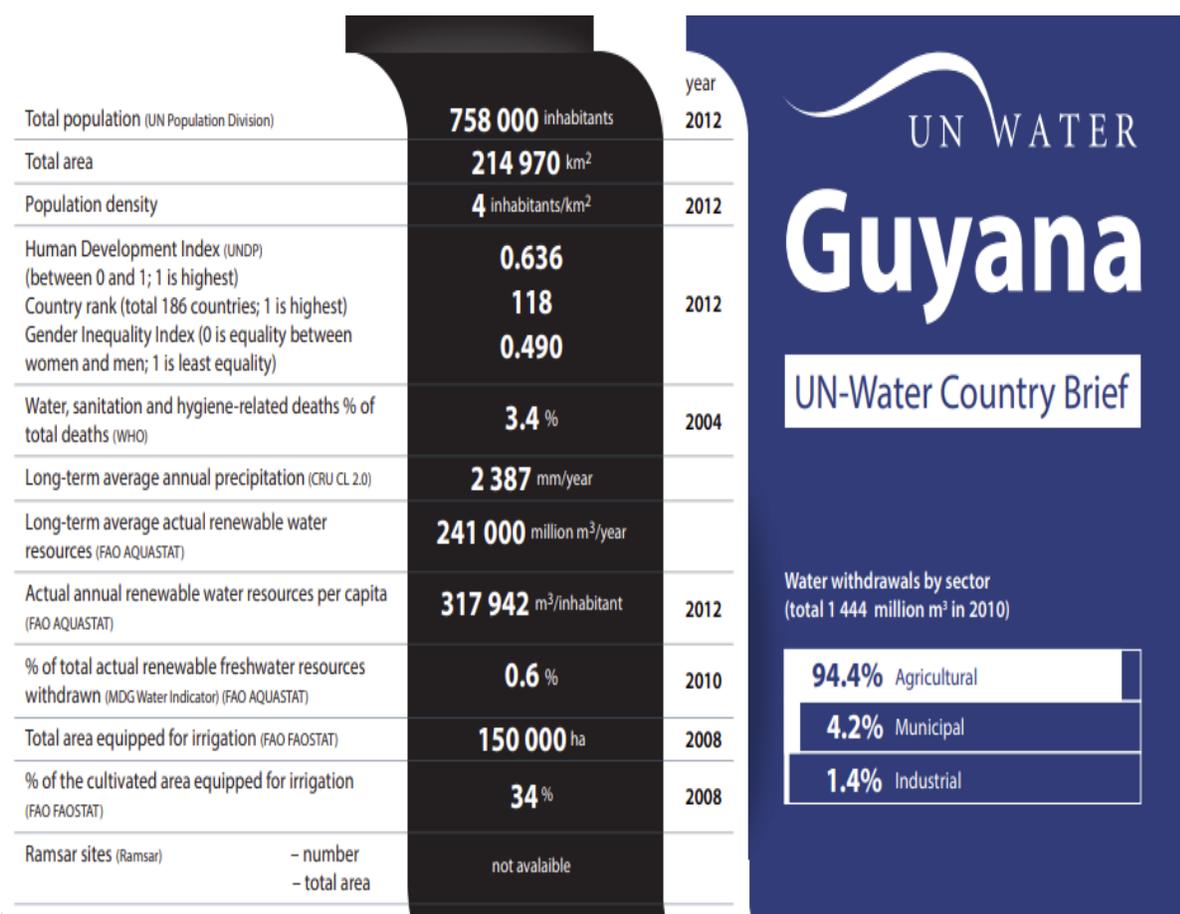
Guyana faces significant water management challenges despite its abundant surface and groundwater resources. Urban areas struggle with inadequate sewage systems, limited water purification, and poorly maintained distribution networks (Water Action Hub 2020). While three

primary water treatment facilities exist in Georgetown, New Amsterdam, and Guymine, access to potable water remains a concern due to substandard services (Water Action Hub 2020).

A growing reliance on groundwater is observed in Amerindian communities in the hinterland, though the sustainability and extent of groundwater supplies remain uncertain (Water Action Hub 2020). Water is vital for the industrial sector, particularly in manufacturing beverages, food processing, and mineral extraction. However, conflicts arise during the dry season when mining activities impact potable water sources (UN Water 2012).

Guyana Water Incorporated (GWI) bears the responsibility for water production and sewerage disposal across the country. Its core mission revolves around ensuring equitable access to high-quality potable water services at affordable rates, aligning with the government's watershed management policies. The corporation has outlined its objectives in a new 5-year strategic plan spanning from 2017 to 2021. Among the key goals outlined in the plan are the expansion of the customer base, particularly targeting hinterland communities, and the reduction of non-revenue water. This entails promptly addressing leak reports, implementing universal metering for all accounts, and minimizing reliance on chemical-intensive processes in treatment plants (GWI 2017). In 2021, a comprehensive metering initiative saw the installation of 15,000 meters and the replacement of nearly 5,000 non-operational or defective ones. Subsequently, GWI set a target to achieve 85% metering coverage along the coastland by 2025. Baseline figures from 2019 indicated a 53% metering rate along the coastland (GWI 2022).

## 6.4 WATER SUPPLY, DEMAND AND USAGE



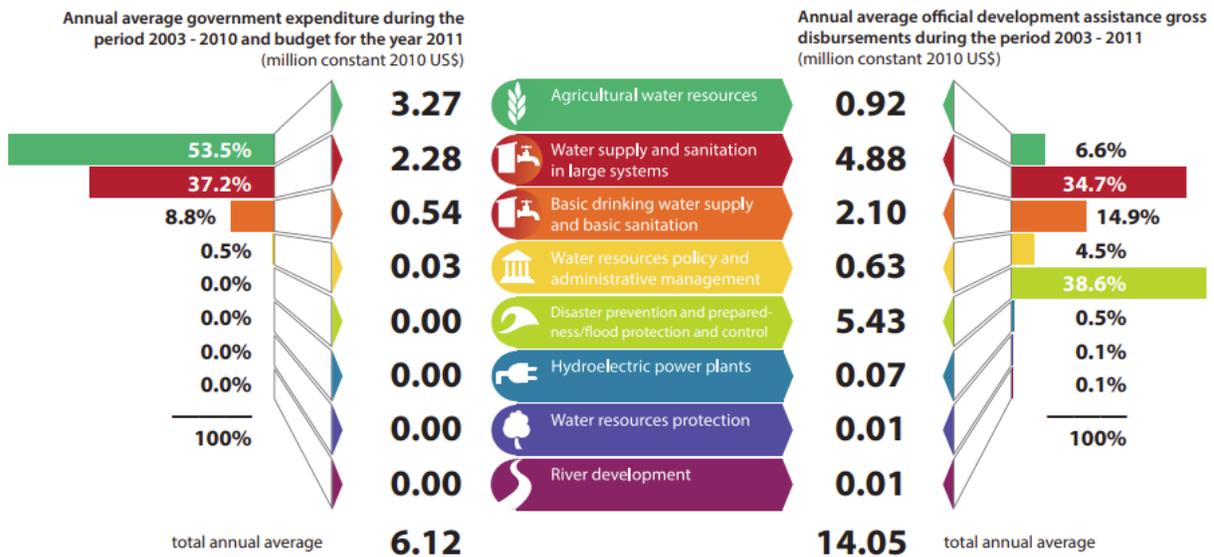
**Figure 28: UN-Water Country Brief (UN Water 2017)**

Guyana is rich in both surface and groundwater resources, strategically located near populated regions, serving as vital water sources. The area benefits from abundant precipitation, leading to significant surface runoff and groundwater replenishment. Groundwater primarily fulfils domestic water needs, while surface water mainly supports agricultural (particularly sugarcane and rice cultivation) and industrial activities (see **Figure 28**).

Urban centres encounter sewage infrastructure challenges, ranging from insufficient to absent systems, with minimal water purification practices such as filtration and chlorination, mainly observed in Georgetown when feasible. In other areas, reliance on septic tanks is widespread. In Georgetown specifically, water distribution systems suffer from inadequate maintenance and reliability issues, prompting many residents to rely on individual cisterns. Despite canals in

Georgetown serving as water sources, they also function as sewers, often contaminated with agricultural and biological pollutants along with solid waste (USCAE 1994).

#### 6.4.1 Source Sustainability, Protection, Access, And Benefit Sharing



**Figure 29: Annual expenditure across the various sectors between 2003-2010 as it relates to water**

From 2003 to 2012, government investments were primarily directed towards agricultural water resources (**Figure 29**), with notable peaks in 2005, 2008, and 2012, when allocations reached 7.5, 5.9, and 6.2 million constant US dollars respectively. In 2003, water supply and sanitation received a significant investment of 7.9 million for large systems, marking the highest amount dedicated by the government to a single water-related category during the period.

Between 2002 and 2011, there were noteworthy contributions to water-related official development assistance (ODA), with average disbursements totalling 14.1 million constant US dollars per year. The highest disbursement occurred in 2009, reaching 20.5 million US dollars, while the lowest was recorded in 2004 at 7.0 million US dollars.

Flood prevention and control, coupled with disaster prevention and preparedness, received the largest share of disbursements. In 2008, this sector accounted for 60 percent, with 9.3 million US dollars allocated in 2010. However, support from ODA for agricultural water resource development was only evident in 2010 and 2011. It is noteworthy that between 2003 and 2011,

various sectors received investments or funding, including water supply and sanitation for large systems, basic drinking water supply and sanitation, water resources policy and administrative management, disaster prevention and preparedness/flood protection and control, and agricultural water resources. Conversely, minimal investment or assistance (less than 1 million) was provided for hydroelectric power plants, water resource protection, and river development (UN Water 2017).

#### 6.4.2 Impact of Climate Variability and Change on Water Supply

Guyana has historically experienced limited impacts from water-related disasters. Nevertheless, data spanning from 1980 to 2011 indicates that more than 650,000 individuals were affected during this period (see Table 15). Climate models forecast a prevailing trend of drying across Guyana, despite its reputation for high precipitation levels. Consequently, Guyana is anticipated to rank among the most severely affected nations globally by climate change, with certain areas experiencing significant rainfall or intense drought periods (see Table 15) which affects water availability in Guyana (UN Water 2017).

**Table 18: Droughts in Guyana and Relation to El Nino**

| <b>DROUGHT</b> | <b>PACIFIC OCEAN</b>      |
|----------------|---------------------------|
| Mar 1987       | El Niño                   |
| Jan 1988       | El Niño                   |
| Oct 1997       | Severe El Niño            |
| Apr 2003       | Immediately after El Niño |
| Sep 2006       | El Niño                   |
| Feb 2007       | Immediately after El Niño |
| Nov 2009       | El Niño                   |
| Jan 2010       | El Niño                   |

| Year | Number of Events | Deaths | Affected | Economic Damage (million current US\$) |
|------|------------------|--------|----------|--|
| 2011 | 0                | 0      | 0        | -                                      |
| 2010 | 1                | 0      | -        | 15                                     |
| 2009 | 0                | 0      | 0        | 0                                      |
| 2008 | 1                | 0      | 100 000  | -                                      |
| 2007 | 0                | 0      | 0        | 0                                      |
| 2006 | 1                | 20     | 35 000   | 165                                    |
| 2005 | 1                | 31     | 354 717  | 500                                    |
| 2004 | 1                | 0      | -        | -                                      |
| 2003 | 1                | 0      | 100 000  | -                                      |
| 2002 | 1                | 0      | 180      | -                                      |
| 2001 | 0                | 0      | 0        | 0                                      |
| 2000 | 1                | 10     | 5 950    | -                                      |
| 1999 | 1                | 0      | 200      | -                                      |
| 1998 | 1                | 0      | 12 200   | -                                      |
| 1997 | 1                | 1      | 7 000    | 29                                     |
| 1996 | 1                | 0      | 27 310   | -                                      |
| 1995 | 1                | 1      | 870      | -                                      |
| 1994 | 0                | 0      | 0        | 0                                      |
| 1993 | 1                | 0      | 3 500    | -                                      |
| 1992 | 1                | 0      | 300      | -                                      |
| 1991 | 0                | 0      | 0        | 0                                      |
| 1990 | 2                | 0      | 300      | -                                      |
| 1989 | 1                | 0      | 0        | -                                      |
| 1988 | 1                | 0      | 550      | -                                      |
| 1987 | 1                | 0      | 2 000    | -                                      |
| 1986 | 0                | 0      | 0        | 0                                      |

**Figure 30: Table illustrating the number of events and its impacts for the period 1980 - 2011**

The nation's coastal regions feature low-lying terrain, with certain areas situated as much as 2 meters below sea level, rendering them highly vulnerable to flooding. Rising sea levels present a significant risk of inundating coastal zones and facilitating the intrusion of saline water into both surface and groundwater sources (CCKP 2024). During the 1987/88 El Niño event, recognized as the most severe on record, the Caribbean encountered extensive drought conditions, with Guyana bearing the brunt of its impact (SALISES 2007).

One of the major problems that affects Guyana, is the intrusion of salt water into the vast river system present in the country. This results in the saline water settling in the river mouth, contaminating the river in the lower reaches. As a result of the density of saline water being higher than that of freshwater, the saline water slides over the bottom of the river, upstream against the flow of the river and can affect the quality of water up to several tens of kilometres upstream (Naryan 2006)

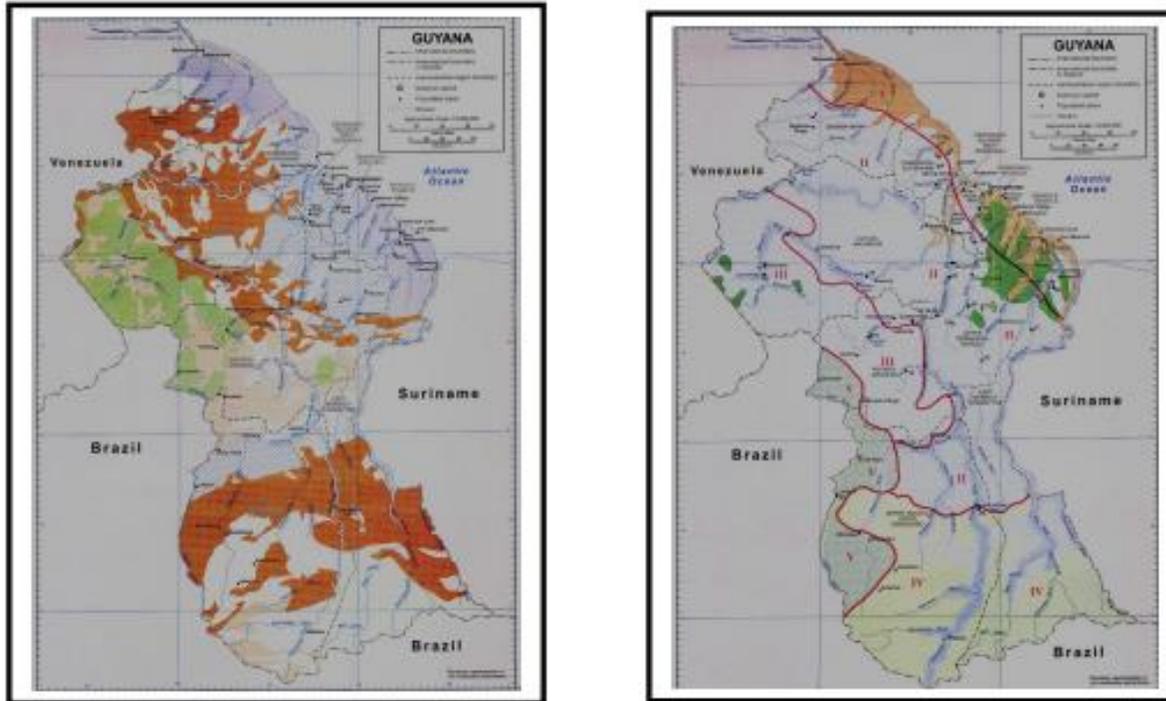


Figure 31: Illustrates ground water resources map of Guyana (left) and surface water resources of Guyana (right)

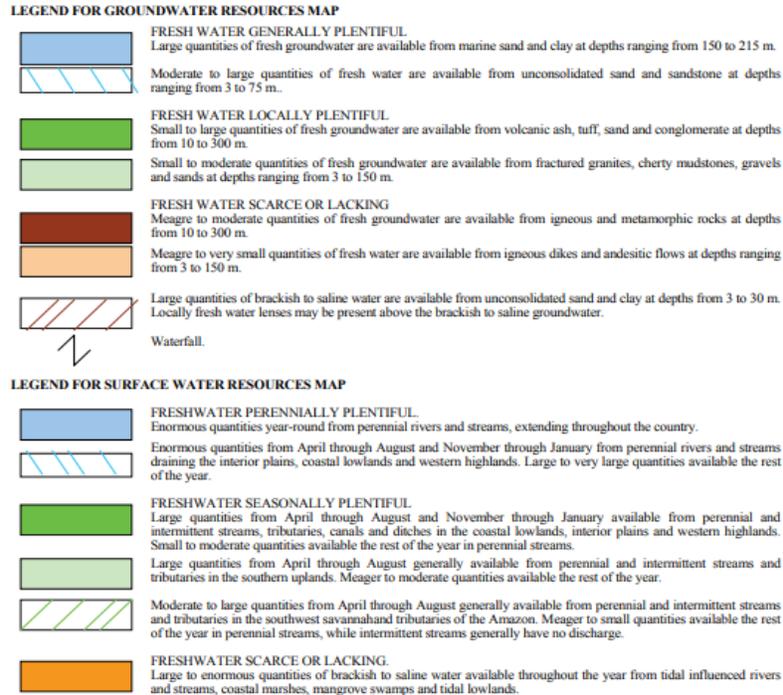


Figure 32: Legend to supplement Figure 28

## 6.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY AND QUANTITY)

### 6.5.1 History of IWRM in Guyana

An official survey was conducted for Guyana to report on Sustainable Development Goal (SDG) 6.5.1: “Degree of integrated water resources management implementation (0-100)” which is used to measure progress towards target 6.5. The tool serves as an instrumental diagnostic tool used to identify the strengths and weaknesses of the various aspects in IWRM implementation and focuses on 4 crucial dimensions of SDG 6.5.1. The survey was conducted in 2017 and 2020 for Guyana and shows an increase in the Final SDG Score indicating a Low score for both years (**Table 19**).

**Table 19: Illustrates the degree of implementation (0-100) for various key dimensions of SDG 6.5.1 for Guyana (2017 - 2020)**

| Key Dimensions                  | Enabling Environment | Institution and Participation | Management Instruments | Financing | SDG 6.5.1 score |
|---------------------------------|----------------------|-------------------------------|------------------------|-----------|-----------------|
| Degree of Implementation (2020) | 19                   | 13                            | 23                     | 20        | 19              |
| Degree of Implementation (2017) | 15                   | 6                             | 21                     | 20        | 16              |

In 2017, Guyana received a score of only 10 out of 100 for its development of national water resources policy. This low score was attributed to the creation of an Integrated Water Resources Management (IWRM) policy and roadmap for implementation, despite the government's failure to approve these initiatives. Additionally, the Guyana Water and Sewerage Act of 2002 addresses water resources management but lacks provisions for the equitable allocation of social and economic benefits. Furthermore, it does not explicitly consider the inclusion of women and other vulnerable groups, nor does it emphasize the need for a participatory approach.

By 2020, there was a slight improvement in the score for the enabling environment for policies and plans. This was due to ongoing consultancy efforts aimed at preparing a water and sanitation

policy for Guyana. However, the IWRM policy and roadmap remained in draft form and had not yet received government approval (UNEP 2020).

Between 2017 and 2020, notable advancements occurred regarding institutional capacity and stakeholder participation. In 2017, it was noted that the Hydrometeorological Department holds the responsibility for data collection, monitoring, and licensing under the Water and Sewerage Act of 2002. However, the department faces constraints in its technical capacity, hindering its ability to fully carry out its mandate. Similarly, the Environmental Protection Agency, mandated to oversee environmental management activities, experiences challenges such as fragmentation and overlap in institutional responsibilities, impeding the achievement of an integrated approach (UNEP 2020).

Recognizing these issues, a pathway forward was identified in 2020. With the restructuring of the government, the Ministry of Housing and Water was designated to spearhead Integrated Water Resources Management (IWRM) implementation. Additionally, in 2017, coordination between national government authorities representing various sectors scored only 10 out of 100. However, initiatives such as the development of the Dakoura Creek Watershed Management Plan fostered communication, consultation, and participation among stakeholders in water resources management. Moreover, entities like Guyana Water Inc. and the Environmental Protection Agency strive to engage a broad spectrum of stakeholders in information dissemination (UNEP 2020).

In 2020, this coordination score saw a slight increase to 20, reflecting efforts to establish more interagency stakeholder groups, as evidenced by initiatives such as the Water Action Hub. Furthermore, ongoing developments, such as the Hydrometeorological Office's efforts to establish Memorandums of Understanding for improved communication and information sharing between agencies, indicate progress toward enhanced coordination and collaboration in water resources management (UNEP 2020).

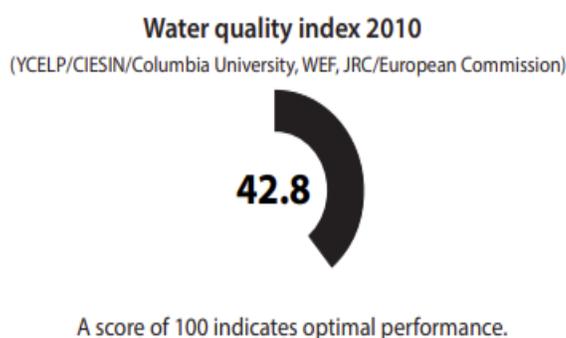
#### 6.5.2 Impact of water use and wastewater management on ecosystems in Guyana

Water use and wastewater management in Guyana have significant impacts on the environment and public health. Excessive water extraction for agriculture, industry, and domestic purposes leads to reduced water availability and threatens ecosystems. Inadequate wastewater treatment

results in pollution of water bodies, affecting aquatic life and human health. The discharge of untreated sewage contaminates rivers and coastal areas, posing risks of waterborne diseases and ecosystem degradation. These issues highlight the urgent need for improved water management practices and infrastructure in Guyana.

### 6.5.3 Terrestrial Ecosystem

As per UN Water (2017), key environmental concerns for Guyana include hydrometeorological hazards, land and water contamination, and heightened stress on biodiversity. A significant issue is the discharge of approximately 17.7 million litres of untreated sewage daily into the Demerara River estuary. Land and water pollution stem from various factors, including inadequate monitoring, limited financial resources, and weak enforcement of environmental regulations. Moreover, mining activities in Guyana's interior contribute to the degradation of both surface water and groundwater quality.



**Figure 33: Water quality index for Guyana, 2010**

### 6.5.4 Agriculture and Food Production Systems

Agricultural irrigation, crucial for crops like sugarcane and rice, faces challenges due to deteriorating drainage and irrigation systems. Guyana's hydropower potential stands at 7,607 GWh/year, with only one operational plant at Moca Moca in Region 9 generating 500 MW. The country's waterway transportation spans approximately 6,000 km, serving the logging industry and Amerindian communities.

Most agricultural activities in Guyana occur in the coastal plains, where the land lies below sea level for more than 8 kilometres inland, making drainage and water control critical challenges.

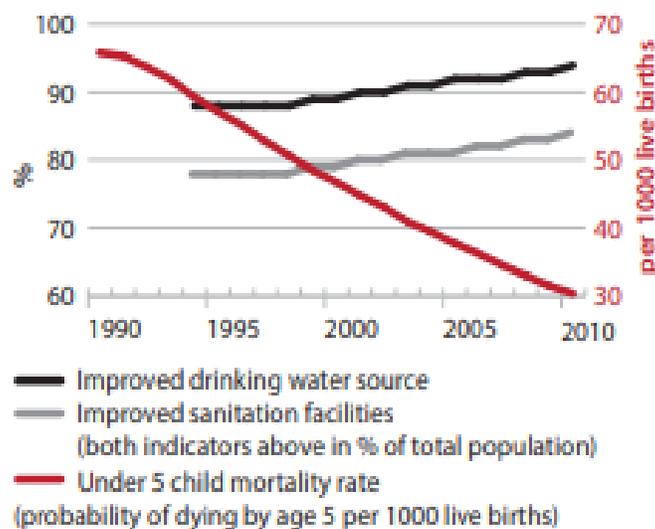
Agricultural development has always been closely linked to efforts to protect against water intrusion from the sea and rainwater runoff.

To address these challenges, conservancies, which are large shallow dams designed to trap surface water runoff, have been established. Additionally, extraction pumps installed along rivers help sustain a reliable water supply for irrigation. These systems ensure adequate water availability even during dry periods, although some shortages may occur during extreme events such as El Niño occurrences (UN Water 2017).

### 6.5.5 Human Health and Sanitation

Quality concerns arise from biological and chemical contamination, especially along the coast where sewage systems discharge into the Atlantic Ocean. Groundwater generally remains suitable for most uses, except for brackish or saline water near the Atlantic coast. Mining poses challenges, contributing to surface and groundwater contamination, sediment loading, and sawmill waste disposal issues.

According to UN Water (2017), water, sanitation, and hygiene-related issues were attributed to more than 300 deaths in 2004, representing 3.4% of all fatalities in Guyana. Overall, enhancing water and sanitation infrastructure and services offers numerous advantages, including mitigating local pollution, improving health outcomes, and boosting labour productivity.



**Figure 34: Access to drinking water and sanitation and under-5 child mortality (UN Water 2017)**

### 6.5.6 Finance Services

The financing aspect of Guyana water resource management registers a notably low performance across various categories, such as the allocation in the national budget for infrastructure investment, recurring expenses linked to integrated water resources management (IWRM) elements, as well as subnational or sub-basin budgets for water resource infrastructure investments. Moreover, there are limited, or no resources designated for revenues from dedicated levies and financing for transboundary cooperation. This status quo, coupled with the repercussions of inadequate wastewater management, leads to profound effects on the financial services sector in Guyana, intensifying health challenges and escalating operational expenses for businesses.

## 6.6 LEGAL POLICY AND INSTITUTIONAL FRAMEWORK

The Constitution of Guyana provides the legal basis for water management. It vests ownership of all waters in Guyana in the state and establishes the principles and framework for water governance. The Water and Sewerage Act of 2002 is the primary legislation governing water resource management in Guyana. It provides for the establishment of the Water and Sewerage Authority responsible for water supply and sanitation services. The act also addresses issues related to water abstraction, pollution control, and water quality standards (Water and Sewerage Act of Guyana, 2002).

Guyana has a national water policy aimed at ensuring sustainable management of water resources for social, economic, and environmental benefits. The policy outlines principles and strategies for water resources management, including conservation, equitable access, and integrated water resource management. The Ministry of Housing and Water is responsible for water resources management and development in Guyana. Within the ministry, the Guyana Water Incorporated (GWI) is responsible for water supply and sanitation services. Additionally, the Environmental Protection Agency (EPA) oversees environmental regulation, including water quality management.

Guyana is a signatory to various international agreements related to water management, including the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention

on Biological Diversity (CBD). These agreements provide a framework for international cooperation on water-related issues, including climate change adaptation and biodiversity conservation.

The following section further discusses the existing legal, policy and institutional environment surrounding water resource management in Guyana.

#### 6.6.1 Regional Setting

In Guyana, the enabling environment for the support of Integrated Water Resources Management (IWRM) implementation is primarily facilitated through legislative frameworks aimed at regulating water resources, environmental protection, and sustainable development (Guyana Water Incorporated, 2020). These international Multilateral Environmental Agreements and regional economic communities provide Guyana with frameworks and platforms for cooperation, collaboration, and technical assistance to support its efforts towards inclusive and sustainable development of its terrestrial and aquatic resources, as well as regional integration and cooperation in the Caribbean region (United Nations Development Programme, 2018). These agencies are also mandated to provide clear technical and policy guidance to their Member States towards the optimal development of the individual nations as well as harmonisation for greater regional integration and collaboration (Caribbean Community Secretariat, n.d.).

**Table 20** provides a listing of some key Multilateral Environmental Agreements (MEAs) that Guyana has signed onto or ratified, along with selected regional guidance documents produced by regional economic communities. These legislative frameworks provide the basis for promoting IWRM principles, including the integration of water-related policies, stakeholder participation, and sustainable water resource management. Additionally, Guyana's commitment to international agreements and conventions related to water resources and environmental protection further supports the implementation of IWRM approaches within the country.

**Table 20: Key MEAs and Regional Guidance Documents**

| Multilateral Environmental Agreements (MEAs)  | Regional Guidance Documents   |
|---|---|
| <ul style="list-style-type: none"> <li>• United Nations Framework Convention on Climate Change (UNFCCC)</li> <li>• Paris Agreement</li> <li>• Convention on Biological Diversity (CBD)</li> <li>• Ramsar Convention on Wetlands</li> <li>• Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal</li> <li>• Stockholm Convention on Persistent Organic Pollutants (POPs)</li> <li>• Minamata Convention on Mercury</li> </ul> | <ul style="list-style-type: none"> <li>• Caribbean Community (CARICOM) Climate Change Policy</li> <li>• Caribbean Regional Fisheries Mechanism (CRFM) Strategic Plan</li> </ul> |

### 6.6.2 National Setting

The national regulatory framework governing the management of water resources in Guyana is primarily established by the Water and Sewerage Act of 2002. This legislation provides the legal basis for the regulation, management, and development of water resources in the country. **Table 21** below provides an overview of some key pieces of legislation and policy/guidance documents related to watersheds and water resources management.

**Table 21: Overview of key legislation and policy / guidance documents related to watersheds and water resources management.**

| Legislation   | Policy/Guidance document   |
|---|--|
| <ul style="list-style-type: none"> <li>• Water and Sewerage Act of 2002</li> <li>• Environmental Protection Act (1996)</li> <li>• Forestry Act (2009)</li> <li>• Environmental Protection (Water Quality) Regulations (2000)</li> <li>• Fisheries Act (2002)</li> <li>• Environmental Impact Assessment (EIA) Regulations (2005)</li> <li>• Coastal Zone Management Act (2010)</li> </ul> | <ul style="list-style-type: none"> <li>• National Water Policy</li> <li>• National Environmental Policy</li> <li>• Protected Areas Act (2011)</li> <li>• National Development Strategy - Vision 2040</li> <li>• Low Carbon Development Strategy (LCDS)</li> <li>• National Biodiversity Strategy and Action Plan (NBSAP)</li> <li>• National Climate Change Policy</li> <li>• National Adaptation Strategy and Plan of Action (NASPA)</li> </ul> |

### 6.6.3 Community level

In Guyana, customary arrangements for water resources management at the community level are

deeply rooted in traditional practices, informal agreements, and community-based organizations (CBOs) (GWI, 2020). These arrangements are shaped by local customs, cultural norms, and historical practices, reflecting the diverse socio-cultural landscape of the country.

One common customary arrangement is the establishment of Community Water Committees, comprising members of the local community who take responsibility for managing and maintaining local water sources (GWI, 2020). These committees oversee tasks such as the maintenance of wells, boreholes, or hand pumps, and coordinate water distribution among households within the community. Traditional water rights also play a significant role in water resources management in indigenous communities in Guyana (GWI, 2020). These rights are often based on customary laws and practices passed down through generations within indigenous communities, governing access to and use of water resources in accordance with traditional norms.

Furthermore, communal water management practices are prevalent in rural communities, where community members collectively manage and maintain water sources such as rivers, streams, or ponds (GWI, 2020). These practices involve cooperation among community members to ensure equitable access to water for various purposes, including drinking, irrigation, and livestock watering. In addition to these arrangements, community-based water governance institutions are often established to oversee water management activities at the local level (GWI, 2020). These institutions, such as village councils or water user associations, play a crucial role in decision-making, conflict resolution, and the allocation of water resources within the community. Moreover, traditional knowledge and practices are integral to water resource management in indigenous communities, encompassing techniques for water conservation, watershed protection, and sustainable use of water resources (GWI, 2020). These practices are deeply rooted in local culture and may involve rituals or ceremonies to ensure the health and abundance of water sources.

Overall, customary arrangements for water resources management at the community level in Guyana reflect the intersection of traditional practices, cultural values, and local governance structures, contributing to sustainable and equitable access to water resources within communities (GWI, 2020).

## **6.7 CHALLENGES FOR IWRM**

In Guyana, the importance of an integrated water resource management (IWRM) framework has been recognized as a priority due to its critical role in ensuring sustainable development, safeguarding human health, and enhancing resilience to climate change impacts. However, various weaknesses persist, posing challenges for the effective implementation of water resource management practices. The existing management infrastructure in Guyana is inadequate for adequately managing and protecting water-related ecosystems, including rivers, wetlands, and coastal areas. This deficiency hinders the ability to address water quality degradation, habitat loss, and ecosystem degradation, which have significant implications for biodiversity conservation, human well-being, and ecosystem service provision.

### **6.7.1 Policy Challenges**

Guyana faces policy challenges related to fragmented and overlapping regulatory frameworks governing water resources management (Adams, 2019). The lack of comprehensive and integrated policies hampers coordination among government agencies, leading to inconsistencies in decision-making and implementation. Additionally, the absence of specific legislation addressing integrated water resource management further complicates efforts to effectively manage water resources in a holistic and sustainable manner (Adams, 2019).

### **6.7.2 Challenges for Water Security**

Water security is a major concern in Guyana due to various factors such as population growth, urbanization, and competing demands for water resources (GWI, 2020). Limited access to safe drinking water and sanitation facilities, particularly in rural and marginalized communities, further compounds the challenge of ensuring water security for all (GWI, 2020). Additionally, the vulnerability of water sources to pollution from agricultural runoff, mining activities, and industrial discharges threatens water quality and availability, exacerbating water security concerns (GWI, 2020).

### **6.7.3 Capacity Constraints**

Capacity constraints pose significant challenges to effective IWRM implementation in Guyana

(UNDP, 2018). Insufficient human, technical, and financial resources hinder the capacity of government agencies, civil society organizations, and local communities to undertake comprehensive water resources assessments, implement water management strategies, and enforce regulations (UNDP, 2018). Moreover, limited institutional capacity for data collection, analysis, and dissemination hampers evidence-based decision-making and planning in water resources management (UNDP, 2018).

#### 6.7.4 Data Availability and Use

Limited availability and accessibility of reliable water-related data present challenges for evidence-based decision-making and planning in Guyana (World Bank, 2019). Inadequate monitoring and data collection systems, as well as gaps in hydrological and meteorological data, hinder the assessment of water resource status, trends, and vulnerabilities (World Bank, 2019). This lack of data inhibits the development of informed policies and interventions to address water management challenges effectively (World Bank, 2019).

Addressing these challenges requires a concerted effort from government agencies, civil society organizations, and development partners to strengthen policy frameworks, enhance institutional capacities, improve water infrastructure and access, invest in data collection and monitoring systems, and promote stakeholder engagement and participatory decision-making processes (UNDP, 2018). Additionally, integrating climate change considerations into water resources management strategies is essential to enhancing resilience and adaptability in the face of climate variability and change (World Bank, 2019).

Effective water management and investment in water-related projects heavily rely on data as a crucial input. However, data and research availability for Guyana are notably limited. Therefore, it is essential to invest in coordinated efforts for data collection, compilation, analysis, and distribution. Such investments are critical for showcasing the benefits of water-related investments to governments, donors, and private capital investors. It's worth mentioning that finding national-level gender-disaggregated data for almost all themes covered in the UN-Water Country Briefs is exceedingly challenging (UN Water 2017).

## **6.8 SYNERGIES BETWEEN STATE, GAPS AND AREAS TO BE HARMONISED**

In Guyana, there are synergies between various stakeholders, including the government, non-governmental organizations, and international bodies, in promoting Integrated Water Resources Management (IWRM). However, there are also notable gaps that exist and areas that need to be harmonized to ensure the successful implementation of IWRM principles across the country. Like Dominica, Guyana recognizes the importance of political commitment, enhanced governance structures, and integrated planning and management of water resource for the successful implementation of IWRM (FAO, 2011). The government of Guyana has taken steps to develop legal frameworks and policies that support IWRM principles, such as the National Water Policy aimed at ensuring sustainable management of water resources (Guyana Water Incorporated, 2020).

One of the ongoing initiatives in Guyana is the formulation of a Water Resources Inventory and the development of an Integrated Natural Resource Management Plan, similar to the initiatives in Dominica (UNFCCC, 2020). These initiatives aim to assess and monitor water resources, develop early-warning systems, and guide various aspects of water conservation and utilization strategies. However, gaps exist in the implementation of these initiatives, particularly in terms of capacity development and institutional coordination. There is a need for enhanced capacity-building efforts to strengthen the technical expertise of relevant stakeholders involved in water resources management. Additionally, there is a need for better coordination among government agencies, civil society organizations, and local communities to ensure the effective implementation of IWRM practices.

Furthermore, harmonization of supporting legislation and regulations is crucial to regulating development in both coastal and watershed areas, as well as to ensuring the sustainable extraction and conservation of water resources (UNFCCC, 2020). This includes the development of integrated land use capability plans and supporting legislation to regulate water extraction and irrigation practices.

In summary, while Guyana has made progress in promoting IWRM principles, there are gaps that need to be addressed, including capacity development, institutional coordination, and harmonization of supporting legislation. Addressing these challenges will be essential for

achieving sustainable water resource management in Guyana.

#### 6.8.1 Recommended roles and responsibilities of key stakeholders in improving Integrated Water Resource Management in the region.

In Guyana, improving Integrated Water Resource Management (IWRM) requires the collaborative efforts of various stakeholders across different sectors (Ministry of Housing and Water, Guyana). Political will plays a pivotal role in uniting stakeholders and advancing the water resources management process, particularly when changes in legal and institutional structures are necessary or conflicts among stakeholders exist (Ministry of Housing and Water, Guyana). A robust governance structure, featuring competent authorities and mechanisms for coordination, collaboration, and stakeholder participation, is crucial (Ministry of Housing and Water, Guyana). Given water's status as a shared resource, flexible water rights allocation is vital to accommodate evolving needs (Ministry of Housing and Water, Guyana). Developing a comprehensive master plan that aligns individual sector plans fosters coordination among various sectors, optimizing resource utilization (Ministry of Housing and Water, Guyana).

Evaluating existing laws and regulations related to water activities ensures their adaptation to sustainability and integration in water resources management, emphasizing conservation, improved water quality, and the use of efficient technologies (Ministry of Housing and Water, Guyana). Capacity development and training priorities should extend across all levels, including decentralized local government, encouraging participation from all stakeholders (Ministry of Housing and Water, Guyana). Monitoring and evaluation are essential for proper implementation of water resources management, highlighting the need for adaptive strategies, while the incorporation of new technologies is crucial for effective performance at both local and central levels of water management (Ministry of Housing and Water, Guyana).

The FAO's 2011 document on the Implementation of a Comprehensive Integrated Water Resources Management Policy underscores the necessity of good governance for ensuring sustainable water resource management (FAO, 2011). It emphasizes that policies and decisions should consider both short and long-term perspectives. However, the focus on potable water supply and distribution often limits knowledge, hindering the holistic approach required for integrated water resource management. Therefore, there is a need for capacity building in this field.

Recognizing the critical role of political will in achieving sustainability, the Guyanese government is committed to coupling political will with good governance to uphold integrity and ensure success (Ministry of Housing and Water, Guyana). The government outlines its commitment to establishing a robust institutional structure, including a Water Resources Organization, the Water and Sewerage Company, a Utilities Regulatory Organization, and a mechanism for stakeholder coordination, collaboration, and participation (Ministry of Housing and Water, Guyana). The government also plans to set ground rules, facilitate capacity building at various levels, support the right human resource capacities for effective water management, promote public education and awareness, and seek funding for integrated water resources management (Ministry of Housing and Water, Guyana). One immediate action involves separating the responsibilities for water resource management and service provision, currently vested in the Guyana Water Incorporated. The government will restructure institutional arrangements and implement supporting legislation to establish the proper structure. Additionally, sectoral policies and plans will be reviewed and aligned with the National Water Resources Management Policy outlined by FAO in 2011 (FAO, 2011).

#### 6.8.2 Best Practices and Opportunities for Replication and Scaling-Up

The Government of Guyana should prioritize the following initiatives to improve Integrated Water Resource Management (IWRM) in the region:

- 1) Establishment of a National Water Resources Database: Establish and maintain a national water resources database on a geographic information system (GIS) platform (ECLAC, 2007). Ensure continuous assessment of water resources by establishing and maintaining a hydrological and hydrogeological monitoring network, along with complementary environmental data (ECLAC, 2007).
- 2) Data Collection and Information Sharing: Facilitate and support the production of reliable and timely data and information regarding water quality, quantity, and variability to aid in effective decision-making (ECLAC, 2007). Set and uphold data quality standards and control measures. Maintain a comprehensive directory of water-related data and sources, accessible in electronic format, and promote the use of the national water database (ECLAC, 2007).

- 3) **Integration of Climatological Information:** Support efforts to enhance the availability and analysis of climatic data and services (FAO, 2011). Integrate climatological information into water resource planning and management to safeguard and optimize available water resources for supply (FAO, 2011).
- 4) **Capacity Building and Institutional Strengthening:** Foster measures to bolster Guyana's human resources for assessing climate change and variability impacts on water resources, as well as environmental, social, and economic aspects (FAO, 2011). Develop national capacity for hazard assessment and risk management, incorporating vulnerability assessment and risk management principles for water resources (FAO, 2011).
- 5) **Infrastructure Enhancement:** Expand metering to ensure efficient water management and promote conservation practices (ECLAC, 2007). Implement Non-Revenue Water (NRW) Management Programme as part of overall water resource management strategies (ECLAC, 2007).
- 6) **Pollution Control and Groundwater Management:** Implement pollution control interventions designed to protect water resources from contamination (ECLAC, 2007). Conduct mapping of groundwater resources and integrate outputs from relevant projects to enhance groundwater management (ECLAC, 2007).

**Resource Mobilization:** Seek additional external funding to complete and complement activities initiated with local financing (ECLAC, 2007). Pursue funding opportunities, such as the Green Climate Fund (GCF), to support capacity building efforts and sustainable water management projects (ECLAC, 2007).

It's important to address administrative and technical capacity gaps in order to effectively implement these initiatives. This includes developing specialized expertise in water resources management, watershed management, environmental management, and database/GIS management (ECLAC, 2007).

These initiatives and recommendations provide a framework for improving IWRM in Guyana, ensuring sustainable water resource management for future generations.

6.8.3 Strengthen country-wide water partnerships to assist with IWRM.

No collaborative water partnerships at the national level were identified to support Integrated Water Resources Management (IWRM).

## **6.9 CONCLUSION**

In conclusion, Guyana faces significant challenges in managing its water resources, exacerbated by environmental, economic, and climatic factors. To address these challenges effectively, a comprehensive approach is necessary, involving the strengthening of policies, institutional capacity, and investment in infrastructure and technology. Public engagement and community involvement are crucial for promoting sustainable water management practices and ensuring inclusivity in decision-making processes.

Moving forward, prioritizing water safety, pollution control, and groundwater management alongside efforts to mobilize resources will be essential for Guyana. Leveraging external funding, engaging the private sector, and implementing innovative solutions are key strategies for achieving water security and resilience in the country.

Despite the challenges, Guyana demonstrates a commitment to Integrated Water Resource Management (IWRM) and sustainable development through ongoing initiatives and collaborations with regional and international partners. With strategic planning, effective governance, and collaboration among stakeholders, Guyana can address its water management challenges and emerge as a leader in water resilience in the Caribbean region.

## 7.1 OVERVIEW

Haiti, nestled in the Caribbean Sea, comprises the western portion of the island of Hispaniola, alongside smaller islands like Gonâve and Tortue, with Port-au-Prince as its capital. Although Haiti has an average annual rainfall of 1460 mm (approximately 58 inches), and a high per capita potential renewable freshwater resource, it is considered among the poorest countries in terms of access to water supply due to the lack of adequate water storage infrastructure for proper management of floods and droughts and the development of sustained water supply.

Additionally, despite being the second country in the Americas to gain independence from colonial rule in 1804, Haiti has grappled with numerous challenges, including economic struggles, political instability, social issues, and recurrent natural disasters, resulting in persistent poverty. The nation's rugged topography, marked by mountainous terrain, accounts for approximately two-thirds of its landmass, while fertile plains and coastal areas support agricultural activities and dense populations. Haiti's warm, humid tropical climate is characterized by seasonal variations in rainfall, with the southern peninsula particularly susceptible to hurricanes. Deforestation, soil erosion, and habitat loss have further exacerbated environmental degradation, impacting biodiversity and ecosystem health.

Water resources in Haiti, distributed across 30 river basins, face significant challenges stemming from inadequate infrastructure, pollution, and climate variability. Despite abundant surface and groundwater sources, access to clean drinking water and sanitation services remains low, especially in rural areas. The government, NGOs, and international partners are actively engaged in efforts to improve water governance, enhance infrastructure, and address systemic barriers to water access and management. However, the lack of comprehensive data poses a significant obstacle to informed decision-making and effective resource management, highlighting the need for collaborative initiatives to strengthen data collection, analysis, and dissemination.

## 7.2 GEOGRAPHICAL CONTEXT

Haiti, situated in the Caribbean Sea, encompasses the western third of the island of Hispaniola along with smaller adjacent islands such as Gonâve and Tortue. The capital city is Port-au-Prince. Haiti is notable for being the second country in the Americas, after the United States, to gain independence from colonial rule in 1804 (Bachhuber et.al 2010). Despite this historical achievement, the nation has faced significant challenges including economic hardship, political instability, social issues, and recurrent natural disasters, leading to persistent poverty.

Bordered by the Dominican Republic to the east, the Caribbean Sea to the south and west, and the Atlantic Ocean to the north (see **Figure 35**). Haiti's terrain is marked by rugged topography. Approximately two-thirds of Haiti's land lies above 1,600 feet in elevation (Bakun et al. 2012). The coastline is characterized by rocky shores with cliffs and harbors, renowned for their coral reefs. Plains, although limited, are the most productive agricultural areas and densely populated regions (Calais et al. 2010). The island's backbone comprises four major mountain ranges extending from west to east. Notable among these are the Massif du Nord, the Central Plateau, the Matheux Mountains, and the Massif de la Selle. Mount Selle, rising to 8,773 feet, is the country's highest peak. The presence of limestone mountains, volcanic formations, and karstic features like caves and subterranean rivers are prominent geological characteristics (Valls 2016). Haiti is prone to seismic activity, with earthquakes periodically impacting the region, notably the devastating earthquake of January 2010 that severely affected Port-au-Prince and surrounding areas.

Haiti's mountain soils are thin and lose fertility rapidly with cultivation. Lower hills are covered with red clays and loams, while alluvial soils in plains and valleys are fertile but overcultivated. Deforestation has led to significant soil erosion, with estimates suggesting up to one-third of the land may have eroded beyond recovery.

The country experiences a warm, humid tropical climate with diurnal temperature variations influenced by elevation. Average temperatures range from the high 70s°F in January and February to the mid-80s°F in July and August (Valls 2016). Frost can occur in winter at higher elevations. Haiti, located on the leeward side of the island, receives less rainfall compared to the Dominican Republic. Some regions have two rainy seasons, while others experience rainfall from May to

November. The southern peninsula is particularly vulnerable to hurricanes, with notable storms causing widespread damage and loss of life.

Historically, significant deforestation has occurred, reducing natural vegetation to a fraction of its original extent. Pockets of virgin forest remain in some mountainous regions. Thorny woods dominate dry plains, while mangrove swamps on the coast have rapidly declined due to overexploitation (Villeneuve 2002). Wildlife has suffered habitat loss, leading to the disappearance of certain species like wild boars and guinea fowl. Conservation efforts have been limited, resulting in further degradation of habitats and ecosystems.

Haiti, with a population of approximately 11 million, has women constituting about 51% of its population. Despite comprising the majority, Haitian women encounter various systemic obstacles hindering their socioeconomic advancement (Wilson 2018). These challenges include limited access to education, public transportation, and disposable income, which curtails their participation in public spheres and impedes progress towards gender equality. Consequently, Haiti ranked 150th out of 162 countries on the UNDP Gender Inequality Index in 2018. The country's population is growing at a rate of about 1% annually, projected to reach approximately 14 million by 2050. Projections anticipate a decline in national fertility rates from 2.99 births per woman in 2017 to around 2.5 births per woman by 2025–2030 (UNDP 2023).

Various socioeconomic factors contribute to the vulnerability of Haitian citizens to climate change, especially extreme weather events like hurricanes and heavy rainfall. These factors encompass high poverty rates, food insecurity, increasing urbanization, limited access to reliable water and sanitation services, gender disparities, and the structure of the Haitian economy. These aspects will be discussed further in subsequent sections (UNDP 2023).

Overall, Haiti's geographical context encompasses diverse landscapes, from rugged mountains to fertile plains and coastal areas, each presenting unique challenges and opportunities for the nation's development and environmental conservation.

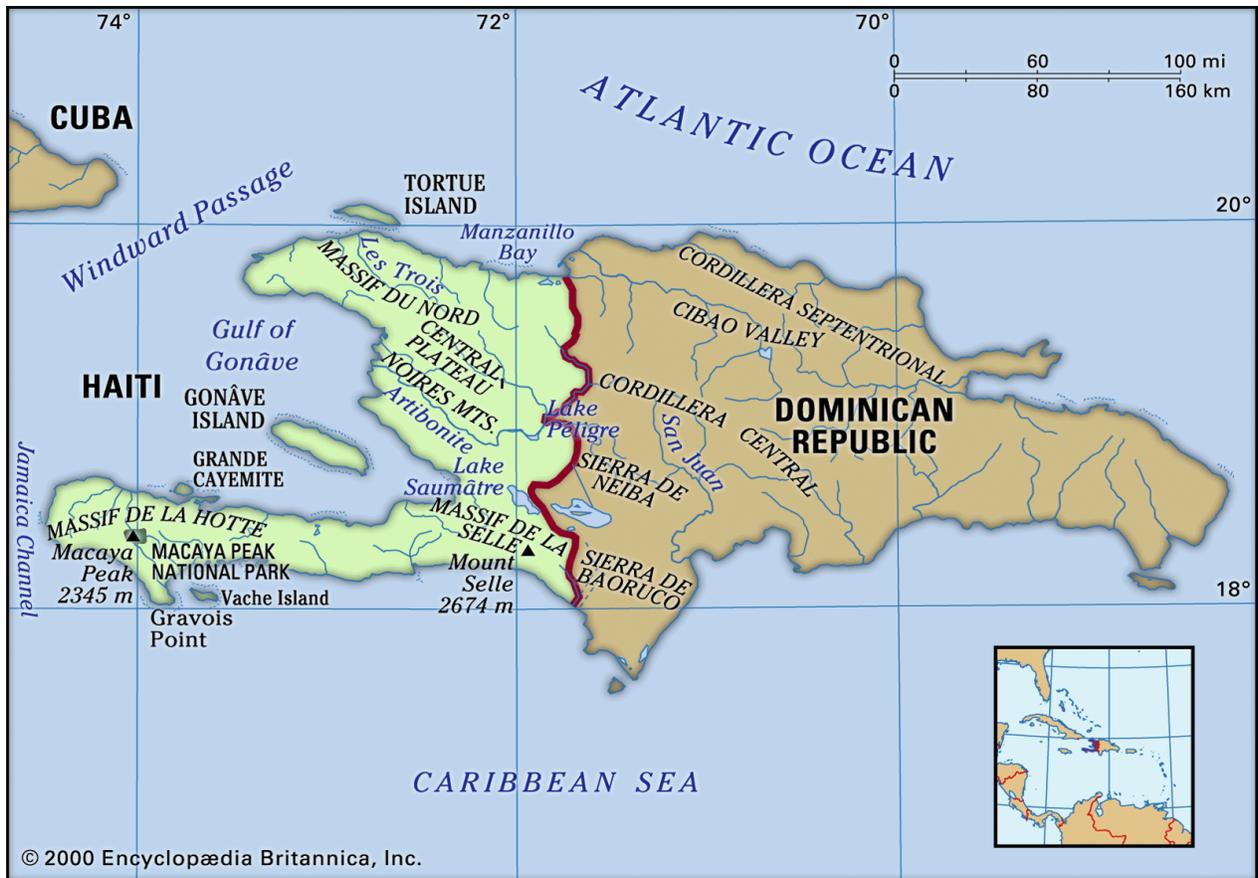


Figure 35: Map of Haiti

### 7.3 STATUS OF WATER RESOURCES MANAGEMENT IN HAITI

Haiti's water resources are diverse and crucial for various purposes, including irrigation, hydropower generation, and domestic use. However, there are significant gaps in understanding and managing these resources effectively, particularly in terms of water quality, quantity, and distribution. Addressing these gaps is essential for ensuring sustainable water management and meeting the needs of Haiti's population in the face of climate variability and increasing water demand.

#### 7.3.1 Source

Haiti's water resources are distributed across 30 river basins, with the largest, the Artibonite Basin, covering approximately a quarter of the country's land area. The rugged terrain and frequent exposure to extreme weather patterns contribute to substantial geographic and inter-annual

variations in rainfall and water availability (UNOSAT 2014). Unfortunately, many of these watersheds remain inadequately studied, resulting in limited understanding of their water quality, quantity, and overall resources.

The Artibonite Basin, situated in central Haiti, stands out as the most water-abundant region, encompassing 25% of the nation's territory. Notably, the Artibonite River, originating in the neighbouring Dominican Republic, boasts an average flow rate ten times greater than any other river in Haiti and ranks as the largest in the Caribbean (Alexandre 2013). This vital water source courses north-westward through Lake Péligre, a 30 km<sup>2</sup> reservoir crucial for both hydropower generation and rice irrigation. Lake Péligre owes its existence to the Péligre dam, the largest of eight main dams across the country.

In addition to Lake Péligre, Haiti hosts the brackish Étang Saumâtre (Lake Azuei), occupying the southern Cul-de-Sac Plain and sharing it with the Dominican Republic. With an expansive area of 113 km<sup>2</sup>, it holds significance as the largest lake within Haitian territory (Baranyi and Louis 2006). Other noteworthy basins include Les Trois Rivières in the north, Estère in the center, Grande Rivière du Nord in the northeast, Grande Rivière du Jacmel in the southeast, and Grand'Anse in the southwest. These basins primarily originate from the Massifs du Nord, de la Hotte, and de la Selle mountain ranges, contributing to the diverse water sources across the nation (Berg 2010).

Groundwater, a critical component of Haiti's water resources (**Figure 36**), exhibits considerable diversity and uncertainty in terms of aquifer characteristics, abstraction rates, and water quality. Approximately 84% of groundwater reserves are concentrated within alluvial plains and valleys, covering just 17% of the country's total land area. The five main aquifer types, including unconsolidated alluvium, interior sedimentary, reef carbonate, semi-consolidated, and igneous formations, provide further insight into the complex groundwater dynamics within Haiti.

| WATER RESOURCES DATA                                   | Year | Haiti  | Central America and the Caribbean (median) |
|--|------|--------|--|
| Long-term average precipitation (mm/year)              | 2017 | 1,440  | 1,880                                      |
| Total renewable freshwater resources (TRWR) (MCM/year) | 2017 | 14,030 | 12,425                                     |
| Falkenmark Index - TRWR per capita (m3/year)           | 2017 | 1,278  | 2,756                                      |
| Total renewable surface water (MCM/year)               | 2017 | 11,870 | 23,095                                     |
| Total renewable groundwater (MCM/year)                 | 2017 | 2,157  | 6,315                                      |
| Total freshwater withdrawal (TFWW) (MCM/year)          | 2002 | 1,450  | 1,402                                      |
| Total dam capacity (MCM)                               | 2015 | 297    | 1,230                                      |
| Dependency ratio (%)                                   | 2017 | 7.24   | 0  |
| Interannual variability                                | 2013 | 2.40   | 1.25                                       |
| Seasonal variability                                   | 2013 | 1.90   | 2.40                                       |
| Environmental Flow Requirements (MCM/year)             | 2017 | 3,188  | 2,687                                      |
| SDG 6.4.2 Water Stress (%)                             | 2002 | 13.37  | 5.30                                       |

Source: [FAO Aquastat](#)

Figure 36: Table Showing Water resources in Haiti between 2002-2017

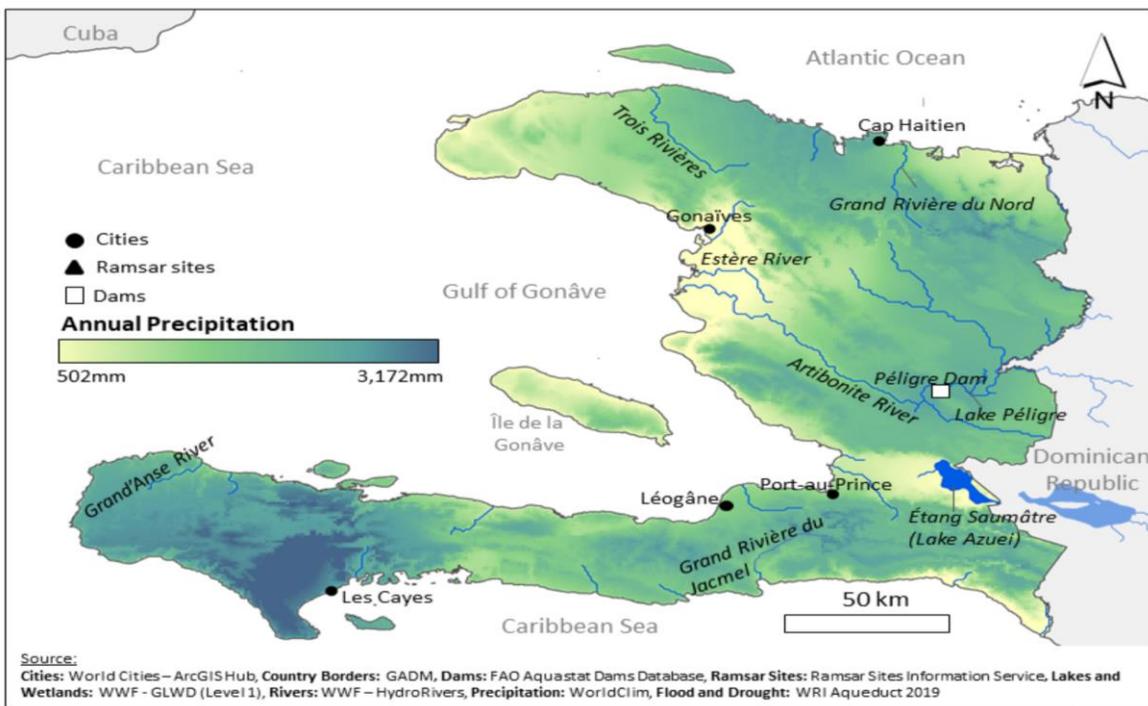


Figure 37: Annual precipitation in Haiti

Furthermore, Haiti's susceptibility to climate change poses significant challenges to water resource management. With an expected reduction in overall rainfall and an increase in drought severity, the country faces heightened vulnerability to climate-related impacts (Charles 2017). Regional disparities in precipitation (**Figure 37**), influenced by the mountainous terrain, result in varying rainfall patterns across different parts of the country. Climate models project declining annual rainfall by the century's end, accompanied by reductions in overall water balance conditions and an escalation in extreme drought events (CNDDR 2011). The Nord-Ouest, Nord-Est, and Artibonite Departments emerge as particularly vulnerable regions, already experiencing delayed rainy seasons and an anticipated increased frequency of droughts.

In light of these challenges, comprehensive research efforts and effective management strategies are essential to enhance water resource resilience, ensure sustainable utilization, and mitigate the adverse effects of climate change on Haiti's water security (Edouard 2013).

### 7.3.2 Distribution

According to the World Bank (2023), in 2020, only 43% of Haiti's rural population had access to basic drinking water supplies, down from 48% in 2015 and 50% in 1990. In Haiti, access to distributed water is limited, with only 62% of urban and 34% of rural residents having access to water collected or distributed within a 500-meter radius of a water point. Additionally, between 2000 and 2012, a smaller percentage of the population in both urban and rural areas used improved water sources, which are protected from external contamination.

Water treatment practices are not widely adopted, with nearly 3 out of 10 households consuming untreated water. The Plaine du Cul-de-Sac Aquifer, a significant urban water source supplying 60% of the population in the Port-au-Prince metropolitan area, faces saline contamination due to excessive pumping practices over the past century, surpassing the aquifer's recharge capacity (World Bank 2023).

Haiti's population, currently exceeding 10 million, is expected to grow to 14 million over the next two decades. This demographic shift, coupled with increasing water consumption rates, highlights the urgent need for effective water governance and management.

The 2009 Framework Law established the Direction Nationale de l'Eau Potable et de l'Assainissement under the Ministry of Public Works to regulate potable water through a decentralized system of regional authorities. However, water management responsibilities are fragmented among six national ministries, each operating under its own rules and budgetary constraints. This decentralized approach complicates efforts to develop a coordinated water management strategy (Widmer et al. 2018).

Furthermore, the involvement of over 50 non-governmental organizations (NGOs) in the water and sanitation sector adds another layer of complexity to water management efforts. Coordinating the activities of these diverse stakeholders presents a significant challenge in ensuring effective water governance and management in Haiti (Widmer et al. 2018).

In light of these pressing issues, concerted efforts are needed to address the underlying factors contributing to the inadequate distribution of water resources and sanitation services in rural Haiti. This necessitates comprehensive strategies aimed at improving infrastructure, enhancing community involvement, bolstering resilience to environmental pressures, and ensuring equitable access to clean water and sanitation for all segments of the population.

#### **7.4 WATER SUPPLY, DEMAND AND USAGE**

Haiti, which has ample surface and groundwater resources, relies heavily on these sources to meet its population's water needs. The country benefits from significant precipitation, leading to abundant surface runoff and groundwater recharge (World Bank 2015). Groundwater serves as a primary source for domestic water needs, while surface water is predominantly used for agricultural purposes, particularly in the cultivation of crops like sugarcane and rice, as well as supporting industrial activities.

However, urban centres in Haiti grapple with significant challenges in sewage infrastructure. Many areas lack sufficient or entirely absent sewage systems, resulting in limited water purification practices, such as filtration and chlorination, primarily observed in larger cities like Port-au-Prince. In areas without proper sewage systems, reliance on septic tanks is widespread. In Port-au-Prince specifically, water distribution systems suffer from inadequate maintenance and reliability issues, leading to many residents resorting to individual cisterns for water storage (The Water Project

2018).

Furthermore, canals in urban areas of Haiti, including Port-au-Prince, serve dual purposes as water sources and sewers. Unfortunately, these canals are often contaminated with agricultural and biological pollutants, as well as solid waste, posing significant health and environmental risks.

#### 7.4.1 Source Sustainability, Protection, Access and Benefit Sharing

Between 2010 and 2020, Haiti directed substantial efforts towards source sustainability and protection, particularly in response to environmental challenges such as deforestation and land degradation. Notable peaks in funding occurred in 2013, 2016, and 2019, with investments reaching 6.5, 7.8, and 8.3 million constant US dollars, respectively (ReliefWeb 2023). In 2010, significant funding of 7.2 million was allocated to reforestation projects, marking a pivotal investment in combating environmental degradation.

Throughout the period from 2009 to 2018, international assistance played a crucial role in supporting Haiti's environmental initiatives. Official development assistance (ODA) for environmental projects averaged 14.6 million constant US dollars annually. The highest disbursement was observed in 2015, totalling 20.2 million US dollars, while the lowest occurred in 2012 at 8.9 million US dollars (UNDP 2023).

Efforts to address environmental challenges in Haiti have focused primarily on reforestation and natural resource management. In 2017, these initiatives accounted for 50 percent of the total ODA disbursements, with 11.3 million US dollars allocated for watershed management and biodiversity conservation. However, support for access and benefit sharing mechanisms was limited, with sporadic funding observed only in 2014 and 2018 (UNDP 2023).

It is important to note that between 2010 and 2018, Haiti made strides in various environmental sectors, including reforestation and natural resource management, sustainable agriculture, climate change adaptation, and disaster risk reduction. Conversely, minimal investment or assistance (less than 1 million) was directed towards marine conservation, protected area management, and access and benefit sharing mechanisms.

#### 7.4.2 Impact of Climate Variability and Change on Water Supply

Climate variability and change pose significant challenges to water supply in Haiti, aggravating existing issues and introducing new complexities. One of the foremost biggest impacts is evident in water availability, where shifting precipitation patterns, marked by irregular rainfall and prolonged droughts, directly affect the quantity and quality of accessible water resources. Reduced rainfall contributes to diminished surface water levels in rivers and streams, exacerbating the strain on water availability across the nation (Diouf 2023). Moreover, the quality of water sources is compromised as climate change exacerbates pollution and contamination issues. Heavy rainfall and subsequent flooding can wash pollutants into water sources, escalating water quality concerns and heightening the risk of waterborne diseases. Additionally, elevated temperatures foster the growth of harmful algal blooms, further deteriorating water quality and exacerbating health risks associated with water consumption (Staub 2020).

Groundwater depletion emerges as another critical concern, driven by rising temperatures and altered precipitation patterns. These factors contribute to increased evaporation rates and reduced groundwater recharge, posing a significant threat to the sustainability of groundwater resources vital for both drinking water supply and agricultural irrigation in Haiti (Charles 2017). Furthermore, sea-level rise, a direct consequence of climate change, poses a grave threat to coastal aquifers in Haiti. As sea levels continue to rise, saline water infiltrates freshwater aquifers, rendering them unsuitable for human consumption or agricultural use—a phenomenon known as saltwater intrusion. This process jeopardizes the availability of freshwater resources in coastal regions, exacerbating water scarcity and compounding existing challenges faced by vulnerable communities.

The intensification of extreme weather events, such as hurricanes, storms, and floods, further exacerbates water supply issues in Haiti. These events damage water infrastructure, disrupt water supply systems, and contaminate water sources, amplifying water scarcity and sanitation challenges in affected areas. Additionally, the heightened competition for limited water resources induced by climate-induced water stress can lead to social unrest and exacerbate vulnerabilities, particularly among marginalized populations (Edouard 2013).

Addressing the multifaceted impacts of climate variability and change on water supply in Haiti

necessitates comprehensive adaptation strategies. These strategies encompass investments in resilient water infrastructure, enhanced water management practices, sustainable groundwater management, and robust disaster risk reduction measures. Concurrent efforts to mitigate climate change through the reduction of greenhouse gas emissions are imperative to safeguarding water resources and ensuring water security for Haiti's population amidst the evolving climate landscape.

## **7.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY AND QUANTITY)**

The linkages between Integrated Water Resources Management (IWRM) and water, encompassing both quality and quantity, are crucial for sustainable water management in Haiti. Water serves as the cornerstone of the environment, impacting various sectors and facets of life, including agriculture, industry, and human health. Given its central role, the responsibility for water management extends beyond the water sector alone and requires collaboration with key stakeholders from various departments and sectors. In Haiti, the implementation of IWRM principles is closely intertwined with efforts to address both the quantity and quality of water resources. Sustainable management practices aim to ensure the availability of an adequate quantity of water for various uses, including domestic consumption, agriculture, and industry, while also safeguarding water quality to protect human health and ecosystems (UNDP 2023).

To achieve these objectives, coordination and alignment with sectoral policies and plans are essential. The National Water Resources Management Policy serves as a guiding framework, providing a roadmap for integrated and sustainable water management practices. It establishes principles and guidelines that must be reflected in sectoral policies related to agriculture, the environment, health, and infrastructure development, among others. By integrating IWRM principles into sectoral policies and plans, Haiti can enhance the coherence and effectiveness of its water management efforts. This integration ensures that actions taken in sectors such as agriculture, industry, and urban planning are consistent with the goals of sustainable water use, conservation, and protection of water resources. Additionally, it promotes synergies and collaboration among different sectors, fostering a holistic approach to water management that considers both quantity and quality aspects.

Overall, the linkages between IWRM and water quality and quantity underscore the interconnected

nature of water resource management in Haiti. By integrating IWRM principles into sectoral policies and plans, Haiti can promote sustainable water management practices that address the complex challenges of water availability, accessibility, and quality while supporting broader socioeconomic development goals.

### 7.5.1 History of IWRM Haiti

A comprehensive assessment was conducted in Haiti to evaluate progress towards Sustainable Development Goal (SDG) 6.5.1, which measures the degree of integrated water resources management (IWRM) implementation on a scale from 0 to 100. This survey, conducted in 2017 and 2020, aimed to gauge the effectiveness of various aspects of IWRM implementation and focused on four critical dimensions of SDG 6.5.1. The results indicate a low level of implementation, as reflected in the Final SDG Score, which remained relatively stable between the two assessment periods (see **Table 22** and **Table 23**).

**Table 22: Illustrates the degree of implementation (0-100) for various key dimensions of SDG 6.5.1 for Haiti (2017)**

| Key Dimensions           | Enabling Environment | Institution and Participation | Management Instruments | Financing | SDG 6.5.1 score |
|--------------------------|----------------------|-------------------------------|------------------------|-----------|-----------------|
| Degree of Implementation | 27                   | 38                            | 28                     | 25        | 29              |

In 2018, Haiti faced significant challenges related to outdated laws and policies governing water resource management. Despite the initiation of the IWRM policy development process in 2013, progress remained slow, with the draft policy pending government approval and undergoing review. Existing legislation, such as the Water Resources Act (2009) and the Environmental Code (2003), provided a legal framework for water management but lacked comprehensive implementation mechanisms. However, efforts were underway to strengthen institutional capacity and stakeholder participation, as evidenced by capacity-building initiatives and stakeholder consultations facilitated by international organizations (USAID 2021).

In 2021, there was notable progress in advancing Haiti's IWRM agenda. A key milestone was the

establishment of a dedicated consultancy funded by international donors, aimed at developing a National Water Sector Strategy (NWSS). This strategic initiative aimed to modernize Haiti's water governance framework and align it with international best practices in IWRM. Additionally, efforts were made to enhance financial mechanisms for water management, including the establishment of dedicated funding mechanisms and the mobilization of resources from international development partners.

The formal launch of the National Water Sector Strategy in 2022 marked a significant step forward in Haiti's IWRM journey. This strategic roadmap outlines priority areas for intervention, including improving water infrastructure, enhancing water quality monitoring, and promoting sustainable water use practices. Furthermore, the strategy emphasized the importance of stakeholder engagement and collaboration in achieving its objectives, underscoring the need for multi-sectoral approaches to water management (UNDP 2023).

**Table 23: Illustrates the degree of implementation (0-100) for various key dimensions of SDG 6.5.1 for Haiti (2020)**

| Key Dimensions           | Enabling Environment | Institution and Participation | Management Instruments | Financing | SDG 6.5.1 score |
|--------------------------|----------------------|-------------------------------|------------------------|-----------|-----------------|
| Degree of Implementation | 27                   | 38                            | 28                     | 25        | 30              |

## **7.6 IMPACT OF WATER USE AND WASTEWATER MANAGEMENT ON ECOSYSTEMS IN HAITI**

In Haiti, water use, and wastewater management practices have significant impacts on ecosystems, particularly in coastal and freshwater habitats. The indiscriminate use of water resources for agricultural, industrial, and domestic purposes often leads to overexploitation and depletion of freshwater sources, resulting in habitat loss and altered hydrological regimes. Additionally, inadequate wastewater treatment and disposal practices contribute to water pollution, degrading water quality and posing serious threats to aquatic biodiversity and ecosystem health (USAID 2021).

Coastal ecosystems in Haiti, including coral reefs, mangroves, and seagrass beds, are particularly vulnerable to the impacts of water use and wastewater management. Increased sedimentation and nutrient runoff from agricultural activities and untreated wastewater discharge can lead to eutrophication, algal blooms, and coral reef degradation. Mangroves, critical for shoreline protection and nursery grounds for numerous marine species, are also affected by changes in water quality and hydrology, impacting the overall resilience of coastal ecosystems (UNDP 2023).

Inland freshwater ecosystems in Haiti, such as rivers, streams, and wetlands, are similarly impacted by water use and wastewater management practices. Excessive water extraction for irrigation and domestic use, combined with pollution from untreated wastewater discharges and agricultural runoff, threatens the ecological integrity of these habitats. Reduced water flow, habitat fragmentation, and contamination negatively affect freshwater biodiversity, including fish populations, amphibians, and aquatic plants, disrupting ecosystem functioning and reducing the ecosystem services they provide.

#### 7.6.1 Terrestrial Ecosystem

In Haiti, terrestrial ecosystems play a critical role in supporting biodiversity, regulating water flow, and protecting watersheds essential for water supply and hydroelectricity generation. Although specific legislation governing protected areas may be limited, efforts are made to manage and conserve terrestrial ecosystems through various policies and regulations. The preservation of watersheds and biodiversity is a primary focus, reflecting the importance of safeguarding these ecosystems for sustainable water management and environmental conservation. Despite the absence of comprehensive land-use legislation, land-use management initiatives are implemented to mitigate soil erosion and maintain ecosystem integrity within protected areas (SWA 2019).

Improper disposal of solid waste and effluent from commercial and industrial activities, combined with suboptimal land management and agricultural practices, pose significant threats to terrestrial ecosystems and watersheds in Haiti. These activities contribute to environmental degradation, impacting water quality and ecosystem health. There is a pressing need for improved data collection and monitoring systems to inform effective watershed management strategies. This includes assessing erosion levels, deforestation rates, and the status of marine and coastal environments to address ongoing environmental challenges and ensure the sustainable

management of terrestrial ecosystems (USAID 2021).

Haiti's vulnerability to natural disasters, particularly hurricanes, further emphasizes the importance of robust watershed management practices. Events such as Hurricane Dean in August 2007 underscore the potential disruptions to the hydrological cycle and the critical need to strengthen resilience measures. Addressing global warming and climate change is paramount, given their potential adverse effects on watersheds, coastal areas, and water supply systems. Implementing strategies to mitigate these impacts and enhance ecosystem resilience is essential for ensuring the sustainability of terrestrial ecosystems and the availability of water resources in Haiti.

### 7.6.2 Aquatic Ecosystem

In Haiti, the state of aquatic ecosystems is influenced by various factors, including agricultural practices and pesticide use. However, the assessment of pesticide impact on water quality remains inconclusive due to the absence of formal monitoring protocols mandated for pesticide and fertilizer testing. Pesticides are commonly used in agricultural activities, particularly in the cultivation of bananas, citrus fruits, coconuts, and other crops. Despite their widespread use, limited formal monitoring has been conducted to assess their impact on water quality.

In January 1990, the Consortium for International Crop Protection (CICP) conducted a limited sampling initiative across selected rivers in Haiti to assess the presence of specific pesticides, including paraquat, glyphosate, carbamates, organochlorides, and organophosphates. Although the results from this sampling did not detect any pesticide residues in the water, concerns were raised by CICP investigators regarding the concentrations of organochlorides in wildlife populations. This indicates potential environmental risks associated with pesticide use in Haiti and highlights the need for further research and monitoring to understand the long-term impacts on aquatic ecosystems (SWA 2019).

The lack of comprehensive monitoring protocols and data on pesticide residues in water bodies underscores the importance of implementing robust monitoring and regulatory measures to protect aquatic ecosystems in Haiti. Effective pesticide management strategies, including the promotion of integrated pest management (IPM) practices and the use of less toxic alternatives, are essential to minimize environmental contamination and safeguard water quality. Additionally, capacity-

building initiatives and public awareness campaigns can play a crucial role in promoting sustainable agricultural practices that mitigate the adverse impacts of pesticides on aquatic ecosystems and human health (UNDP 2023).

### 7.6.3 Agriculture and Food Production Systems

In Haiti, agriculture and food production systems predominantly rely on rainfall for irrigation, with limited existing infrastructure for artificial irrigation. However, there is recognition of the potential benefits associated with implementing irrigation systems to enhance agricultural productivity and food security in the country. Presently, small-scale irrigation systems are utilized by farmers for cultivating various crops, particularly vegetables, utilizing surface water sources.

Plans are underway to expand irrigation coverage in Haiti, with a focus on approximately 1,000 acres of agricultural land. This expansion primarily targets the cultivation of banana and vegetable crops, aiming to increase agricultural output and support food production systems in the country. The proposed irrigation scheme is envisioned to utilize gravity-fed systems or water pumped from rivers and streams to facilitate irrigation activities, as outlined in a report by the United States Caribbean Assessment of Agriculture and Food Production Systems in a 2004.

The implementation of irrigation systems has the potential to transform agricultural practices in Haiti, offering opportunities for increased crop yields, improved water management, and enhanced resilience to climate variability. By utilizing surface water sources and employing sustainable irrigation techniques, such as gravity-fed systems, Haiti can mitigate the impacts of rainfall variability and seasonal droughts on agricultural production. Furthermore, expanding irrigation coverage can contribute to strengthening food security, reducing dependency on rainfall-dependent agriculture, and supporting the livelihoods of farmers across the country (SWA 2019).

### 7.6.4 Human Health and Sanitation

Access to clean drinking water and adequate sanitation services in rural Haiti faces significant challenges, with access rates not only low but also declining over the years. In 2020, only 43% of the rural population had access to basic drinking water supplies, representing a decrease from 48% in 2015 and 50% in 1990. This stands in stark contrast to the Latin America and Caribbean region's average access rate of 90% in 2022, signalling a troubling downward trend (ReliefWeb 2023).

In Haiti, the disposal of solid and industrial wastes in rural areas poses significant challenges to human health and sanitation. Communities such as Marigot, Castle Bruce and La Plaine, among others, experience contamination of streams due to the improper management of waste disposal. The absence of a centralized waste collection system in these rural areas exacerbates the problem, leading to household garbage being frequently discarded into nearby streams. Additionally, industrial facilities operating in these areas, including rum distilleries, auto repair shops, and furniture manufacturers, contribute to pollution by disposing of their waste and by-products directly into the streams adjacent to their operations (SWA 2019).

The contamination of streams resulting from improper waste disposal practices poses serious health risks to local communities in Haiti. Waterborne diseases, such as diarrhea, cholera, and typhoid fever, are prevalent in areas where streams are contaminated with solid and industrial waste. Moreover, the pollution of water sources adversely impacts access to clean and safe drinking water, further exacerbating health concerns among the population. The lack of adequate sanitation infrastructure and waste management systems in rural areas compounds these challenges, highlighting the urgent need for comprehensive interventions to address human health and sanitation issues (UNOSAT 2014).

Furthermore, rural Haiti grapples with sanitation challenges, as evidenced by the persistent practice of open defecation among 31% of the rural population in 2020. Moreover, public toilet facilities and water points often lack accessibility for people with disabilities, compounding the sanitation deficit. This dual challenge, stemming from both demand- and supply-side constraints, poses significant health risks, particularly for children, including susceptibility to diseases and malnutrition (UNDP 2023).

Efforts to improve human health and sanitation in Haiti require multifaceted approaches that address both the causes and consequences of improper waste disposal. This includes the implementation of sustainable waste management practices, such as waste reduction, recycling, and proper disposal methods, to mitigate pollution and protect water sources. Additionally, investments in sanitation infrastructure, including the establishment of centralized waste collection systems and wastewater treatment facilities, are essential to ensure access to safe drinking water and promote public health in rural communities. Collaborative efforts involving government

agencies, local communities, and international partners are crucial to effectively address the human health and sanitation challenges posed by improper waste disposal in Haiti (UNOSAT 2014).

#### 7.6.5 Finance Services

The financial aspect of water resource management in Haiti received a low score of 30 out of 100 across several performance categories for the last reporting period (2020). These include the allocation in the national budget for infrastructure investment, recurring expenses related to integrated water resources management (IWRM), and budgets at the subnational or sub-basin levels for water resource infrastructure projects. Additionally, there is a lack of designated resources or limited funding from dedicated levies for transboundary cooperation. This situation, compounded by the consequences of insufficient wastewater management, has significant implications for Haiti's financial services sector, exacerbating health issues and increasing operational costs for businesses.

#### 7.6.6 Socioeconomic, Security and Livelihood

Haiti grapples with multifaceted challenges across socioeconomic, security, and livelihood domains, stemming from its complex historical, political, and environmental contexts. Socioeconomic hurdles loom large, with over half the population entrenched in poverty, and a significant portion living in extreme deprivation. This economic fragility is exacerbated by reliance on vulnerable agricultural practices, susceptible to natural disasters and climate change impacts. Moreover, political instability and systemic corruption thwart economic progress and infrastructural development, perpetuating the cycle of poverty (UNOSAT 2014).

Security concerns loom as a pervasive issue in Haiti, characterized by rampant crime, gang violence, and widespread instability. Inadequate law enforcement and judicial systems have fostered an environment of lawlessness, where citizens face daily threats from gang-related violence, kidnappings, and intergroup conflicts. The prevalence of armed groups further undermines governance structures, impeding efforts to restore security and stability across the nation.

Livelihood challenges compound Haiti's socioeconomic landscape, particularly in rural areas where access to essential services and economic opportunities remains limited. Agriculture, the

backbone of Haiti's economy, grapples with issues such as land degradation, deforestation, and climate change impacts, compromising agricultural productivity and food security. Additionally, insufficient access to education and vocational training opportunities hampers socioeconomic mobility and perpetuates cycles of poverty and vulnerability (World Bank 2015).

Tackling these multifaceted challenges demands holistic and sustainable interventions that prioritize economic development, social inclusion, and environmental resilience. Efforts to uplift livelihoods must focus on expanding access to education, healthcare, and basic services while promoting sustainable agricultural practices and economic diversification. Strengthening governance institutions and security mechanisms is crucial to restoring stability and fostering an environment conducive to economic growth and social progress in Haiti (Staub 2020).

## **7.7 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK**

In Haiti, the legal, policy, and institutional framework for water resources management is governed by various laws, policies, and governmental structures aimed at ensuring sustainable water governance and addressing the country's water-related challenges. The Haitian Constitution serves as the cornerstone of the legal framework for water management, outlining the principles and framework for water governance. It establishes the ownership of water resources within Haiti, emphasizing the state's responsibility for their management and regulation.

The Water Resources Management Act is the primary legislation governing water management in Haiti. It outlines provisions for the establishment of regulatory bodies and authorities responsible for water supply, sanitation services, and the management of water resources. This act addresses key issues such as water abstraction, pollution control, and the establishment of water quality standards to safeguard public health and environmental integrity. Haiti has also developed a national water policy aimed at promoting sustainable management of water resources for social, economic, and environmental benefits. This policy articulates principles and strategies for water resources management, including conservation, equitable access, and integrated water resources management approaches to address the country's water challenges (World Bank 2015).

The Ministry of Environment and the Ministry of Agriculture, Natural Resources and Rural Development are key governmental institutions responsible for water resource management and

development in Haiti. These ministries oversee the implementation of water policies and regulations, as well as the coordination of efforts with other relevant stakeholders. Additionally, Haiti is a signatory to various international agreements related to water management, including the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). These agreements provide a framework for international cooperation on water-related issues, including climate change adaptation, biodiversity conservation, and sustainable water resource management (UNDP 2023).

### 7.7.1 Regional Setting

In Haiti, the regional setting for supporting Integrated Water Resources Management (IWRM) implementation is influenced by legislative frameworks aimed at regulating water resources, environmental protection, and sustainable development. These frameworks are essential for fostering cooperation, collaboration, and technical assistance to advance inclusive and sustainable development of terrestrial and aquatic resources, as well as regional integration and cooperation within the Caribbean region.

International Multilateral Environmental Agreements (MEAs) and regional economic communities play a crucial role in providing frameworks and platforms for cooperation and collaboration to support Haiti's efforts towards sustainable development. These agencies are mandated to provide technical and policy guidance to their member states, aiming for optimal development of individual nations and harmonization for greater regional integration and collaboration (UNDP 2018).

Haiti has also signed onto or ratified various key Multilateral Environmental Agreements (MEAs), which provide guidance and frameworks for environmental protection and sustainable development (refer to **Table 24**). These include agreements such as the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the Ramsar Convention on Wetlands, among others. Additionally, regional guidance documents produced by regional economic communities offer strategic plans and policies tailored to address specific regional challenges.

**Table 24: MEAs and Regional Guidance Documents**

| Multilateral Environmental Agreements (MEAs)   | Regional Guidance Documents   |
|--|---|
| <ul style="list-style-type: none"> <li>• United Nations Framework Convention on Climate Change (UNFCCC)</li> <li>• Convention on Biological Diversity (CBD)</li> <li>• Ramsar Convention on Wetlands</li> <li>• Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal</li> <li>• Stockholm Convention on Persistent Organic Pollutants (POPs)</li> </ul> | <ul style="list-style-type: none"> <li>• Caribbean Community (CARICOM) Climate Change Policy</li> <li>• Caribbean Regional Fisheries Mechanism (CRFM) Strategic Plan</li> </ul> |

These legislative frameworks and international commitments provide the basis for promoting IWRM principles in Haiti, including the integration of water-related policies, stakeholder participation, and sustainable water resource management. By aligning with international agreements and conventions related to water resources and environmental protection, Haiti can further support the implementation of IWRM approaches to effectively manage its water resources and promote sustainable development.

### 7.7.2 National Setting

In Haiti, the national setting governing the management of water resources is primarily established by various legislative frameworks and policies aimed at regulating, managing, and developing water resources across the country (**Figure 38** and **Table 25**). Additionally, both at a national and subnational level, there are various institutions responsible for water resources across various ministries and committees (**Figure 39**). One of the key legislative instruments in this regard is the Water Resources Management Act, which provides the legal basis for the regulation, management, and development of water resources in Haiti. The Water Resources Management Act outlines provisions for the establishment of regulatory bodies and authorities responsible for water supply, sanitation services, and the management of water resources. It addresses key issues such as water abstraction, pollution control, and the establishment of water quality standards to safeguard public health and environmental integrity (UNDP 2018).

| Name  | Year | Purpose  |
|---|------|--|
| Framework Water Law                                   | 2009 | Defines organizational responsibilities for drinking water provision and established a national water management agency.                 |
| Environmental Management Decree                       | 2006 | Assigns coordination responsibilities to the Ministry of the Environment.  |
| Rural Code  | 1984 | Declares water as property of the state and assigns responsibility for management and construction of water infrastructure to the state. |
| Ministry of the Environment Environmental Action Plan | 1999 | Defined a vision for environmental management, including land use and watershed management plans.  |
| Ministry of Agriculture Watershed Management Policy   | 1999 | Requires collectivities to develop micro-watershed plans that can be integrated into watershed plans in higher levels of government.     |

**Figure 38: Table Illustrating Key Laws, Policies and Plans in Haiti as it relates to water**

In addition to the Water Resources Management Act, Haiti has also developed a National Water Policy aimed at promoting sustainable management of water resources for social, economic, and environmental benefits. This policy articulates principles and strategies for water resources management, including conservation, equitable access, and integrated water resources management approaches to address the country's water challenges. There are also other policies and legislations that guide water resources management components in Haiti (USAID 2021).

Furthermore, Haiti's commitment to international agreements and conventions related to water resources and environmental protection, such as the United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD), further supports the implementation of national policies and frameworks for water resources management.

**Table 25: Legislation and Policy Guidance documents in Haiti**

| Legislation  | Policy/Guidance document   |
|--|--|
| <ul style="list-style-type: none"> <li>• Water Resources Management Act</li> <li>• Environmental Protection Act</li> <li>• National Environmental Policy</li> <li>• Water and Sanitation Sector Policy</li> <li>• Forest Code</li> </ul> | <ul style="list-style-type: none"> <li>• National Water Policy</li> <li>• Integrated Water Resources Management (IWRM)</li> <li>• National Adaptation Plan for Climate Change</li> <li>• National Biodiversity Strategy and Action Plan</li> <li>• Strategic Plan for Environment and Development</li> </ul> |

| Mandate      | Institution  | Roles and Responsibilities  |
|--------------|--|---|
| National     | Ministry of Environment (MDE)  | Responsible for regulating water quality, monitoring and evaluation, setting water policies, overseeing coordination between ministries, water conservation, and enforcement of regulations.  |
|              | Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR) | Manages coordination, studies, construction, and management related to agriculture and irrigation.  |
|              | National Directorate of Drinking Water and Sanitation (DINEPA)             | Housed within the Ministry of Public Works, Transportation, and Communication. Formed by the 2009 Framework Water Law. Responsible for water supply and sanitation services and infrastructure, policy, sector and donor coordination, and regulation.  |
| Sub-national | Regional Office of Drinking Water and Sanitation (OREPA)                   | Regional agencies of DINEPA (four total, one in each region), responsible for implementing the water and sanitation strategy. Provide guidance to URDs, CAEPAs, and CPEs.   |
|              | Rural development units (URDs)   | Supervise and coordinate CAEPAs and CPEs at departmental levels (ten total, one in each department). Focused on water management in rural areas.  |
|              | Drinking Water Supply and Sanitation Committees (CAEPAs)                   | Roughly 650 water user associations with elected members that manage water supply systems in communities with less than 10,000 people.  |
|              | Water Point Committees (CPEs)  | Manage water supply for populations living less than 500 meters from a water distribution point.  |
|              | Communal Water Supply and Sanitation Technician (TEPAC)                    | Operate with two technicians in 133 communes. Support CAEPAs and CPEs activities, monitoring water quality, evaluation and inventory of water infrastructure, technical support for operation and maintenance, water chlorination, and promotion of sanitation and hygiene behavior change. Coordinate activities during emergencies. |

**Figure 39: Table Illustrating Water Resources Management Entities**

These legislative frameworks, policies, and guidance documents play a crucial role in regulating, managing, and developing water resources and watersheds in Haiti, aiming to ensure sustainable use, conservation, and protection of these vital natural resources.

### 7.7.3 Community Level

In Haiti, customary arrangements for water resources management at the community level are influenced by traditional practices, informal agreements, and community-based organizations (CBOs). These arrangements are deeply intertwined with local customs, cultural norms, and historical practices, reflecting the diverse socio-cultural landscape of the country. One common customary arrangement in Haiti is the establishment of Community Water Committees, comprising members of the local community who assume responsibility for managing and maintaining local water sources. These committees oversee tasks such as the maintenance of wells, boreholes, or hand pumps, and coordinate water distribution among households within the community (UNDP 2018).

Traditional water rights also play a significant role in water resources management in various communities across Haiti. These rights are often based on customary laws and practices passed down through generations, governing access to and use of water resources in accordance with traditional norms and values. In rural communities, communal water management practices are prevalent, where community members collectively manage and maintain water sources such as rivers, streams, or ponds. These practices involve cooperation among community members to ensure equitable access to water for various purposes, including drinking, irrigation, and livestock watering.

Moreover, community-based water governance institutions are often established to oversee water management activities at the local level in Haiti. These institutions, such as village councils or water user associations, play a crucial role in decision-making, conflict resolution, and the allocation of water resources within the community (USAID 2021). Furthermore, traditional knowledge and practices are integral to water resources management in Haiti's communities, encompassing techniques for water conservation, watershed protection, and sustainable use of water resources. These practices are deeply rooted in local culture and may involve rituals or ceremonies to ensure the health and abundance of water sources.

Overall, customary arrangements for water resources management at the community level in Haiti reflect the intersection of traditional practices, cultural values, and local governance structures, contributing to sustainable and equitable access to water resources within communities.

## 7.8 CHALLENGES FOR IWRM IN HAITI

Haiti faces significant water management challenges despite its abundant surface and groundwater resources. Urban areas grapple with inadequate sewage systems, limited water purification, and poorly maintained distribution networks. While efforts have been made to establish primary water treatment facilities in cities like Port-au-Prince, Cap-Haïtien, and Les Cayes, access to potable water remains a concern due to substandard services and infrastructure. The erratic distribution of rainfall throughout the year exacerbates water-related issues in Haiti. Heavy rainfall from May to October often leads to flooding in low-lying areas, while prolonged dry spells result in drought conditions, particularly in the northern and western regions. Groundwater serves as a crucial water source, especially in rural and coastal areas, where distinct aquifers in limestone formations provide water for domestic and industrial purposes (USAID 2021).

A growing reliance on groundwater is observed in rural communities, including those in the mountainous regions and coastal plains, although the sustainability and extent of groundwater resources remain uncertain. Water plays a vital role in Haiti's industrial sector, particularly in agriculture, food processing, and manufacturing. However, conflicts arise during the dry season when competing demands for water resources emerge, especially in areas where mining and industrial activities impact potable water sources (USAID 2021).

### 7.8.1 Policy Challenges

Stoa (2017) revealed that Haiti's water law framework suffers from fragmentation, with ministries at the national level having overlapping mandates and minimal coordination. Additionally, the roles assigned to subnational governments are unclear and often unrealistic. A capacity assessment conducted in northern Haiti shows that although local stakeholders are involved, there is a lack of human and financial resources to fulfil their statutory duties. Therefore, it is recommended that water resources management planning involve local governments and community leaders, with additional support from national or international entities to bolster capacity



**Figure 40: Enabling Environment Score for IWRM Implementation**

After the national reporting for SDG 6.5.1 on IWRM in Haiti in 2020, it was found that the country's enabling environment, which includes policies, plans, and legislation supporting IWRM, scored only 27 out of 100. This indicates a poor implementation of IWRM policies, plans, and legislation, with some being implemented, while others remain in draft form.

Additionally, there is low stakeholder engagement in the process (UNEP 2020). It should be noted that between 2017 and 2020, there were no changes in the scoring, thereby showing no progress in this dimension of IWRM.



**Figure 41: Results based on National survey for Enabling environment dimensions**

## 7.8.2 Challenges for Water Security

In Haiti, rural communities face significant challenges in maintaining their water supply systems. According to the Integrated Drinking Water and Sanitation Information System's database, there were 13,626 improved water source facilities recorded in 2022. However, only 51% of these facilities were operational. Similarly, out of the 1,041 piped water supply systems serving densely populated rural areas and small towns, only 41% were functioning that year. This situation arises from years of insufficient funding for the sector, limited community ownership, and infrastructure breakdown due to poor operation and maintenance practices, inadequate post-construction support, and vulnerability to natural disasters and the impacts of climate change (World Bank 2023).

In 2016, Hurricane Matthew struck the southern coast of Hispaniola, causing significant damage to water and sanitation infrastructure in vulnerable communities in Haiti. This Category 5 hurricane emphasized the urgent need for climate risk management (CRM) strategies to protect community water and sanitation systems. USAID, in the midst of planning a water and sanitation project, responded by conducting a climate risk assessment and integrating its findings into the design of what later became the USAID Water and Sanitation Project.

Beyond hurricanes, Haiti faces more frequent and severe rainfall, resulting in floods, landslides, and periods of intensified drought. These extreme weather events pose a threat to the availability and quality of Haiti's surface water and groundwater. Storms and landslides can disrupt water distribution, while damaged and overflowing latrines can contaminate public water sources, increasing the risk of waterborne diseases such as cholera (Quinn 2022).

Save the Children (2021) has raised concerns about escalating health risks for children in Haiti due to persistent water shortages three months after a devastating earthquake. The organization warns of the potential resurgence of cholera in Haiti, which has been making progress toward eliminating the disease.

Following the August 14 earthquake, which claimed approximately 2,248 lives, Haiti has grappled with severe fuel shortages, heightened insecurity, and worsening water scarcity, hindering efforts to restore essential services for those in need.

There are fears of a repeat of events following the 2010 earthquake, which led to a prolonged cholera outbreak affecting 820,000 people and resulting in nearly 10,000 fatalities. Save the Children (2021) expresses concern that diminishing access to clean water could undermine the progress made against cholera in Haiti, which was nearing three years without a reported case as of January 2022.

Urban communities like Port-au-Prince have been severely affected, with disrupted water access due to non-functional pumps caused by fuel shortages. Meanwhile, rural infrastructure in areas such as Sud and Grand'Anse departments continues to suffer from the lingering effects of the 2010 earthquake.

Even before the recent earthquake, many rural communities in these areas relied on rainwater and mountain sources to meet their water needs. Water treatment facilities and delivery programs, often run by non-governmental organizations, have provided clean water to other communities. However, fuel shortages have significantly reduced or halted these vital services.

### 7.8.3 Capacity Constraints

Capacity constraints for Integrated Water Resources Management (IWRM) in Haiti present significant challenges to effective water management. These constraints include limited institutional capacity due to a lack of trained personnel, inadequate funding, and weak organizational structures within government agencies (UNDP 2023). Fragmented governance and coordination further hinder decision-making and implementation of water management initiatives, while a shortage of technical expertise in fields such as hydrology and engineering limits the country's ability to assess water resources and develop sustainable management practices. Financial constraints, weak legal frameworks, and socioeconomic factors such as poverty and population growth exacerbate the situation, leading to limited access to clean water and sanitation services, particularly for vulnerable communities. Addressing these challenges requires comprehensive efforts to strengthen institutional capacity, improve governance mechanisms, enhance technical expertise, secure adequate funding, and develop robust legal frameworks for water management in Haiti.

Projects from various organizations often operate independently, neglecting their interrelated

impacts or the broader resilience needs of the country. Additionally, there is limited coordination among donors and between government ministries during project execution. Local authorities and stakeholders responsible for managing climate change impacts lack the necessary training and resources to integrate climate considerations into decision-making processes or to implement climate-resilient water management strategies. This deficiency is evident in the absence of administrative structures at the catchment and sub-catchment levels, hindering participatory, equitable decision-making on water and land use. Consequently, households often prioritize individual gains over the collective benefits of catchment-wide initiatives (UNDP 2023).

Additionally, despite efforts to improve water infrastructure, a concerning disparity exists between the number of recorded improved water sources and their functionality. Out of the 13,626 improved water source facilities documented in 2022, only 51% were operational. Moreover, among the 1,041 piped water supply systems catering to dense rural areas and small towns, merely 41% were functional during the same period. This underperformance can be attributed to chronic underfunding of the water sector, low community engagement, and the deteriorating condition of infrastructure due to inadequate operation and maintenance practices, insufficient post-construction support, and vulnerability to natural hazards and climate change impacts.

#### 7.8.4 Data Availability and Use

In Haiti, the absence of comprehensive and accessible data presents a significant barrier to the successful implementation of Integrated Water Resources Management (IWRM). Despite the critical importance of water resources in the country, data on water availability, quality, usage, and management practices are often fragmented, outdated, or inaccessible. This lack of reliable data hampers evidence-based decision-making, making it challenging to address pressing water-related issues such as scarcity, contamination, and unsustainable use. Furthermore, the underutilization of existing data exacerbates the problem, as valuable information remains untapped for informing policy, planning, and investment decisions in water management. To overcome these challenges, concerted efforts are needed to improve data collection, management, sharing, and analysis capacities within Haiti. Enhancing data infrastructure and promoting data-driven decision-making are essential steps towards effectively managing Haiti's water resources for long-term sustainability and resilience. The quality and availability of hydrologic data are low, which

constrains the ability to effectively plan and manage Haiti's water resources (USAID 2014). Additionally, there were significantly fewer data points available for the management of water systems and financial aspects such as grants (USAID 2022).

## **7.9 SYNERGIES BETWEEN STATES, GAPS AND AREAS TO BE HARMONISED**

In Haiti, as in many other nations, the pursuit of sustainable development and effective governance requires synergies between various states, institutions, and stakeholders. However, amidst the diverse array of actors and policies, significant gaps persist, hindering progress towards harmonized approaches to key issues. These gaps encompass areas such as water resource management, environmental conservation, and socioeconomic development, where fragmented policies, inadequate infrastructure, and limited institutional capacity impede collective action and exacerbate existing challenges. Addressing these gaps necessitates concerted efforts to foster collaboration, enhance coordination mechanisms, and promote coherence across sectors and levels of governance. By identifying and bridging these divides, Haiti can unlock synergies, capitalize on shared opportunities, and chart a more sustainable and inclusive path towards development and resilience.

### **7.9.1 Recommended Roles and Responsibilities of Key Stakeholders in Improving Integrated Water Resource Management in Haiti**

In improving Integrated Water Resource Management (IWRM) in Haiti, key stakeholders play pivotal roles, each contributing unique expertise and resources to address the country's water challenges. The government of Haiti holds primary responsibility for creating and enforcing policies and regulations conducive to sustainable water management. This includes establishing clear frameworks for water governance, allocating resources for infrastructure development and maintenance, and ensuring compliance with environmental standards. Additionally, the government can facilitate coordination among various ministries and agencies involved in water management to foster a cohesive approach.

Non-governmental organizations (NGOs) and civil society groups also play crucial roles in advancing IWRM in Haiti. These organizations often have deep community ties and grassroots networks, enabling them to engage directly with local populations to promote water conservation,

hygiene education, and participatory decision-making processes. NGOs can provide technical expertise, capacity-building support, and advocacy efforts to complement government initiatives and bridge gaps in service delivery. By empowering communities and fostering collaboration among stakeholders, NGOs contribute to the sustainability and inclusivity of water management efforts. This can allow for significant improvements in the Institution and partnership dimension of SDG 6.5.1.

International donors and development partners constitute another key stakeholder group in Haiti's IWRM landscape. Through funding support, technical assistance, and knowledge exchange, these entities bolster the country's capacity to address water-related challenges effectively. By aligning their investments with national priorities and leveraging their global networks, donors and partners can amplify the impact of local initiatives and promote innovation in water management practices. Moreover, they can facilitate partnerships between Haitian institutions and international experts, fostering mutual learning and best practice dissemination. By harnessing the collective expertise and resources of diverse stakeholders, Haiti can chart a sustainable path forward for IWRM, ensuring equitable access to clean water resources for all its citizens.

In addition to their respective roles, key stakeholders in Haiti must collectively address the critical issue of the lack of comprehensive data for effective water resource management. The government, in collaboration with international partners, should prioritize initiatives aimed at improving data collection, analysis, and dissemination. This includes investing in hydrological monitoring networks, enhancing water quality testing capabilities, and developing robust data management systems. NGOs and civil society organizations can support these efforts by conducting community-based surveys, participatory mapping exercises, and knowledge-sharing initiatives to gather localized data and empower communities to actively engage in water management decision-making processes. International donors and development partners can provide technical assistance and financial resources to strengthen Haiti's data infrastructure, promote data-driven decision-making, and facilitate knowledge exchange with other countries facing similar challenges. By addressing the lack of data in a collaborative manner, stakeholders can lay the foundation for evidence-based policies and interventions that effectively safeguard Haiti's water resources for future generations.

### 7.9.2 Best Practices and Opportunities for Replication and Scaling-Up

In Haiti, several best practices, and opportunities for replication and scaling-up in Integrated Water Resources Management (IWRM) exist, offering promising avenues for sustainable water management. One notable example is the establishment of community-based water management initiatives, where local stakeholders collaborate to address water-related challenges at the grassroots level.

This draws on initiatives already being conducted like A Community-led Pathway to Sustainably Managing Water Supplies in Rural Haiti. Over the past 15 years, Haiti Outreach, a small NGO operating from a single office, has achieved remarkable success in developing a network of hundreds of communities with sustainably managed rural water supplies. With approximately 90 percent of these water supplies consistently functional, the organization's efforts have significantly improved access to clean water in rural areas. This stands in stark contrast to the overall trend in Haiti, where access to rural water supplies has historically been the lowest in the Western Hemisphere and continues to decline. In fact, according to the World Bank's analysis, Haiti ranks last among the 15 countries studied in terms of rural water supply sustainability. The success of Haiti Outreach's model, which prioritizes disciplined structure and patient commitment to ensuring that infrastructure development aligns with community needs, underscores its potential for replication and expansion. With over 500 current community partners, there is ample opportunity to extend this effective approach to new locations and encourage other rural water supply service providers to adopt similar strategies, thus addressing the persistent challenges faced by Haiti in this vital sector (WASH Agenda for Change 2021).

These initiatives promote community ownership, foster participatory decision-making, and enhance the resilience of water systems to climate variability and change. Additionally, innovative approaches to water infrastructure development, such as increasing rainwater harvesting systems (GWP 2019) and the creation of decentralized wastewater treatment plants, demonstrate the potential for scalable solutions that can be tailored to the specific needs of diverse communities across Haiti.

Furthermore, leveraging traditional knowledge and practices in water management, particularly within indigenous communities, presents opportunities for incorporating culturally appropriate and

environmentally sustainable strategies into broader IWRM frameworks. By embracing these best practices and opportunities, Haiti can strengthen its capacity for integrated and inclusive water management, ensuring equitable access to clean water resources and enhancing the resilience of vulnerable populations in the face of evolving water challenges.

## **7.10 CONCLUSION**

In conclusion, Haiti's journey towards sustainable water management is multifaceted, requiring coordinated efforts across various sectors and stakeholders. Despite abundant water resources, persistent challenges such as inadequate infrastructure, pollution, and climate change threaten water security and public health. Addressing these challenges necessitates a holistic approach that prioritizes community engagement, infrastructure development, and policy reform. By leveraging innovative solutions, enhancing data-driven decision-making, and fostering partnerships, Haiti can pave the way for a more resilient and equitable water future. As the nation navigates its path towards sustainable development, ensuring access to clean water and sanitation for all remains paramount, reflecting Haiti's commitment to safeguarding its most precious resource for generations to come.

## 8.1 OVERVIEW

The island of Montserrat, nestled in the Lesser Antilles chain as a British Overseas Territory, presents a unique blend of physical geography and socioeconomic challenges. Its volcanic landscape, shaped by the Soufrière Hills eruptions since 1995, has transformed the island's topography significantly. This report describes Montserrat's physical geography and climate, in the aftermath of volcanic activity. Simultaneously, it examines the country's socioeconomic status, exploring the impact of the eruptions on the population, agriculture, and the economy.

The island's tropical climate, influenced by consistent northeast trade winds, brings warm temperatures, distinct wet and dry seasons, and occasional threats from tropical storms or hurricanes. Montserrat's economic trajectory, on the other hand, has been profoundly shaped by volcanic events in the mid-1990s, leading to population displacement, economic disruptions, and challenges in the agriculture sector.

As the report unfolds, it transitions into an in-depth analysis of water resources management in Montserrat. Focusing on the source, distribution, and usage of water, it highlights the island's dependence on springs and groundwater aquifers. The discussion extends to water supply-demand dynamics, quality testing, and the linkages between Integrated Water Resources Management (IWRM) and the environment, agriculture, human health, and financial services.

Moreover, the report explores the legal, policy, and institutional framework surrounding water resource management, both at regional and national levels. The challenges faced in IWRM, such as infrastructure issues, training deficiencies, outdated policies, and the potential impacts of climate change, are scrutinized in detail.

## 8.2 PHYSICAL GEOGRAPHY AND SOCIOECONOMIC CONTEXT

### 8.2.1 Physical Geography

Montserrat is a British Overseas Territory of the Leeward Islands in the Lesser Antilles chain. Montserrat is located 300 miles (480 km) east-southeast of Puerto Rico and 30 miles (48 km) southwest of Antigua with latitude 16°45' north and longitude 62°12' west. Its total land area is 39

square miles (102 km<sup>2</sup>) and is gradually increasing due to the buildup of volcanic deposits on the southeast coast. Figure 39 shows the general topography of Montserrat highlighting the influence of volcanic activity in the south.

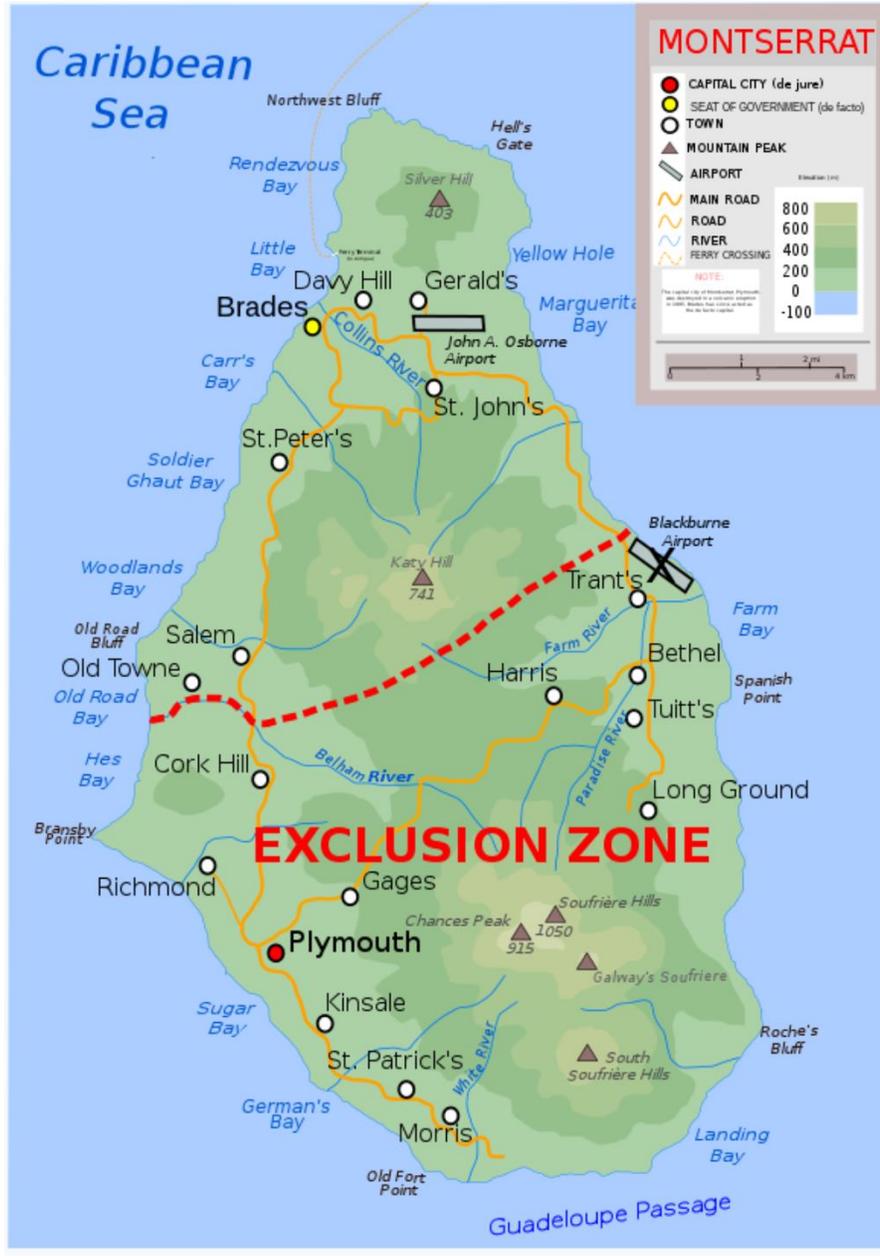


Figure 41: Topographic map of Montserrat

Montserrat’s volcanic landscape is molded by three mountainous areas; the Silver Hills, the Centre Hills and the Soufrière Hills, listed in descending order from North to South. The higher elevations

of these mountainous slopes are forested, and secondary scrub exists on their lower contours. They are cut by narrow valleys and gorges known locally as ghauts.

The modern era of volcanic activity in Montserrat began with the eruption of the Soufrière Hills volcano. The first significant volcanic eruption took place in July 1995. Prior to this eruption, Chances Peak was the highest point on the island at 3000 feet (915 meters). The series of eruptions changed the landscape of the island, making two-thirds of the land an exclusion zone and altered the physics of the volcanic domes in the Soufrière Hills. Now, the lava dome that currently forms the summit of the Soufrière Hills volcano is the highest point on the island at 1089 m above sea level. In December 1997, approximately 2.7 square miles (7 square km) of agricultural land, forests and villages were flattened by the pyroclastic flow and debris after the eruption. Although Montserrat's most-lush vegetation in the southern highlands was destroyed in the eruptions, the Centre Hills remained largely unaffected.

Montserrat's coastal topographical diversity is heavily influenced by the volcanic activity of the Soufrière Hills. The beaches are composed of mainly grey or brown sand deposits. The single white-sand beach, Rendezvous Bay, is in the north. The erosion and deposition have also shaped the coastal landforms, with distinct variations in elevation and the formation of coves and inlets. Coral reefs, situated in the surrounding waters, contribute to the coastal ecosystem's biodiversity.

Montserrat experiences a tropical climate characterized by warm temperatures, high humidity, and distinct wet and dry seasons. The island's climate is influenced by its location, which is subject to consistent northeast trade winds. The average annual temperature ranges from lows of 21°C to 24°C (70°F to 76°F) and highs of 27°C to 30°C (80°F to 86°F). The wet season typically spans from June to November, coinciding with the Atlantic hurricane season. During this period, Montserrat may experience heavy rainfall and an increased risk of tropical storms or hurricanes. Hurricane Hugo in 1989 was particularly devastating. Annual precipitation averages about 57 inches (1,448 mm). The period from December to May is considered the dry season.

The island's elevation and topography contribute to microclimates, with variations in temperature and precipitation at different elevations. The coastal areas may feature slightly higher humidity

levels, while the interior, including the elevated volcanic peaks, may experience cooler temperatures.

### 8.2.2 Socioeconomic Context

The economic trajectory of Montserrat has been significantly impacted by the series of devastating volcanic events in the mid-1990s. These led to the closure of both the airport and seaports, resulting in extensive economic and social disruptions. Subsequently, a substantial portion of the population, approximately two-thirds of the 12,000 inhabitants, evacuated the island. While a gradual return began in 1998, the availability of housing remained a limiting factor. The agriculture sector sustained ongoing challenges, grappling with the scarcity of arable land and the devastation of crops.

Despite recovery efforts, half of the island remains uninhabitable. In January 2013, the European Union (EU) offered \$55.2 million to Montserrat to catalyse economic recovery. The aid package focused on bolstering public finance management, facilitating public sector reform, and promoting economic management.

In 2020, Montserrat's GDP was negative EC\$5.30 million with a growth rate of -3.21%. In 2022, the GDP growth rate was reported to be 2.52%. In this same year, the percentage contribution to GDP from agriculture and manufacturing had a distribution of 1.1% and 4.3% respectively, with public administration, defence and compulsory social security contributing the largest percentage (56.8%). The Government of Montserrat employs 40% of the total labour force and the unemployment rate was 6.5% in 2018.

Montserrat's population declined by 50.6% between 1990 and 2015, to 4,433 in 2022 as refugees fled the island following the volcanic activity in the 1990s. A census conducted in 2017 established that most of the population is of African descent (88.4%) followed by those of mixed ethnicity (3.7%) and Hispanics (3%) with Caucasians, East Indians and other groups making up the remainder.

Montserrat's energy sector is fully supported by imported fossil fuels; however, the government has shown interest in exploring geothermal energy. Their utility rates start at US\$ 0.53 per kWh which is above the regional average.

### 8.3 STATUS OF WATER RESOURCES IN MONTSERRAT

#### 8.3.1 Source and distribution

Given the highly permeable surface geology on volcanic islands like Montserrat, the water supply is largely dependent on the utilization of springs and groundwater aquifers. Montserrat has a large supply of natural spring water, which finds extensive applications across the island, spanning various purposes from household to business use.

The country is host to numerous watersheds. Water channels into ghauts, rivers, and streams that all flow into the sea around the coastline. The water pathways are wider in the northern regions, and have gentle slopes. As one moves southward, these watercourses become deeper, originating from more rugged peaks. The water supply is exclusively sourced from a network of springs located in the Centre Hills, generally replenished by rainfall. **Figure 42** shows that even during the driest year, over a 90-year period, the annual rainfall in Montserrat was 972 mm. Additionally, the records indicate that rainfall is concentrated and tends to occur within a relatively short period, frequently during rainstorms.

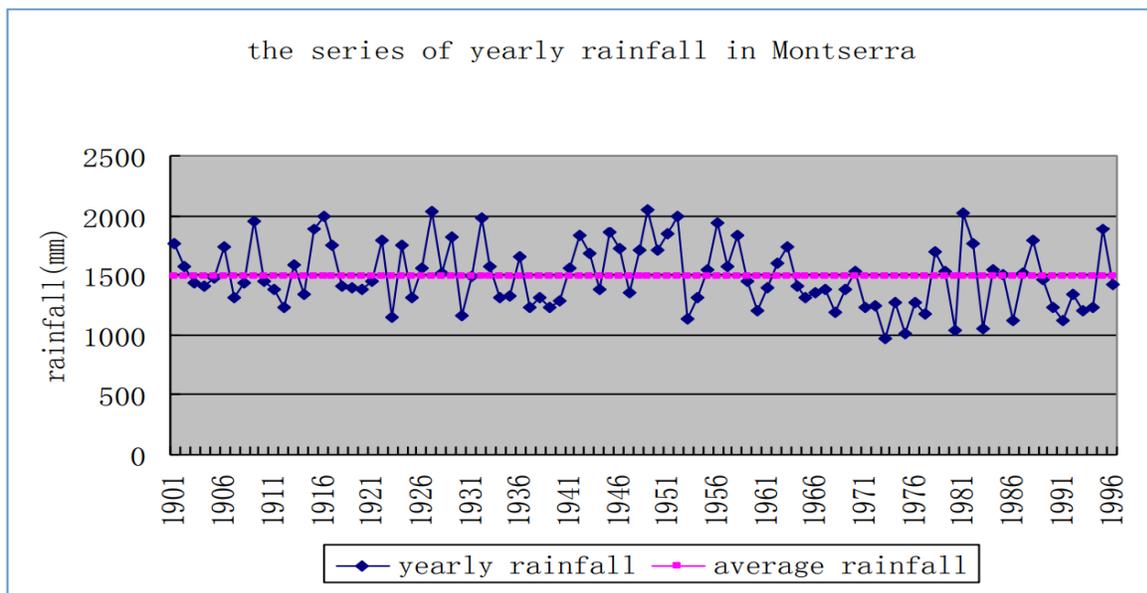
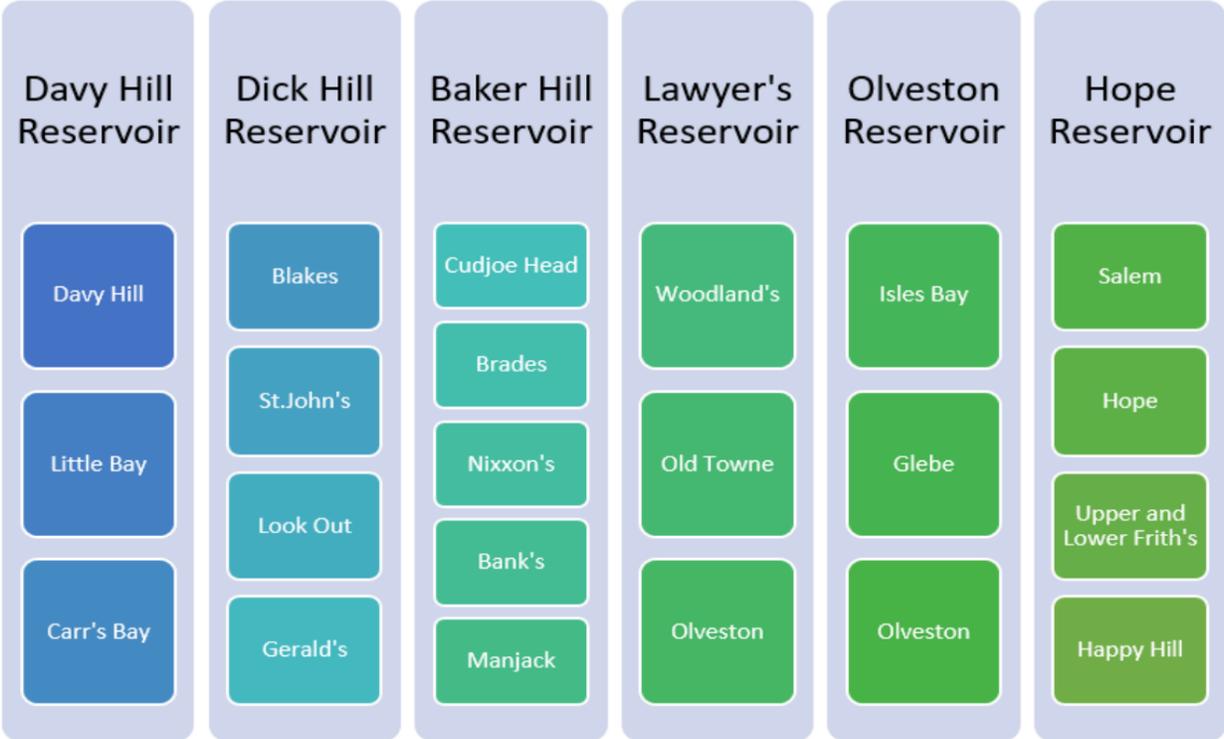


Figure 42: Rainfall series data for Montserrat (at Grove)

As of 2021, there are 6 springs named Killiecrankie, Hope, Olveston, Quashie, Lawyers, and Forgathy springs and 1 well that supply water to 4096 connections in the piped water system around the island. The water is gravity-fed through a network to tanks located around the country where it is disinfected with chlorine. It is important to note that since all the reserves are interconnected, particular reservoirs are not confined to serving specific areas. Montserrat currently possesses 11 reservoirs which have a total capacity of 1,665,000 gallons of water. **Figure 43** highlights the areas that are supplied by various reservoirs while **Figure 44** lists the capacity in gallons of the reservoirs.



**Figure 43: Categorization of water distribution system**

| RESERVOIRS      | CAPACITY |
|-----------------|----------|
| Baker Hill      | 480,000  |
| Davy Hill       | 20,000   |
| Lower Dick Hill | 100,000  |
| Upper Dick Hill | 40,000   |
| Friths          | 60,000   |
| Hope 1          | 135,000  |
| Hope 2          | 400,000  |
| Lawyers 2       | 150,000  |
| Mars Hill       | 40,000   |
| Oveston         | 60,000   |
| St. Peters      | 180,000  |

Figure 44: Volume of water in various reservoirs (expressed in gallons)

A total volume of 182,526,270 gallons of water was generated for 2020 the highest amount in March (16,483,280 gal) and the lowest in February (14,224,930 gal). The majority of water is provided from the Killiecrackie spring (Figure 45). It is important to note that Montserrat has no lakes and there are no rivers that have a continuous supply of water throughout the year

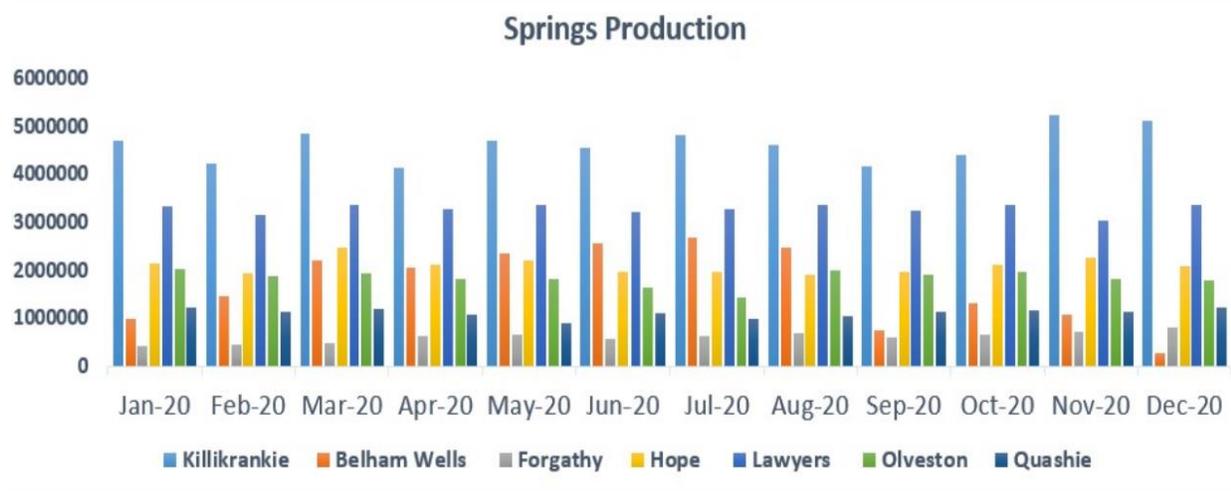
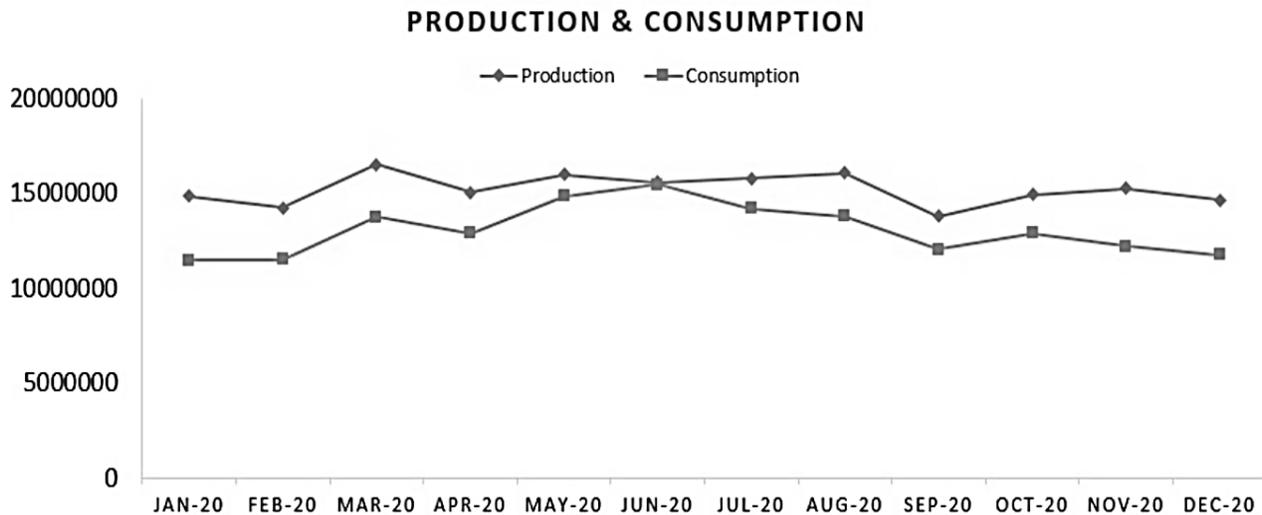


Figure 45: Bar graph illustrating water production from springs and well in Montserrat over 2020

## 8.4 WATER SUPPLY, DEMAND AND USAGE

maps both the water production from springs and the consumption of treated water by consumers in 2020. This data was recorded by pump operators. It can be noted that more water is generated than is consumed by the public. Approximately 435,000 gallons of water are consumed in Montserrat per day and the demand for water almost matches the supply in June but there was an excess of 118,960 gallons of water. Consumption was greater for the period May – July, likely associated with increased residential use.



**Figure 46: Graph comparing water production and consumption volume in Montserrat in 2020**

Montserrat’s water quality is tested by a third party at CARPHA’s Environmental Laboratory, in St. Lucia, where they test the for bacteria and chemicals.

## 8.5 LINKAGES BETWEEN IWRM AND WATER (QUALITY AND QUANTITY)

### 8.5.1 History of IWRM in Montserrat

The government of Montserrat issued the Utilities Act in 2007 that merged both the water (MWA) and electricity (MONLEC) utility services. Montserrat Utilities Limited (MUL) having received all assets is responsible for both the water and electrical services. With regards to water services, they are in charge of delivering water to the nation, the wastewater system and water resource

management in the country. The Environment Department, however, has overall responsible for environmental issues.

## 8.5.2 Impact of water use and wastewater management on ecosystems and social systems

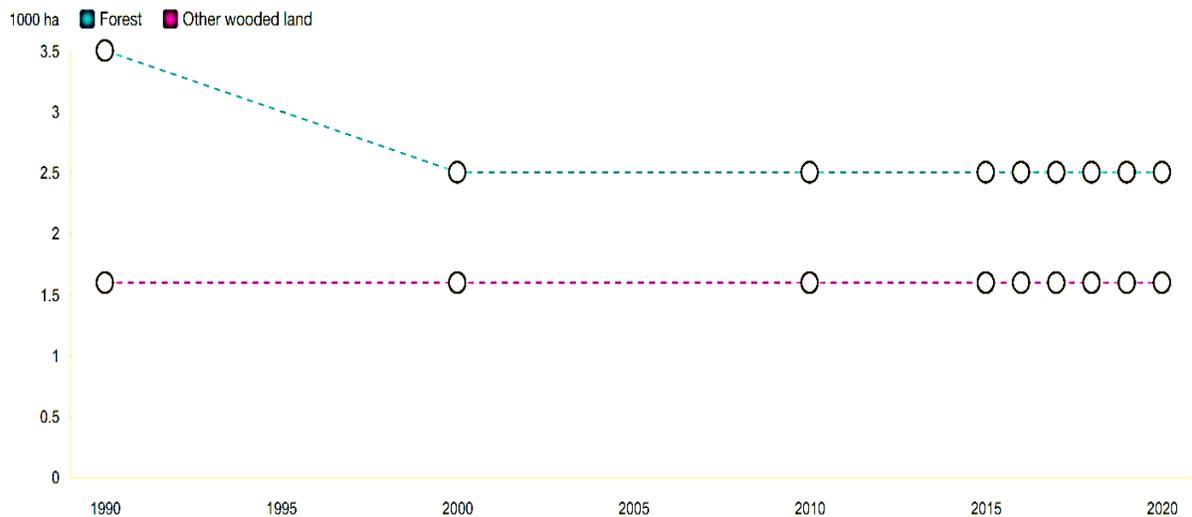
### 8.5.2.1 Terrestrial ecosystem

Data from 2020 shows that forest cover was approximately 25% with a further 35% compromised of thickets and scrub. The data in **Figure 47** expands on the areas utilised by various land features.

|                   | Habitat                            | Extent (ha)   | Percentage  |
|-------------------|------------------------------------|---------------|-------------|
| Super Class       | Class                              |               |             |
| Ash / mud         | Ash / mud                          | 2,148         | 21%         |
| Bare ground       | Bare ground                        | 436           | 4%          |
| Beach             | Beach                              | 249           | 2%          |
| Developed Land    | Buildings                          | 48            | 0%          |
| Cultivated area   | Cultivated area                    | 31            | 0%          |
| Cultivated area   | Disturbed ground / Cultivated area | 302           | 3%          |
| Dry forest        | Dry forest                         | 1,220         | 12%         |
| Dry scrub         | Dry scrub                          | 1,995         | 19%         |
| Dry scrub         | Dry thicket                        | 1,973         | 19%         |
| Wet woodland      | Elfin woodland                     | 122           | 1%          |
| Wet woodland      | Mesic forest                       | 1,077         | 10%         |
| (marine)          | Open water                         |               |             |
| Rivers and ghauts | Rivers and ghauts                  | 101           | 1%          |
| Developed Land    | Roads                              | 46            | 0%          |
| Developed Land    | Urban                              | 295           | 3%          |
| Wet woodland      | Wet forest                         | 334           | 3%          |
|                   | <b>Total</b>                       | <b>10,376</b> | <b>100%</b> |

**Figure 47: Table Illustrating the Extent of Terrestrial Areas in Montserrat in 2020**

**Figure 48** shows an estimation of forest area loss over a few years. There is a lack of information with respect to forest area data for Montserrat after 1982. Thus, data from 1982 is used for 1990 and data between 2000-2010 is estimated based on area loss from volcanic activity. (The Ecosystem Assessment of Monserrat has confirmed data from 2010-2020.)



**Figure 48: Graph showing the area variation for forested and wooded land over 30 years [15]**

Montserrat is considered a biodiversity hotspot and has 3 important bird areas and 2 proposed Ramsar sites, supporting 4 plant, 1 reptile, 1 amphibian, 4 bats, 4 turtles and 2 bird species of global conservation concern, several of which are endemic species.

When considering water resource management in Montserrat, it is important to note that excessive water extraction may lead to habitat degradation, affecting plant and animal species dependent on specific moisture levels. In contrast, inadequate wastewater management poses a threat to soil and water quality, potentially contaminating terrestrial ecosystems. Montserrat's ecosystems, including forests and diverse plant life, are vulnerable to disruptions caused by imbalances in water use and improper wastewater disposal.

#### 8.5.2.2 Aquatic ecosystem

Montserrat's marine ecosystem mostly consists of various reefs, mangroves and sedimentation along its coast. These reefs are important for fishing and to protect the island's beaches. Commonly found mangrove species include *Rhizophora mangle*, *Avicennia germinans*, *Laguncularia racemosa*, and *Conocarpus erectus* but this ecosystem is not significantly developed due to the coastal morphology. **Figure 49** illustrates the marine ecosystem structures present on Montserrat's borders and their land areas.

|  |                             |               |             |
|--|-----------------------------|---------------|-------------|
|  | Algal Reef (Hard Bottom)    | 4,149         | 32%         |
|  | Algal Reef (Mixed Bottom)   | 1,043         | 8%          |
|  | Artificial Reef             | 14            | 0%          |
|  | Colonized Volcanic Boulders | 350           | 3%          |
|  | Coral Reef                  | 875           | 7%          |
|  | Hard Bottom and Sand        | 1,339         | 10%         |
|  | Sand                        | 4,600         | 36%         |
|  | Sargassum Forest            | 1             | 0%          |
|  | Seagrass                    | 449           | 3%          |
|  | <b>Total</b>                | <b>12,821</b> | <b>100%</b> |

**Figure 49: Extent of marine areas in Montserrat in 2020**

Inadequate wastewater treatment and runoff containing pollutants can pose a threat to the health of coral reefs by introducing harmful substances such as nutrients and sediments. Excessive nutrients can lead to algal blooms, negatively affecting coral growth and vitality while sedimentation can smother coral polyps and hinder the photosynthetic capabilities of symbiotic algae. Montserrat's reefs are vital for marine biodiversity (which also impacts the fishing sector) and coastal protection. Thus, sustainable water use and comprehensive wastewater management are needed to mitigate adverse impacts and preserve these crucial ecosystems.

The Department of Environmental Health in Montserrat highlighted that land-based pollutants (that enter the bay from ghauts) and beach pollution are the two major issues. The Organization of Eastern Caribbean States (OECS) introduced the Reduction of Marine Litter (ReMLit) programme in 2019 which aimed to resolve these environmental issues.

#### 8.5.2.3 Agriculture and Food Production Systems

Efficient water use is critical for supporting agriculture, but improper management, including over-extraction or inadequate irrigation, can lead to soil degradation and reduced crop yields.

Additionally, the quality of water for irrigation and efficient irrigation systems are crucial, and poor wastewater management may introduce contaminants that can harm both soil fertility and crop health. These challenges are compounded by the limited arable land available in Montserrat. Livestock also require good quality water.

In the past, Montserrat played a significant role in sugar and tobacco production. However, the eruptions of the Soufrière Hills volcano between 1995 and 1997 caused extensive damage to a substantial portion of fertile land on the island. Following the eruptions, the relocated population settled in the northern part of Montserrat which has less favourable conditions such as poorly developed soils and limited rainfall, bringing agricultural challenges. Currently, Montserrat has 20 km<sup>2</sup> of cultivated land, constituting 20% of the country's total territory.

With the minor role agriculture plays in Montserrat's economy, the government is dedicated to revitalizing the agricultural sector through investments in new technology. The goal is to make the island more self-sustainable and reduce dependence on food imports. For example, CARDI plans to provide climate smart technology to Montserrat to increase resilience to extreme weather phenomena. Increasing water use efficiency and decreasing the impact of hydroclimatic hazards are important sectoral goals.

#### 8.5.2.4 Human Health and Sanitation

Adequate access to clean and safe water is vital for maintaining public health and preventing waterborne diseases. Inadequate wastewater management poses a risk by contaminating water sources with pollutants. MUL in Montserrat treats approximately 60,000 gallons of sewage every day. The wastewater goes through their sewer system to a water treatment plant (in Davy Hill and Lookout). Here the water is cleaned and filtered to remove impurities and it is returned to a larger body of water where it re-enters the water cycle. Wastewater and water quality data is not readily available to verify the status of water and wastewater resources across the island.

#### 8.5.2.5 Finance Services

Every year, approximately US\$ 2.3 million is allocated to the water distribution system to facilitate the implementation of IWRM. However, this budget cannot cover all IWRM elements. Furthermore, the revenues generated from water usage are integrated into the government's

consolidated fund (i.e. funds are not provided under the Constitution (1983) or the Finance Administration Act (2007)). Consequently, there is a need to develop additional funding and budgets to adequately incorporate the implementation of various IWRM elements. However, after COVID-19, the government launched a programme which helped cover some of the residents' water and electricity bills called the "utility support programme". In 2021 the Global Water Partnership-Caribbean (GWP-C) granted MUL funding to implement a small-scale IWRM project on the island. MUL's project focused on ensuring a consistent power supply and improved energy efficiency at particular water pump stations in Montserrat. This was achieved through the implementation of automatic transfer switches (ATS) at a few stations. As all pump stations were electronically powered, the ATS maintained the required water level in tanks to supply communities.

## **8.6 LEGAL, POLICY AND INSTTUTIONAL FRAMEWORK**

Some of the existing legislation and policies surrounding water resources management in Montserrat are discussed in the following sections.

### **8.6.1 Regional and International Setting**

Montserrat is a member state of OECS and the Caribbean Community (CARICOM). These agencies offer both technical and policy guidance to their member states, ensuring optimal development at the national level and promoting regional integration and collaboration.

Listed below are some related guidance documents from the regional economic bodies:

- Organisation of Eastern Caribbean States (OECS) Biodiversity and Ecosystems Management Framework 2020-2035
- OECS Regional Green-Blue Economy Strategy and Action Plan (Draft)
- St. Georges' Declaration of Principles for Environmental Sustainability in the OECS
- Revised OECS Regional Plan of Action for Agriculture 2012 – 2022
- Eastern Caribbean Regional Climate Change Implementation Plan - Final Report

- OECS Climate Change Adaptation Strategy and Action Plan
- Eastern Caribbean Regional Climate Change Implementation Plan
- OECS Model Water Policy

Even though Montserrat is a UK Overseas Territory (OT), it is the responsibility of the UK government to determine whether they would like to extend treaties and conventions to their OT's. Thus, multilateral environmental agreements that are ratified or accessed by the UK do not automatically hold for Montserrat. The country, however, is part of the Overseas Territory Environment Programme (OTEP) which boosts and supports the implementation of environmental management and the Environmental Charters of UK OTs.

## 8.6.1 National Setting

### 8.6.1.1 Legal and Policy Framework

The regulatory structure overseeing water resource management in Montserrat consists of various legislation and policy documents. Multiple authorities are involved in water resource management.

Listed below are some key laws related to water resource management for Montserrat [26]:

- The Montserrat Utilities Limited Act (revised in 2013)
- The Licensing of Utility Services Act and Subsidiary Legislation (revised in 2011)
- Underground Water Act (revised in 2013)
- Montserrat National Trust Act (revised in 2013)
- Forestry, Wildlife, National Parks and Protected Areas Act (revised in 2008)
- Beach Protection Act (revised in 2013)
- Public Health Act (revised in 2019)
- Agriculture Act (revised in 2019)
- Physical Planning Act (revised in 2019)
- Agricultural Small Holdings Act (revised in 2019)
- Montserrat Land Development Authority Act (revised in 2013)
- Fisheries Act (revised in 2013)
- Conservation and Environmental Management Act (revised in 2019)

Listed below are some key laws related to water resource management for Montserrat [27]:

- Agricultural Development Strategy & Marketing Plan 2016-2021
- Food Safety Policy – Montserrat
- Montserrat Economic Growth Strategy and Development Plan 2018-2022
- Montserrat Energy Policy, 2008 -2027
- National Climate Change Action Plan for Montserrat
- Physical Development Plan
- Physical Development Plan for North Montserrat 2012-2022
- The Food and Nutrition Security Policy and Plan of Action for Montserrat 2013
- The Montserrat Energy Policy 2016 - 2030
- The Power to Change: The Montserrat Energy Policy 2016-2030
- Montserrat Sustainable Development Plan 2008 to 2020: Journey to Sustainable Prosperity

#### 8.6.1.2 Institutional Framework

**Table 26** describes some key responsibilities regarding water resource management for sectors in Montserrat.

**Table 26: Agencies and Ministries involved with water resource management**

| Agency                                     | Responsibility   |
|--|--|
| Montserrat Utilities Limited               | <ul style="list-style-type: none"> <li>• Provide an adequate water supply.</li> <li>• Invest in infrastructure to provide quality water services.</li> <li>• Take away wastewater safely.</li> <li>• Maintain sewage system.</li> <li>• Treat wastewater</li> </ul>  |
| Department of Agriculture                  | <ul style="list-style-type: none"> <li>• Responsible for irrigation supplies.</li> <li>• Responsible for developing agricultural systems like crop, livestock, aquaculture and fisheries using traditional and new techniques and technologies to promote food security, sustainable livelihood and foreign exchange.</li> </ul> |
| Physical Planning and Development Services | <ul style="list-style-type: none"> <li>• Responsible for regulating development of land and buildings on the island, considering the social, economic, environmental, physical and ecological factors.</li> </ul>  |

|                             |   |
|-----------------------------|---|
| Department of Environment   | <ul style="list-style-type: none"> <li>Responsible for climate change mitigation, biodiversity conservation and maintaining MEA's.</li> </ul> |
| Lands and Survey Department | <ul style="list-style-type: none"> <li>Manages land records and provides both land registry and survey services.</li> </ul>                   |

**8.7 CHALLENGES FOR IWRM**

- The absence of insurance for fixed assets poses a risk to MUL and the economy in the event of natural disasters. Financial setbacks can hinder the plant's ability to recover quickly and resume operations if an event happens, potentially leading to prolonged disruptions in the supply of clean water.
- While utility deliveries in Montserrat are currently sufficient, the infrastructure is old. The existing infrastructure faces increasing risks and inefficiencies. A considerable portion of the water pipes are aged, with repairs and replacements occurring reactively instead of through regular upgrades. Addressing these infrastructure challenges is crucial for ensuring reliable utility services.
- Insufficient water-storage is a concern for MUL, with water tanks spread across the island exhibiting varying levels of adequacy. Also, Montserrat's water-storage falls below the standard 3-day levels. Reports highlight satisfactory storage for Salem and St. Peters, but notably low storage for Lookout and St. Johns. Despite some districts experiencing growth in residents and businesses, there has been a lack of corresponding investments in additional water-storage, as indicated by the Government of Montserrat's 2012 report. This situation has led to instances of water-rationing, impacting sanitation, hindering business development and customer satisfaction, and posing potential risks to public health. Addressing these storage challenges is crucial for ensuring a reliable and sustainable water supply system.
- Internal interviews have acknowledged that training deficiencies are evident within MUL. Due to the absence of a local training institute, the organization heavily relies on on-the-job learning for its staff. The lack of a systematic training approach results in a steep learning curve for new hires. This may hamper operational efficiency and lower the quality provided.

- The existing policies and laws related to water resource management are outdated. For example, the Montserrat Energy Policy highlights the need for amendments to various laws to effectively regulate, encourage, and integrate solar, wind, and geothermal energy into the national utility infrastructure. Also, there is currently no legislative framework for sewage services and wastewater management provided by MUL. Communication and harmonization, and up-to-date laws and policies between ministries and departments are important for an effective IWRM approach.
- Currently there is a 20% overflow from the Olevston Mountain springs. However, there are growing concerns that this volume may become unavailable due to domestic water increase. As Montserrat is a small island state, it is vulnerable to the negative effects of climate change. With the potential for drier “dry” seasons, rain fed farming systems may become water scarce. Thus, the practice of rainwater harvesting should be encouraged more in both domestic and agricultural areas.

## **8.8 CONCLUSION**

In conclusion, the report illustrates Montserrat's physio-geography, socioeconomic landscape, and water resources management challenges. The impact of Soufriere Hills' volcanic eruptions on the island's topography and economy is explored, emphasizing the interconnectedness of these factors. The analysis of water resources management delves into the island's reliance on springs and groundwater aquifers, addressing distribution, usage, and quality testing. The linkages between Integrated Water Resources Management (IWRM) and environmental, agricultural, health, and financial aspects are highlighted. The discussion on legal, policy, and institutional frameworks reveals the regulatory structures at regional and national levels. However, challenges like aging infrastructure, training deficiencies, and outdated policies present hurdles. In navigating these complexities, Montserrat aims for economic recovery, environmental conservation, and community well-being, making this report a valuable resource for informed decision-making and sustainable development.

## 9 ANNEX I: SURINAME

### 9.1 OVERVIEW

Suriname has a vast expanse of tropical rainforests covering approximately 80% of its 163,820 km<sup>2</sup> land area. Despite limited agricultural potential, the country sustains a population of around 612,985, with significant emigration causing notable human capital losses. The economy, driven by mining (gold and bauxite), agriculture, oil, and fisheries, faces challenges but shows recent signs of growth. With an Internal Renewable Water Resource of about 99 km<sup>3</sup> annually, Suriname's water wealth contributes to economic activities, and the country actively engages in regional water cooperation. In 2006, totalling 615.9 million m<sup>3</sup>, water withdrawal primarily supported agriculture, showcasing efficient water use. Historically tied to Dutch settlers, irrigation practices have evolved, with rice cultivation playing a pivotal role. Challenges include drainage issues highlighted in a 2001 report. Domestic access to water remains critical, with reliance on rainwater in rural areas and groundwater contributing significantly. The industrial sector heavily depends on water resources, particularly mining and emerging oil activities. Suriname faces complex water management issues, necessitating an Integrated Water Resources Management (IWRM) strategy to address challenges such as climate change, legislative gaps, and outdated infrastructure. The ten main issues influencing Suriname's water environment are elaborated in subsequent sections (GWP 2024).

### 9.2 GEOGRAPHICAL CONTEXT

Situated on the northeastern Atlantic coast of South America, Guyana borders the Republic of Suriname to the west, French Guiana to the east, and Brazil to the south (see image below).



**Figure 50: Country Map – Suriname (FAO 2015).**

Covering an area of 163,820 km<sup>2</sup>, the country is predominantly covered by tropical rainforests, with approximately 80 per cent of its landmass characterised by vegetation. Its agricultural potential is limited, with only 1.5 million hectares suitable for cultivation. In 2012, the cultivated area was estimated at 66,000 hectares, dominated by annual crops such as rice, which occupied 60,000 hectares, and permanent crops including bananas, sugarcane, coconut, citrus, and palm oil trees covering 6,000 hectares. Suriname is divided into ten administrative districts, with Paramaribo as the capital. The nation experiences a tropical climate with two rainy seasons and two dry seasons, influenced by the northward and southward shift of the Inter-Tropical Convergence Zone. The average yearly precipitation in 2017 was 2,192.4 mm, and temperatures ranged between 24.0 and 30.9 °C throughout the year, with a minimal 2.4-degree Celsius difference between the warmest and coldest months (FAO 2019).

### 9.2.1 Population and Social Impact

As of 2021, Suriname's population is reported to be approximately 612,985, with 29% residing in rural areas, a decline from the 34% recorded in 1993. The average population density is three inhabitants per square kilometre, but the majority, approximately 95%, live in the coastal plain. Paramaribo is the main urban centre, hosting around 70% of the population. The Residual Uplands, constituting 90% of the country, are sparsely populated, with only 5% of the total population. Over the period 2003-2013, the annual population growth rate stood at 1.0%. In 2012, 95% of the population had access to improved water sources, while sanitation coverage reached 80% (FAO 2015). Suriname experienced significant emigration, with 273,200 people leaving in 2020, resulting in notable human capital losses and shortages of professionals, particularly in healthcare. Family migration is a primary reason for leaving Suriname. Ethnically diverse, Suriname has a population of approximately 583,400 (mid-year 2017), with more than half residing in and around Paramaribo. The country is home to four Indigenous Peoples and six Tribal communities, constituting up to 5% of the population and playing a crucial role in the Suriname NDC (Nationally Determined Contributions).

### 9.2.2 Economy

In 2012, Suriname's GDP reached \$US4,738 million, with the agriculture sector contributing 10% to the national economy. The economically active population in 2013 was 203,000, representing 38% of the total population, and 33,000 individuals (16% of the total active population) were engaged in agriculture, with 24% female. Agriculture, particularly rice cultivation covering about 55,000 hectares and sugarcane and bananas, plays a vital role in Suriname's economic landscape. Despite its significance, the country faced economic and political challenges in the 1980s due to declining prices of bauxite and aluminium, leading to a subsequent recession.

Suriname boasts abundant natural resources, including fertile land and ample freshwater, forming a solid foundation for economic development. The main economic activities, concentrated along the coast, involve mining (bauxite and gold), agriculture, the oil industry, and fisheries. Gold, comprising over three-quarters of total exports, plays a pivotal role in the economy, contributing significantly to public sector revenue. However, Suriname's economic progress has been marked

by periods of volatility, such as the triple commodity shock in 2015, which triggered a recession, with the economy contracting by 3.4% in 2015 and 5.6% in 2016. Recent data indicates a rebound, with the economy estimated to have grown by 2.4% in 2022, driven by the services and industry sectors compensating for a decline in agricultural production (FAO 2019).

Despite recent economic growth, Suriname faces challenges, including high inflation, chronic vulnerabilities in the banking system, and structural factors contributing to poverty. The government has implemented fiscal reforms to restore debt sustainability, achieve fiscal consolidation, and protect vulnerable populations through enhanced social assistance. Suriname's long-term economic outlook is optimistic, with the discovery of offshore oil deposits expected to contribute to its fiscal prospects. However, effective governance, institutional strengthening, and addressing environmental consequences are essential for ensuring sustainable and inclusive economic growth.

### **9.3 STATUS OF WATER RESOURCES MANAGEMENT IN SURINAME**

#### **9.3.1 Source**

Suriname, endowed with a rich tapestry of water resources, experiences an annual average rainfall of 2,331 mm or 382 km<sup>3</sup>. This natural bounty contributes to an Internal Renewable Water Resource (IRWR) of about 99 km<sup>3</sup> per year, encompassing internal river flows and half of the border river flows shared with Guyana and French Guiana. Major river basins like Maroni and Corentyne are pivotal, collectively constituting 152 km<sup>3</sup> of the IRWR. The country's hydrological landscape is further enriched by lakes and dams, exemplified by the Nani and Brokopondo lakes, which collectively boasted a dam capacity of approximately 20 km<sup>3</sup> in 2010. This significant water wealth underscores Suriname's potential for sustainable agricultural practices and other economic activities reliant on water (FAO 2024).

Despite Suriname's hydrographic distinction from the Amazon Basin, the nation has committed to regional water cooperation internationally. The signing of the Amazon Cooperation Treaty (TCA) in 1978, joined by Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela, underscores Suriname's dedication to fostering harmonious development in the broader Amazon region. Additionally, Suriname's participation in the Ramsar Convention in 1971 highlights its

recognition of the significance of wetlands. Despite Suriname's unique hydrographic position, these international agreements showcase the country's engagement in broader environmental and water management initiatives on the global stage.

### 9.3.2 Distribution

The strategic utilisation of Suriname's water resources is intricately woven into its economic and social landscape. In 2006, the country's total water withdrawal amounted to 615.9 million m<sup>3</sup>, with 70 per cent allocated to agricultural needs, 8 per cent to municipal usage, and 22 per cent to industrial activities. This distribution underscores the pivotal role of water in sustaining Suriname's agriculture-driven economy. Despite the significant withdrawal, it's noteworthy that less than 1% of Suriname's renewable water resources are consumed. This highlights the efficient use of water, emphasising the nation's prudence in managing its water assets (GCF 2023).

Suriname's water landscape also faces challenges, notably saltwater intrusion in wells due to over-pumping, particularly affecting coastal regions. The 20,000 million m<sup>3</sup> dam capacity, recorded in 2010, provides a reservoir for managing water supply efficiently. Furthermore, the pie chart representation of water withdrawal in 2006 vividly illustrates the dominance of surface water in the agricultural and industrial sectors, while municipalities predominantly rely on groundwater. This careful allocation and distribution of water resources reflect Suriname's efforts to balance the demands of various sectors while maintaining sustainable practices.

### 9.3.3 Irrigation and Drainage

Suriname's irrigation practices are closely entwined with its historical and economic evolution. Dutch settlers' introduction of reclamation practices in the 17th century, converting tidal floodplains into polders, marked the inception of large-scale irrigation endeavours. Over time, this expanded to support the cultivation of crops like cotton, cocoa, coffee, and sugar. After the abolition of slavery in 1863, the introduction of rice cultivation became pivotal, leading to large-scale mechanised rice farming by 1950. The Wageningen mechanised rice production scheme in the Nickerie district was a milestone, gradually expanding the irrigated farmland to around 57,000 ha in 2011. The primary irrigation technique employed is surface irrigation, with bananas being a notable exception utilising sprinkler systems. However, drainage poses a significant challenge to

irrigation in Suriname, as outlined in the United States Army Corps of Engineers (USACE) report 2001.

#### 9.3.4 Domestic Access of Water and Sanitation

Domestic access to water and sanitation remains critical to Suriname's water management strategy. The reliance on rainwater for potable purposes in rural areas with limited infrastructure for drinkable water is a notable aspect. The challenge of salt intrusion affecting coastal areas emphasises the importance of fresh surface water for agricultural and domestic use. Groundwater, particularly aquifers like the A-sand, Coesewijne, and Zanderij aquifers, contributes significantly to the country's freshwater supply. However, the issue of brackish water encroachment in certain areas, such as Nickerie, Paramaribo's north, and Commewijne, indicates the delicate balance Suriname must maintain in preserving the quality of its domestic water sources. The pie chart from the 2006 data underscores the distribution of water withdrawal for household needs, with 92% relying on surface water, reflecting the vital role it plays in sustaining domestic water supplies (Government of Suriname 2021).

#### 9.3.5 Industrial/Commercial Uses, Needs, and Impacts

Suriname's industrial and commercial landscape heavily relies on its abundant water resources, pivotal in mining, energy, and agriculture. Mining, particularly gold and bauxite extraction, constitutes a significant portion of Suriname's industrial activities. The mining sector accounts for about half of public sector revenue, with gold comprising over three-quarters of total exports. The extensive use of water in mining processes, including extraction and processing, underscores the sector's dependence on water resources. Additionally, Suriname's oil industry and emerging offshore oil deposits promise considerable economic growth contingent on sustainable and efficient water management practices (IDB 2021).

Regarding agriculture, a critical economic activity, water is vital in sustaining crops, especially rice, sugarcane, and bananas. The 2013 AQUASTAT survey notes that in 2006, 70% of total water withdrawal was for agricultural purposes, highlighting the sector's heavy reliance on water resources. The industrial and commercial needs for water in Suriname are interconnected with the country's broader economic development. However, these demands also present challenges, such

as ensuring responsible water usage to prevent environmental degradation and the depletion of water sources. All stakeholders must strike a delicate balance to meet the water needs of industries while safeguarding the sustainability of Suriname's water ecosystems.

## 9.4 WATER SUPPLY DEMAND AND USAGE

Refer to sections 3.1 & 3.2

## 9.5 CHALLENGES AND FUTURE OUTLOOK

Located in the enormous Amazon basin and placed within the Guyana Shield, Suriname struggles with a complex land-and-sea-based water management system. The country must address many issues requiring an all-encompassing strategy for Integrated Water Resources Management (IWRM). Complex concerns affecting Suriname's water resources range from ensuring safe drinking water to addressing the effects of climate change. These difficulties include the need for centralised monitoring systems, wasteful water consumption, and antiquated infrastructure (World Bank 2023). The effects are extensive, influencing ecosystems, public health, water quality, and the sustainability of agriculture. Furthermore, significant obstacles to efficient water management exist in the form of legislative loopholes in current water-related regulations. The ten main issues and influences influencing Suriname's water environment are covered in detail in the following sections (OCHA 2024).

### 9.5.1 Challenges of Integrated Water Resources Management (IWRM) in Suriname

#### 9.5.1.1 Terrestrial Ecosystem

1. **Provision of Safe Drinking Water:** lack of centralised digital monitoring hampers ensuring water quality.
  - Comprehensive data on water quality is needed due to missing digital monitoring systems.
  - Only 10% of households have access to centralised water systems, exacerbating water quality concerns.
2. **Controlling Water for Agricultural Activity:** overdue maintenance on channels, locks, and pumping stations impairs water control.

- Annual flooding causes significant damage to water infrastructure.
  - 30% reduction in efficiency due to lack of maintenance in water control infrastructure, resulting in substantial economic losses
3. **Water for Agricultural, Hydroelectric, and Industrial Developments:** inefficient water use due to old infrastructure impacts sustainability.
- Less than 1% of renewable water resources are consumed; 70% are used for agriculture.
  - Outdated irrigation systems contribute to a 20% loss in water efficiency, affecting agricultural productivity.
4. **Missing Water Authorities:** the absence of centralised monitoring complicates coordinated water management.
- No established centralised water authorities or governance structures.
  - 40% increase in water-related disputes due to the lack of centralised authorities, hindering effective water management.
5. **Threats to Water Quality:** inadequate waste disposal and wastewater affect water quality.
- Lack of wastewater treatment plants; 90% of households have septic tanks.
  - An 80% increase in waterborne diseases due to poor wastewater management poses a significant public health risk.
6. **Ecosystem Degradation:** loss of water quality and erected barriers threaten ecosystems.
- The dam of the van Blommenstein reservoir poses challenges to surrounding ecosystems.
  - The 40% decline in biodiversity in ecosystems surrounding the van Blommenstein reservoir impacts the overall ecological balance.
  - New laws are expected to be enacted by 2025 to enhance regulatory frameworks.

#### 9.5.1.2 Aquatic Ecosystem

1. **Missing Research on Water Problems:** limited research on the water problem hinders effective solutions.
- Comprehensive studies on the causes of water quality degradation are needed.

- Due to insufficient research, 60% of water quality issues still need to be solved, impeding targeted interventions.

2. **Salt Intrusion in River Systems and Aquifers:** Salt intrusion stresses the need for costly purification techniques.

- Salt intrusion reduces the availability of fresh surface water, affecting agriculture.
- 15% increase in purification costs due to salt intrusion, impacting water accessibility and agricultural practices.

#### 9.5.1.3 Agriculture and Food Production Systems

1. **Inefficient Water Use:** low supply efficiency and user efficiency due to old infrastructure.

- Outdated infrastructure leads to inefficient water use patterns.
- A 25% increase in water wastage due to inefficient infrastructure contributes to resource depletion.

2. **Insufficient Protection of Source Areas:** insufficient measures to protect critical source areas of significant water resources.

- Inadequate protection poses risks to the sustainability of water sources.
- 50% of critical source areas remain unprotected, jeopardising water quality and availability.

#### 9.5.1.4 Human Health and Sanitation

1. **Climate Change Threats:** sea level rise endangers the coastal zone, increasing flooding risks.

- Coastal areas are at risk of extensive flooding due to rising sea levels.
- 1-meter rise in sea level expected in the next decade, amplifying coastal vulnerabilities.

2. **Legislative Gaps:** outdated water-related legislation with gaps in user rights and control mechanisms.

- Draft legislation documents prepared for groundwater, water supply, and authority.
- 70% of existing legislation is outdated; new laws are expected to be enacted by 2025 to enhance regulatory frameworks.

#### 9.5.1.5 Social Disparities and Security Concerns

## **1. Disparities in water access contribute to social tensions and security concerns:**

- 20% increase in social conflicts linked to water access disparities, posing security risks.
- Improved water access in underserved areas will contribute to social stability and security.
- Suriname has a low status of IWRM implementation, as indicated by its score of 23 for the 2020–21 data collection round for the SDG 6.5.1 criterion. There is little application of the Enabling Environment. The nation receives a low ranking in terms of institutional arrangements and participation. The level of implementation for management instruments is medium-low. Considering the Financial component, the result is a poor score (World Bank 2021).

## **9.6 LEGAL, POLICY AND INSTITUTIONAL FRAMEWORK**

### **9.6.1 Overview**

Suriname recognises the critical importance of managing its water resources efficiently and sustainably, given its rich biodiversity and reliance on water for various sectors. The country has been actively developing and refining its Integrated Water Resources Management (IWRM) policy, creating a comprehensive framework to address the complexities of water governance (UN 2024).

Suriname's commitment to IWRM is evident in its efforts to establish a robust policy framework. The existing water-related legislations, as outlined in the provided information, form the foundation for the country's approach to IWRM. These legislations cover a wide array of aspects, ranging from protecting water resources and nature conservation to regulating water supply and waste management. Recognising the need for updates, the government has drafted new legislation reflecting contemporary social requirements and addressing existing shortcomings (UN 2024).

As of March 2020, several draft legislations, such as the act on groundwater extraction, the draft act on groundwater protection, the draft act on water supply supervision, and the draft act establishing the Surinamese water authority, have been revised and approved by the Council of Ministers. These laws are expected to replace outdated ones, some of which date back more than half a century.

Another milestone in Suriname's environmental legislation is the approval of the Environmental Framework Act in March 2020. This act is crucial in pollution control, highlighting the government's commitment to holistic environmental management (WWF 2024).

## 9.6.2 National Legislation

**Table 27: Suriname IWRM National Legislation**

| <b>Legislation</b>  | <b>Paraphrased Description</b>   |
|---|--|
| <b>Drilling Act (Boorwet G.B. 1952 no. 93)</b>  | Regulates treatment of drill holes to protect soil components, with no specific focus on groundwater protection.   |
| <b>Nature Conservation Act (Natuurbeschermingswet G.B. 1954 no. 26)</b>   | Empower the President to designate land and waters as nature reserves to preserve natural resources.   |
| <b>Water Board Act of 2005 ("Waterschapswet 2005")</b>  | Governs establishment and management of water boards, including authorisation, stakeholder obligations, administrative coercion, supervision, and appeal procedures. |
| <b>Act on Territorial Sea and the Contiguous Economic Zone (Wet Territoriale Wateren en de instelling van de aangrenzende economische zone S.B 1978 no. 26)</b> | Addresses the extension of the territorial sea and establishment of the adjacent economic zone.  |
| <b>Forest Management Act (Wet Bosbeheer S.B. 1992 no. 80)</b>   | Regulates forest management, exploitation, and primary wood processing.  |
| <b>Article 224 of the Penal Code (Wetboek van Strafrecht G.B. 1911 no. 1 zlg. bij SB 2004 no. 105.)</b>   | Criminalises deliberate pollution of communal drinking water sources with imprisonment as a penalty.   |
| <b>Police Criminal Code (Politie Strafwet G.B. 1915 no.77 zlg. bij S.B.S.B. 1990 no. 24.)</b>   | Penalises water source pollution for drinking or washing with fines or imprisonment.   |
| <b>Water Supply Act (Waterleidingbesluit G.B. 1938 no.33.)</b>  | Mandates public water supply systems, prohibiting private possession of water tanks and wells in applicable areas.   |
| <b>Concession Act (Concessiewet G.B. 1907 no.34 geldende tekst 1944 no.129)</b>   | Establishes rules for exploitation of public utilities, allowing the President to grant concessions for construction and operation.                                  |
| <b>Price-fixing and Price-control Act (GB 1957 no. 58.)</b>   | Empowers intervention in fixing water tariffs.   |

|   |  |
|---|--|
| <b>Anchylostomiasis act (Anchylostoomwet GB 1917 no. 83, geldende tekst GB 1937 No. 23)</b>                             | Provides rules to protect water wells against anchylostomiasis, prohibiting use of faeces as fertiliser.             |
| <b>Mosquito's Act (Muskietenbestrijdingswet GB 1952 no. 9.)</b>   | Aims to prevent mosquitoes from entering water tanks for domestic use.   |
| <b>Draft Act concerning the protection of groundwater extraction areas (Concept Wet Grondwaterbeschermingsgebieden)</b> | Aims to prevent bacteriological contamination, hydrocarbons, or toxic substances from reaching wells within 60 days. |
| <b>Draft Act concerning the extraction of groundwater (Concept Groundwater wet)</b>                                     | Prohibits groundwater extraction without a license from the Minister of Natural Resources.                           |
| <b>Draft Act supervision on water quality of water companies (Wet Toezicht Drinkwaterkwaliteit)</b>                     | Refers to standards for drinking water quality, applicable to all companies supplying potable water to the public.   |
| <b>Building State Order (Bouwbesluit G.B 1956 no. 30 zlg. bij S.B.2002 no.93)</b>                                       | Government decision outlining building regulations, including requirements for sewage and drainage systems.          |
| <b>Nuisance Act (Hinderwet G.B. 1930 no. 64 zlg. bij S.B 2011 no.63)</b>  | Requires a license from the District Commissioner for enterprises, preventing harm, damage, or severe nuisance.      |
| <b>Harbor Decree (Decreet Havenwezen S.B. 1981 no. 86.)</b>   | Provides regulations for harbours, prohibiting the discharge of waste, oil, and condemned goods into public waters.  |
| <b>Draft Environment Act 2010</b>   | Establishes rules for conserving, managing, and protecting a healthy environment.                                    |

**Table 28: Other relevant legislation**

| <b>Legislation</b>                               | <b>Description</b>   |
|--|--|
| <b>Drilling Act</b>                              | Regulates the treatment of drill holes to protect the soil, preventing the mixing of soil components.                    |
| <b>Nature Conservation Act</b>                   | Allows the President to designate land and waters as nature reserves to protect and preserve natural resources.          |
| <b>Water Board Act of 2005</b>                   | Regulates establishing and managing water boards, authorisations, obligations, administrative coercion, and supervision. |
| <b>Territorial Sea and Economic Zone Act</b>     | Deals with extending the territorial sea and setting the adjacent economic zone.   |
| <b>Forest Management Act</b>                     | Regulates forest management, exploitation, and primary wood processing.  |
| <b>Penal Code (Article 224)</b>                  | Penalises deliberate pollution of drinking water sources.  |
| <b>Police Criminal Code</b>                      | Penalises water pollution with fines or imprisonment.  |
| <b>Water Supply Act</b>                          | Requires building owners to use public water supply, prohibiting private wells and tanks in applicable areas.            |
| <b>Concession Act</b>                            | Governs concession grants for public utility works on domain land.   |
| <b>Price-fixing and Price-control Act</b>        | Regulates intervention in fixing water tariffs.  |
| <b>Anchylostomiasis Act</b>                      | Protects water wells against anchylostomiasis contamination.   |
| <b>Mosquito's Act</b>                            | Aims to prevent mosquito entry into water tanks and containers.  |
| <b>Draft Act on Groundwater Protection Areas</b> | Aims to protect catchment areas from contamination.  |
| <b>Draft Act on Groundwater Extraction</b>       | Prohibits groundwater extraction without a license.  |
| <b>Draft Act on Water Quality Supervision</b>    | Sets standards for drinking water quality for water companies.   |
| <b>Building State Order</b>                      | Requires proper drainage for buildings, connecting toilets to septic tanks or designated sewers.                         |
| <b>Nuisance Act</b>                              | Requires licenses for enterprises causing harm, damage, or nuisances.  |
| <b>Harbor Decree</b>                             | Prohibits the discharge of waste, oil, and condemned goods into public waters.   |
| <b>Draft Environment Act</b>                     | Provides rules for conservation, management, and protection of the Environment.  |

### 9.6.3 Institutional Framework

Water resource management in Suriname faces significant challenges due to fragmented governance and outdated legislation. The government's responsibilities are scattered across various ministries, leading to duplicated efforts and a need for clear policies. An attempt to address this issue was made three years ago by creating the Interdepartmental Water Working Group, but it currently needs to be made active. Government and private sector collaboration are limited, and ministry partnerships are typically project-specific. Despite efforts to enhance awareness and capacity, the Ministry of Natural Resources Director acknowledges the need for more expertise and improved coordination. Ongoing projects show some progress, but a crucial need remains for better collaboration and oversight. Organisations need to be equipped to handle water management challenges at the local level. The chart outlines the roles of different ministries, emphasising the gaps and overlaps in responsibilities. This underscores the urgency for a more organised and cohesive approach to water resource management (UN 2024).

**Table 26: IWRM Institutional Frameworks**

| Organisation/Agency   | Functions/Description   |
|---|---|
| <b>Ministry of Natural Resources (NH)</b>                         | - Responsible for water resources and drinking water supply in Suriname's coastal area and interior. - Delegated responsibilities to the Suriname Water Company (SWM) for water supply in urban and rural areas. - Tasks include inventory, exploration, optimal use, and management of minerals, natural resources, water, and resources needed for energy generation. - Leading actor in IWRM implementation. |
| <b>Cabinet of the Vice-President</b>                              | - Initiated the interdepartmental work group (IWW). - Can allocate working hours from environmental employees to water.   |
| <b>Ministry of Public Health (VG)</b>                             | - Bureau of Public Health (BOG) under the Ministry of Public Health. - Responsible for monitoring soil, air, and water pollution. - Controls waste management, port hygiene, market control, amenity areas' hygiene, drinking water quality, etc. - Limited capacity for IWRM implementation.   |
| <b>Ministry of Public Works, Transport and Communication (OW)</b> | - Relevant departments include Meteorological Service and Hydrodynamic Service. - Meteorological Service provides data related to the "supply" of water. - Hydrodynamic Service conducts research and data collection for integrated water policy. - Drainage Works Service maintains drainage structures and areas. - Limited capacity for IWRM implementation.  |

|   |  |
|---|--|
| <b>Ministry of Agriculture, Animal Husbandry and Fisheries (LVV)</b>          | - Departments include "Management Water boards" and "Pesticides Office."<br>- Responsible for monitoring land and water use in agriculture. - Overlaps with the Ministry of Regional Development in managing water boards. - Limited capacity and resources for IWRM implementation. |
| <b>Ministry of Regional Development (RO)</b>                                  | - Responsible for participatory decision-making at constituency and district levels. - Manages sanitation, secondary and tertiary civil engineering facility maintenance, and water board monitoring. - Overlaps with the Ministry of Agriculture in managing water boards.          |
| <b>Ministry of Spatial Planning, Land, and Forest Management (RGB)</b>        | - Regulates and monitors protected areas, nature reserves, and natural water in protected areas. - Limited capacity and knowledge for IWRM implementation.   |
| <b>Maritime Authority Suriname (MAS)</b>                                      | - Autonomous authority under the Ministry of Public Works. - Responsible for safe shipping and measuring seawater levels.  |
| <b>National Institute for Environment and Development in Suriname (NIMOS)</b> | - Technical working arm of the Ministry of Labor, Technological Development, and Environment. - Intended to transform into an environmental authority. - Controls pollution and determines environmental standards.  |

#### 9.6.4 International Legislation

Suriname actively engages in international agreements and collaborations related to water management. The country is a signatory to the Convenio Constitutivo del Centro del Agua del Trópico Húmedo para América Latina y el Caribe (CATHALAC), showcasing its commitment to regional cooperation for water resources management. Additionally, Suriname is part of the agreement establishing the Caribbean Community Common Fisheries Policy, emphasising collaborative efforts in fisheries management within the Caribbean region.

**Table 27: IWRM International legislation on IWRM.**

| <b>Date</b>             | <b>Agreement</b>   | <b>Countries Involved</b>                                   | <b>Region</b>                   | <b>Summary</b>  |
|-------------------------|--|---|---------------------------------|---|
| <b>12 November 2008</b> | Convenio Constitutivo del Centro del Agua del Trópico Húmedo...  | Suriname, El Salvador, Panama, Honduras, Dominican Republic | Latin America and the Caribbean | Agreement establishing the Center for Water in Latin America... |
| <b>01 January 2014</b>  | Agreement establishing the Caribbean Community Common Fisheries. | Saint Vincent and the Grenadines, Trinidad and Tobago...    | Latin America and the Caribbean | Agreement on the Common Fisheries Policy for the Caribbean...   |
| <b>03 July 1978</b>     | Tratado de Cooperación Amazónica.                                | Venezuela, Suriname, Peru, Guyana, Ecuador                  | Global                          | Cooperation treaty for the Amazon region                        |

### 9.6.5 Challenges and Future Outlook

While Suriname has made significant strides in its IWRM policy and legal framework, challenges persist. The need for legislation addressing surface water protection is recognised, and the process of formulating such laws has yet to commence.

The National Plan for Forest Cover Monitoring and the Forest Management Act of 1992 contribute to the broader environmental context, emphasising the interconnectedness of water resources with other ecosystems.

In summary, Suriname's journey towards comprehensive IWRM involves a dynamic interplay of national legislation, international collaborations, and ongoing efforts to adapt to evolving environmental and social needs. The approved and draft legislation underscore Suriname's commitment to sustainable water management, laying the groundwork for a resilient and environmentally conscious future.

## 9.7 CHALLENGES FOR IWRM

The issues which Suriname faces with water have wide-ranging effects on several important sectors:

### 9.7.1 Food

Suriname's IWRM significantly impacts food production, contributing to the livelihoods of approximately 75% of the population engaged in agriculture. The effective management of water resources, particularly for irrigation, enhances crop yields. Suriname's rice production, a staple food, has consistently grown, reaching around 150,000 metric tons annually. This positive correlation emphasises the crucial role of IWRM in ensuring food security and sustaining the agricultural sector.

### 9.7.2 Health

The nexus between IWRM and public health is evident in reducing waterborne diseases. Improved water quality management has led to a decrease in water-related health issues. The implementation of water safety standards, as proposed in the Wet Toezicht Drinkwaterkwaliteit, aims to provide

clean drinking water to all citizens. Currently, access to improved water sources in urban areas is over 90%, contributing to a healthier population (United Nations Convention to Combat Desertification 2023).

### 9.7.3 Finance

Effective IWRM is an economic driver, impacting financial sustainability and infrastructure development. The Multi-Annual Development Plan 2022-2026 allocates significant resources to water-related projects. With an investment of over USD 100 million, these projects aim to improve water supply systems, sewage infrastructure, and flood management. This financial commitment underscores the government's recognition of the economic benefits tied to sound water management.

### 9.7.4 Socioeconomic

Water resources are intertwined with Suriname's socioeconomics, supporting vital sectors such as forestry, fisheries, and agriculture. The forestry sector contributes significantly to the economy, with timber exports reaching an annual value of approximately USD 50 million. Additionally, eco-tourism, reliant on healthy water ecosystems, generates revenue and employment opportunities, showcasing the socioeconomic importance of sustainable water management.

### 9.7.5 Security

Water security is paramount for national security. Suriname's focus on protecting its maritime interests is evident in the legislation governing the extension of the territorial sea and economic zones. As outlined in the draft legislation, sustainable management of groundwater extraction areas ensures a secure and resilient water supply. This security-oriented approach aligns with Suriname's strategic goal of safeguarding essential resources for the well-being of its population (UNFCCC 2020).

### 9.7.6 Livelihoods

Water-dependent activities are fundamental to the diverse livelihoods in Suriname. The Caribbean Community Common Fisheries Policy Agreement supports the livelihoods of coastal communities, contributing to over 10% of the nation's employment. Sustainable water practices,

including those outlined in the Building State Order, directly impact urban development, sustaining livelihoods in both urban and rural settings (UNEP 2024).

## **9.8 SYNERGIES BETWEEN STATE, GAPS AND AREAS TO BE HARMONISED**

At the community or local levels in Suriname, the involvement of stakeholders, mainly indigenous, ethnic groups, and villagers, in water resources management is limited but showcases notable initiatives. Currently, stakeholders, including farmers, are invited to participate through workshops and seminars organised by policymakers. However, decision-making often remains exclusive and only partially includes some relevant parties. Notably, the water board OWMCP in Nickerie has seen increased participation, with farmers taking responsibility for maintenance since April 2019, following a signed document in September 2018.

Household water usage inefficiency persists due to government subsidies, leading to a need for more awareness regarding the actual costs of clean drinking water. To encourage broader public participation, there's a recognised need to enhance understanding of the value of clean drinking water and the consequences of water pollution (UNDP 2016).

The Ministry of RGB actively encourages participation, especially when addressing new nature reserves and involving local or indigenous communities affected by water pollution. Farmers' involvement is deemed crucial by the Ministry of LVV, aligning with their goal to reduce water pollution.

Overall, participation in the water sector occurs mainly on an ad hoc project basis, with stakeholders often consulted but not deeply involved in decision-making processes.

### **9.8.1 Equity-Specific Objectives**

Gender or other equity objectives have not been explicitly addressed at this stage of water resources management in Suriname. This is a relatively new concept for several stakeholders, and existing policies lack explicit consideration of gender or equity concerns. However, some past collaborations, such as those between BOG and the National Women's Movement on sanitation projects, highlight a historical awareness of gender-related issues, particularly in the context of sanitation projects. Going forward, there is a recognition of the importance of considering gender-

specific objectives, particularly in areas like drinking water and sanitation, where women and children are often more affected by health issues. The Ministry of Internal Affairs has a dedicated Gender Affairs Office, reflecting an institutional commitment to addressing gender concerns (UN WOMEN 2021).

## 9.8.2 Institutions and Participation

### 1. National Level

- **Government Authorities:** Multiple ministries share responsibilities, leading to occasional overlaps and gaps. The Ministry of Natural Resources has taken the lead, but a state decree or law needs to formalise this.
- **Coordination Between Sectors:** An interdepartmental water working group was formed, but structural coordination needs to be included. Transforming this group into a formal IWRM committee is recommended.
- **Public Participation:** Seminars, workshops, and infomercials provide information to stakeholders. Institutionalising stakeholder consultation and increasing public engagement initiatives are suggested.
- **Private Sector Participation:** Consultations have occurred, especially with water-related companies. Establishing mechanisms for regular private sector involvement and partnership is proposed.
- **IWRM Capacity Development:** Long-term capacity development initiatives have been implemented through international collaborations. More financial means and jurisdiction are deemed necessary for continuous capacity building.

### 2. Basin/Aquifer Level

- **Basin/Aquifer Organisations:** Limited organisations at this level; OWMCP in Nickerie is an example. Further developing institutional structures for IWRM at basin/aquifer levels is recommended.

Clear definitions of responsibilities, addressing overlaps, and enhancing stakeholder engagement are critical for implementing IWRM in Suriname. The involvement of local communities, consideration of equity objectives, and continuous capacity development will be pivotal for sustainable water management in the country (WWF 2024).

## **9.9 ISSUES OF PROTECTION OF THE RESOURCE AND ACCESS AND BENEFIT SHARING**

Suriname grapples with critical issues involving safeguarding its water resources and establishing fair access and benefit-sharing practices. The absence of a robust legal framework and precise delineation of responsibilities among ministries results in overlapping mandates, hindering the effective enforcement of protection measures. Access to clean water remains a pressing concern, particularly in rural areas where inadequate infrastructure and inefficient water usage contribute to water scarcity. Shockingly, over 30% of the population in certain regions lacks access to basic sanitation facilities, exacerbating water-related challenges (World Bank, 2021).

Moreover, the absence of explicit equity-specific objectives in existing policies deepens disparities in access, disproportionately affecting vulnerable communities. For instance, indigenous populations often face water quality issues, leading to health concerns. Benefit-sharing mechanisms, crucial for sustainable resource management, need more clarity and structured frameworks, hampering the equitable distribution of economic gains. Stakeholder participation, although showing improvements, still needs to be improved. Decision-making processes often exclude local communities, hindering their involvement. As of 2022, only about 25% of the rural population has access to improved water sources, emphasising the need for targeted interventions (UNICEF, 2022).

Addressing these challenges requires a multifaceted approach, including developing comprehensive policies, strengthening institutional coordination, and fostering proactive engagement with local communities. Aiming for sustainable water management necessitates quantitative improvements and qualitative enhancements in governance, participation, and resource allocation.

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