DELIVERABLE 2 - PHASE 2

Findings of the Integrated Water Resources Management Study from the Comprehensive Review of Water Resource Issues in the Caribbean Community Region

Consultancy to Develop a Regional Action Framework for Integrated Water Resources Management for the Caribbean Community Region

Prepared by Global Water Partnership-Caribbean (GWP-C)

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Glossary

AAR	Adopt-A-River Programme
APUA	Antigua Public Utilities Authority
BWI	British Virgin Islands
BWA	Barbados Water Authority
BWS	Belize Water Services
CANARI	The Caribbean Natural Resources Institute
CARICOM	Caribbean Community
CARPHA	Caribbean Public Health Agency
CNE	National Emergency Commission
CWP	Country Water Partnership
CWSA	Central Water and Sewerage Authority
DD	Drainage Division
DOMLEC	Dominica Electricity Services
DOWASCO	Dominica Water and Sewage Company Limited
ECCB	Eastern Caribbean Central Bank
EMA	Environmental Management Authority
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEF-IWCAM	The Global Environment Facility-funded Integrating Watershed and Coastal Areas Management in Caribbean Small Island Developing States Project
GEF IWEco	Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States Project
GOJ	Government of Jamaica
GWI	Guyana Water Incorporated
HDI	Human Development Index
I/AWRM	Integrated and Adaptive Water Resource Management
IDB	Inter-American Development Bank
IMA	Institute of Marine Affairs
IRWR	Internal Renewable Water Resource
IWRM	Integrated Water Resource Management
MCM	Million Cubic Metres

MoALF .....Ministry of Agriculture Land and Fisheries
MoH .....Ministry of Health
MoPE .....Ministry of Planning and the Economy
MUL.....Montserrat Utilities Limited
NAPL .....Nonaqueous Phase Liquids
NAWASA .....National Emergency Management Agency
NEMA.....National Emergency Management Agency
NEMS .....National Environmental Management Strategy and Action Plan
NEPA .....National Environment and Planning Agency
NDCs.....Nationally Determined Contributions
NGO .....Non-governmental Organisation
NHS.....National Hydrological Service
NOWRA .....National Integrated Water Resources Authority
NIWRMP .....National Integrated Water Resources Management Policy
NODS.....National Office of Disaster Services
NRCA .....Natural Resources Conservation Authority
NRW .....Non-Revenue Water
NWC .....National Water Commission
NWSS .....National Water Sector Strategy
OECS .....Organisation of the Eastern Caribbean States
ONE .....National Office Statistics
PPCR.....Caribbean Regional Track of the Pilot Programme for Climate Resilience
RWH .....Rainwater Harvesting
SDG.....UN Sustainable Development Goals
SIDS .....Small Island Developing States
SPCR.....Strategic Programme on Climate Resilience
SVG.....St. Vincent and the Grenadines
SWMCOL .....The Trinidad and Tobago Solid Waste Management Company
TCA.....Amazon Cooperation Treaty
THA .....Tobago House of Assembly

T&CPD .....Town and Country Planning Division
UN.....United Nations
UNDP.....United Nations Development Programme
UNFCCC.....United Nations Framework Convention on Climate Change
UWI.....University of the West Indies
WASA.....Water and Sewerage Authority
WASCO .....Water and Sewerage Company
WCA .....Water Corporation of Anguilla
WMU .....Watershed Management Unit
WRA (Jamaica).....Water Resources Authority
WRA (Trinidad and Tobago).....Water Resources Agency
WRAC.....Water Resources Advisory Committee
WRM.....Water Resources Management
WRMA.....Water Resources Management Agency
WSS .....Water Supply Systems
WUG .....Water Use Group

Executive Summary

This gap analysis commissioned under the project "Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (GEF-IWEco)" was conducted based on a previous assessment that was conducted to evaluate the readiness of Caribbean Community (CARICOM) countries in adopting and implementing integrated water resource management (IWRM) practices. The earlier analysis focused on examining the existing policies, legislative frameworks, and institutional capacities and identified challenges within the region.

The key components of the gap analysis include the following points:

- Policy and Legislative Review: Analysing existing policies and legislative frameworks related to water, land and ecosystem management across CARICOM countries.
- Institutional Capacity Assessment: Evaluating the institutional capacities within each member state to implement IWRM practices effectively.
- Identification of Challenges and Needs: Identifying gaps and challenges that hinder the adoption and integration of IWRM approaches at the national and regional levels.
- Sustainable Finance: Evaluating a sustainable finance plan to secure funding and resources necessary for the successful implementation of IWRM initiatives.

The findings from the initial assessment were instrumental in shaping the development of strategic goals and a detailed Roadmap of Actions for IWRM in the CARICOM Region spanning from 2022 to 2028. This roadmap includes a comprehensive implementation plan timeline, a monitoring and evaluation framework, and a sustainable finance chart.

These elements were presented at the 103rd Special Meeting of the Council for Trade and Economic Development (COTED) Environment and Sustainable Development in 2022 where support was received. At the COTED meeting, the Council of Ministers:

- Noted and commended the draft action framework for IWRM for the CARICOM region, including the OECS Member States.
- Requested the OECS Commission to continue the collaboration with the CARICOM Secretariat, CARPHA, UNEP, GWP-C, Caribbean Water Net/Cap-Net UNDP and other regional agencies to ensure further consultation on the draft Action Framework

for IWRM with other OECS/ CARICOM Member States that were not involved in the initial initiative on the Development of the Framework and Roadmap.

- Supported the advancement of the IWRM framework at the regional level (COTED) and implementation at the national level.

To support the inclusion of member states that were not initially involved in the development of the framework and roadmap, the study was expanded in its scope to encompass CARICOM Member States that were not part of the initial initiative. This ensures comprehensive coverage across the entire region, enabling all countries to contribute to and benefit from the development of the framework and roadmap for IWRM.

The expanded study presented in this document is the result of a thorough assessment of the policies, legislation, institutional capacities and challenges related to water, land and ecosystem management in the newly included member states. This ensures the analysis is inclusive and reflective of the diverse contexts and needs within the CARICOM region.

Regional Overview

The 19 small island developing states (SIDS), covered by this assessment (i.e., Anguilla, Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Lucia, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname, Bahamas and Trinidad and Tobago) share many similarities. These include their precolonial and colonial history, physical geography and socioeconomic characteristics. Nevertheless, countries also have a set of unique national circumstances that influence their approaches to and challenges faced in adopting integrated water and wastewater management. Accordingly, this assessment examines the needs and challenges that countries encounter in implementing actions for IWRM. Issues related to institutional and legal arrangements, vulnerability to climate variability and change, water resources use and management practices, data and knowledge gaps and financial constraints are seen as being among the main barriers to adopting IWRM practices at the national level. The assessment also identified opportunities that exist to capacitate governments and other relevant national stakeholders to develop and implement actions that address barriers to adopting integrated water and wastewater management. The following sections discuss the broad findings of the Country Assessments under thematic areas common to all or a majority of the countries.

Water Sources, Availability and Access

UN-Water defines water scarcity as "scarcity in availability due to physical shortage, or scarcity in access due to the failure of institutions to ensure a regular supply or due to a lack of adequate infrastructure." A majority of the 19 assessed countries were found to be either water-scarce or borderline water-scarce. Countries such as Belize and Guyana, where their water supply was derived from both groundwater and surface water sources, demonstrated a higher potential for water abundance. However, such abundance added further complexities to their IWRM. Water scarcity was most common in the countries with a coralline geology. These countries utilised groundwater stored in aquifers, and desalination as their primary sources of potable water. Conversely, countries with volcanic origins and steep topography tended to be slightly less water-scarce than others due to higher levels of precipitation. These countries generally utilise surface water (in rivers, lakes and ponds) as their main source of potable water. Notably, the countries relying on surface water have done very little exploration into alternative sources of freshwater (e.g., groundwater resources).

Nonetheless, all countries face water scarcity issues related to water resource management (e.g., policy environment, finance, capacity and infrastructure) and the impact of climate change events. All countries reported high levels of access to municipal water supply for domestic and sanitation purposes.

Wastewater Management

Access to sanitation facilities was found to be high in the majority of the countries assessed. Both municipal sewage systems and stand-alone septic systems are generally used to manage waste. Countries have reported significant inadequacies in their ability to effectively treat and manage the disposal of wastewater. Although it is not a ubiquitous practice, the release of effluent directly into the sea with minimal or no treatment was reported among several of the countries reviewed. Several of the reviewed countries had either outdated or no institutional framework to guide the management of wastewater in their respective countries. Further to this, inadequate wastewater infrastructure coupled with unregulated and fragmented management of wastewater appeared to be a commonality among several of the countries reviewed. This presents a significant hazard to the surrounding marine environment and increases the possibility of human contact with highly dangerous and contagious pathogens. A designated Wastewater Policy and/or Strategy is not commonplace among the assessed countries. Some countries are currently in the draft stage. However, the approval process is typically protracted, with further delays and inefficiencies experienced during implementation and enforcement.

Climate Variability and Change

All the assessed countries identified climate change as a major challenge to their water sector. Climate Change is expected to affect water sectors through sea level rise, saltwater intrusion of nearshore freshwater sources, decreased annual precipitation/an increase in drought conditions, an increase in mean annual temperature and increased intensity of tropical storms and hurricanes. These pose significant risks to water sources, water quality and the supply and distribution infrastructure/systems. Additionally, climate-related stressors on the water sector will impact other critical, water-dependent, economic sectors such as agriculture and tourism. Biodiversity and the presence of critical species are projected to be further threatened by climate change, posing unique disadvantages in several of these countries that rely on ecosystems and their services. Additionally, climate change is

expected to exacerbate existing issues and reveal new ones within social systems such as healthcare, sanitation and social safety nets.

Legal, Policy and Institutional Framework

The region lacks an environment for enabling IWRM in law and policy. Despite clear acknowledgement and acceptance of IWRM as a best practice for managing national water resources, most countries lack an IWRM policy, plan, strategy or clear guidance for integrated management and development of the water sector. In most instances, the sector is governed by legislation, policies and inadequate strategies that. This is because they are either archaic or remain in draft form for an extended period. The resulting fragmentation of the mandate across several institutions with no designated responsible/accountable party for water resource management leads to inefficiencies and poor execution of the principles of IWRM and the prescribed mandate for managing the sector. Additionally, the outdated and uncoordinated framework has led to further inefficiencies such as unclear and unrealistic roles expected of the agencies responsible for IWRM. Many of these agencies lack the institutional capacity to fulfil their mandates.

Institutional Strengthening

This fragmented legal and policy environment leads to weak institutions in most countries. In addition to the disaggregated mandate for water resource management across several agencies, a lack of technical capacity has been cited as a major hindrance to conducting the business of IWRM. Imperative to the strengthening of the institutional arrangements of these countries for IWRM is the need to establish and maintain a centralised authority and monitoring system for the management of water resources. The lack of an adequately trained cohort of professionals to manage the countries' water resources is reflected in a lack of innovation, inefficiencies and overall slow progress towards sustainability within the water sector. It is also imperative for institutions charged with IWRM to move away from the outdated, fragmented sectoral approach to operational activities (i.e., the silo approach). Effective communication and coordination between responsible agencies, the private sector and civil society are essential to IWRM implementation.

Data and Knowledge Management

All the assessed countries highlighted a lack of data as a major challenge to making practical evidence-based decisions to manage the water sector. The data challenge is far-reaching and varies in severity and causes across the islands. These challenges may be due to the fragmented mandate (previously discussed), poor interagency communication (a lack of a designated modality for sharing data and heavy reliance on interpersonal relationships/favours), the lack of/inadequate specialised equipment for collecting data (this may be linked to a lack of finance, and procurement and maintenance challenges), a lack of trained technical personnel, and the absence of data standards/protocols to ensure that the data collected and processed is useful, among other reasons.

Sustainable Financing

The availability and mobilisation of finance often strangle IWRM within this sector. The lack of funding for operational activities of the institutions with responsibility for IWRM perpetuates other challenges such as inadequate technical capacity, poor data collection and processing, the inability to procure and maintain specialised equipment, and weak legislative, policy and institutional frameworks.

IWRM Case Studies

Jamaica

Pathway of Jamaica Towards an IWRM Approach: Case Study of the Rio Minho Watershed in Clarendon

The Rio Minho Hydrological Basin in Clarendon (one of the southernmost parishes on the island) is subdivided into three watershed management units (WMUs). The Rio Minho Watershed has the island's longest river (Rio Minho River) at 92.8 kilometres (57.7 miles). There are many land use practices that support the locals' livelihoods within the Rio Minho WMUs. The watershed has been recognised as requiring critical intervention and was categorised as "severely degraded" by the National Environment and Planning Agency in 2002, 2009 and 2010 to 2015. The major issues include unsustainable farming practices, a high rate of deforestation, the destruction of aquatic life, the deterioration of groundwater quality and a lack of adequate drainage capacity.

Actions Taken: Increasing concerns about Jamaica's watersheds have led to a series of project-based interventions intended to mitigate and prevent the factors that harm the watersheds, such as initiatives to enhance the resilience of the agriculture sector and coastal areas to protect livelihoods and improve food security (Jamaica Adaptation Fund Programme, 2012). Aimed to protect the livelihoods and food security of vulnerable communities via the improvement of land and water management for the agricultural sector, as well as to strengthen coastal protection. Interventions aimed to support the "ridge to reef approach." Including infrastructure like green gullies, minimum or zero tillage, intercropping, contour ridges, vegetative and trash contour barriers, mulching and composting. Directed at improving soil nutrient content, infiltration and soil permeability which eventually controls runoff and reduces soil erosion/landslips within the watershed and reduces downstream flooding, turbidity and coastal water pollution. Other infrastructure included: water catchment facilities like rainwater harvesting (RWH) and micro dams. The establishment of water use groups (WUGs), Disaster Risk Reduction training of local community members/entities and building capacities of vulnerable farming communities and farmer field schools to develop solutions and demonstration of effective practices also occurred.

Rapid Characterisation of the Upper Rio Minho Watershed prepared for the Strategic Programme on Climate Resilience (SPCR, 2013). Launched as an effort to climate-proof

Jamaica's development. Infrastructural recommendations include designing new climate-resilient cropping systems, rainwater harvesting and artificially recharging the Rio Minho Basin's Limestone Aquifer to buffer against the impacts of climate extremes. Adaptation Programme and Financial Mechanisms under the Pilot Programme for Climate Resilience (PPCR, 2015).

Outcomes: Actions being implemented can be considered effective and sustainable as the majority of efforts can be categorised as "no regret" interventions. Further equipping communities and farmer groups with capacity building and engineered structures.

Lessons Learnt: Improvement of institutional and local level capacity building in relation to adaptation is required when implementing aspects of Integrated and Adaptive Water Resource Management (I/AWRM).

An Integrated Approach to Managing the Marine, Coastal and Watershed Resources of East Central Portland

The Global Environment Facility-funded Integrating Watershed and Coastal Areas Management (GEF-IWCAM) Project supported the (GEF-IWCAM) Jamaica Demonstration Project. Portland is divided into five WMUs. It is known for its lush vegetation and agricultural products. The Drivers River Watershed has one of the most pristine watersheds in Jamaica and the Caribbean. The Portland parish historically has had many high-level environment-centric interventions with varying degrees of success. However, to date, none of them has sought to build on previous interventions or structurally capture the various elements undertaken by previous projects.

Actions Taken: To achieve the two-fold objectives of capturing the best practices and lessons learnt through other initiatives, in creating an effective watershed management mechanism for Eastern Portland and developing transfer methodologies to allow for the replication of these lessons for other Jamaica WMUs, the project included work on the following:

1. Improvements of institutional and human resource capacity within sustainable watershed and environmental management agencies in the project area.
2. Monitoring of environmental and other indicators like solid waste, water quality and governance to assess project impacts and to guide policy reform.

3. Encouragement, development and implementation of participatory approaches to environmental stewardship and awareness, dissemination of information and the enforcement of existing policies among communities in the project area.
4. Promotion of developing economic activities like agriculture, tourism and fishing as alternative practices with reduced impact on WMUs via conservation and environmental management programmes in the project area.
5. Identification of solutions to ongoing detrimental activities that threaten and harm the watershed, coastal environment and human welfare integrity.

Outcomes: The project highlighted the importance of community participation, skill building and augmenting technical capacity. Contributing to social development via the following:

1. Community involvement in planning
2. Addressing community priorities
3. Using community skills and talents over imported ones
4. Livelihood enhancements of the local community
5. Increased access to physical assets by the community
6. Increased appreciation of local culture and traditions
7. The project also contributed to the environment (i.e., solid waste and liquid waste management practices and improved conservation practices) via the following:
8. Improved solid and liquid waste management
9. Innovative appropriate technologies
10. Improving water conservation and quality practices
11. Improving soil conservation and reduction in sedimentation
12. Environmental management systems
13. Education and awareness-building activities to change behaviour

The project contributed to and demonstrated how small grants programmes can catalyse small business opportunities around environmental management initiatives in the following ways:

14. Potential for viable small businesses
15. Employment opportunities
16. Opportunities for entrepreneurial activity
17. Access to finance for spin-off business initiatives

Overall, the Drivers River (GEF-IWCAM) Demonstration Project in East Portland is a success. The host communities were strategically involved in deciding priorities and finding solutions from inception through to the end.

Other Notable Projects:

- JA-T1111: Support to Update the Jamaica Water Resource Development Master Plan. Updating Jamaica's Water Resources Master Plan. Implemented by the WRA and funded by the Inter-American Development Bank (IDB).
  Project Status: Closed

  Link: https://www.iadb.org/en/project/JA-T1111

- JA-T1118: Support to the National Water Commission (NWC) for Improvements in Corporatisation and Institutional Strengthening. Supporting the NWC in improving the sustainability and quality of the Commission's services to its customers. Implemented by the NWC and funded by IDB.
  Project Status: Closed

  Link: https://www.iadb.org/en/project/JA-T1118

- Caribbean Regional Track of the PPCR. Improving regional processes to acquire, store, analyse, access, and disseminate climate-relevant data, in attempting to pilot and scale up innovative climate change resilient activities in the region. Within Jamaica, the main activity was the financing of water adaptation in Jamaica's housing sector. Subcomponents included raising awareness of the threats of climate change and interrelated opportunities presented by water efficiency to local businesses, financial institutions, civil society and the Government of Jamaica (GOJ), supporting climate change resilience and entrepreneurship programmes, building local capacities to design and install water adaptation measures and demonstrating the business case for water efficiency for construction companies and developers.
  Link: https://ppcrja.org.jm/investment-plan-for-the-caribbean-regional-track/

Saint Vincent and the Grenadines

Adapting to the Effects of Drought Through Increasing Water Storage Capacity to Address Climate Change on Mayreau

Mayreau, the smallest inhabited island of the Grenadines, with an area of 1.5 sq. miles and a population of approximately 271, suffered from drought and water scarcity. The potable water resource management project aimed to increase the island's water storage capacity by providing sixty 1,000-gallon water tanks for households and public entities with the greatest need. In addition to this, the project included the refurbishment of an existing 10,000-gallon cistern located at the Mayreau Primary School. This allowed for an increase in the community's water management capacity. The project further equipped the residents with hands-on knowledge of the maintenance and operation of water storage tanks to enable them to maintain high-quality water for drinking and to utilise it in a sustainable manner. Figure 1 shows the main outcomes of the project.

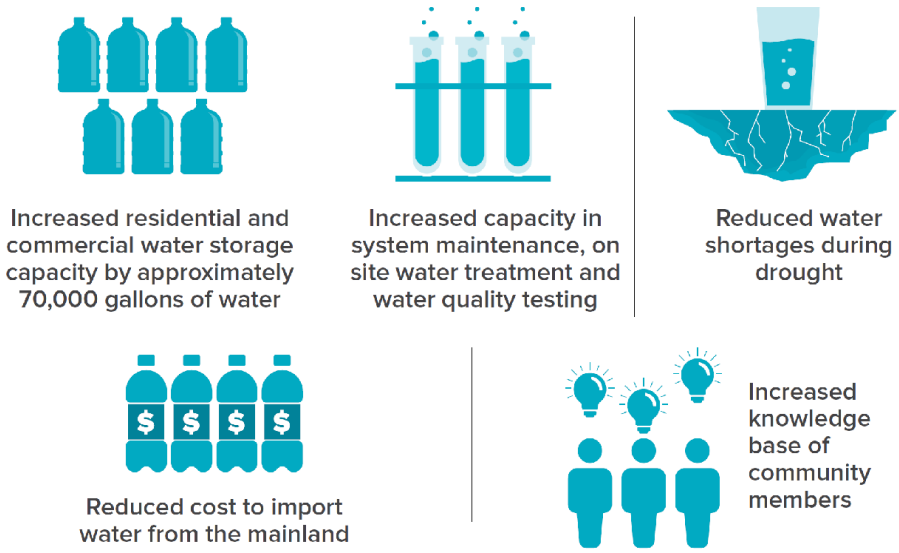

Figure 1: Outcomes of project IWRM interventions on Mayreau

Roadmap to IWRM Planning for Union Island, SVG

The project developed the key action areas to guide stakeholders in an integrated fashion towards developing IWRM plans. Union Island, one of the islands of the Grenadines, was selected as the pilot to demonstrate the IWRM development process on a small water-scarce island. One that represents similar circumstances on islands in the northern Leewards, the Virgin Islands, the Bahamas and the Turks and Caicos Islands. Pressing issues related to

water scarcity on Union Island include maintenance of health and sanitation and expanding water supply availability, particularly during severe drought periods.

Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco): St. Vincent & the Grenadines Sub-Project 1.7

The project within the Georgetown watershed management area in Saint Vincent involves targeting reforestation and conservation forestry interventions over at least 7.5 hectares within upland areas where landslides have occurred and along some 1.8 km of riverbank that continue to actively erode. Approximately 10 hectares of farmland were affected by the flood event of April 2011. At least 2 hectares of the most severely degraded area will be reclaimed using a range of soil stabilisation and forest management techniques. This area will be used to demonstrate best practices and will serve as a learning centre for sustainable land management practices.

The Bahamas

A case study was conducted at the community level to share knowledge and enhance water resource management. The case study highlights the success of stakeholder participation, reflecting a shift towards collaboration and addressing critical challenges. Some gaps still exist, despite having laws protecting water resources as limited information was presented about who or which organisation was responsible for collecting and managing the data on water resources, particularly monitoring and allocating existing fresh groundwater supplies. Some effort was made to try to address the overlaps that exist within and across policies and sectors such as health, works and utilities, and agriculture.

Establishing a Joint Water Quality and Pollution Control Unit within a joint department of environment and technology was a proactive step towards addressing environmental challenges collaboratively. By integrating both environmental management and technological expertise, such a unit can effectively monitor water quality, implement pollution control measures and foster collaboration among various stakeholders such as governmental bodies, research institutions and local communities.

The case study collected information on vulnerable groups and communities, particularly women and girls in the face of climatic and environmental risks and highlighted large disparities in access to safe drinking water and sanitation. Additionally, challenges

posed by climate change are sought to be addressed in the updated NDCs including technological solutions for drinking water, modelling and understanding climate risks, investments in desalination and renewable energy and climate change awareness for vulnerable populations. In the Bahamas, women and girls face heightened vulnerability to the impacts of tropical cyclones. 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.

Trinidad and Tobago

Customary Arrangements at the Community Level to Enhance Water Resource Management

Several initiatives have been conducted to address the issues associated with freshwater resources (MoPE, 2012). These include the development of major water sources, including the construction of additional desalination plants, the construction of a National Water Transmission and Distribution Grid, completion of the Beetham Water Re-Use Project, implementation of an aggressive Demand Management Programme of Universal Metering, and the completion, refurbishment and upgrade of water treatment plants, booster stations and service reservoirs; upgrading of the wastewater management system and sewerage systems through the refurbishment of the Primary and Secondary Clarifiers at the San Fernando Wastewater Treatment Plant; Integration and Expansion of the Wastewater Systems in the City of San Fernando and environs, and the design of treatment, collection and outfall systems for the South-West Tobago Environment and Wastewater Project; and Implementation of a Beetham Wastewater Reuse Project to provide a dedicated water supply to the Point Lisas Industrial Estate from non-traditional source wastewater.

Beetham Wastewater Reuse Project (MoPE, 2012)

Point Lisas Industrial Estate is one of Trinidad and Tobago's largest consumers of water. The Beetham Wastewater Reuse Project was developed to address the great demand for water by reusing the treated wastewater rather than discarding it into the sea. The project was started in 2015 to create a high-quality, reliable water supply that recycles 10 MGD of wastewater to industrial standards, allowing for delivery to 150,000 people. The project has

three components: a water reuse treatment facility, a submarine transmission system and a localised water distribution network. The Implementation of Sludge Management at Beetham Wastewater Treatment Plant to improve the quality of sludge being discharged from the Beetham Wastewater Treatment Plant project treats the high-quality effluent from the Beetham Wastewater Treatment Plant to a standard that will permit its use by industries in the Point Lisas Industrial Estate via a Submarine Pipeline in the Gulf of Paria.

Adopt-A-River Programme–Trinidad and Tobago (FAO, 2015)

The Water and Sewerage Authority (WASA) of Trinidad and Tobago in 2011 put forward an IWRM plan to decrease pollution in rivers and challenges faced in the treatment of water supply (Mahabir, 2004). The plan was intended to help people achieve local IWRM through the water resource management functions of the WASA and new initiatives that can be implemented. Additionally, the plan identifies challenges present in major watersheds in Trinidad and Tobago and offers suggestions for improvement. Following the assessment of these watersheds, solutions have been identified for the various watersheds and actions necessary such as public education and participation, watershed rehabilitation activities and water quality monitoring have been determined to be crucial initiatives.

The following table contains short-term and long-term initiatives suggested for IWRM implementation in Trinidad and Tobago.

Table 1. Suggested initiatives for IWRM in Trinidad and Tobago

		Short-term					Long-term	
No.	Watershed	Public Education and Participation	Rehabilitation Activities	Water Quality Monitoring	Community Governance	Company Incentives	Legislation	Landuse Planning
1	Arima	x	x	x	X		x	x
2	Guanapo	x	x	x	X		x	x
3	Aripo	x	x	x	X		x	x
4	Mausica	x	x	x	X		x	x
5	Tacarigua	x	x	x	X	x	x	x
6	St. Joseph	x	x	x	X	x	x	x
7	San Juan/Santa Cruz	x	x	x	X	x	x	x
8	Arouca	x	x	x	X	x	x	x
9	Cumuto	x	x				x	x
10	Talparo	x	x				x	x
11	Tumpuna	x	x				x	x
12	Couva			x				x
13	Guaracara			x				x
14	Caparo		x	x				x
15	Killdere	x	x	x			x	x
16	Nariva	x	x	x			x	x
17	South Oropuche	x	x	x	X		x	x
18	South Cunapo	x	x	x	X		x	x
19	Guapo	x	x	x	X		x	x
20	Erin	x	x	x	X		x	x
21	Courland	x	x	x	X		x	x
22	Louis D'Or	x	x	x	X		x	x
23	Hillsborough West	x	x	x	X		x	x

Source: Mahabir 2004

The recommendations from these assessments prompted the development of the Adopt-A-River (AAR) Programme. The function of the AAR programme was to implement short-term initiatives to allow for the IWRM of local watersheds that involve both communities and corporate entities that work together in a sustainable, holistic and coordinated manner to improve watersheds in Trinidad and Tobago. The AAR programme does the following:

- Provides an avenue for open dialogue between stakeholders to make positive changes in watersheds
- Brings about coordination between government agencies, community groups and tertiary educational institutions
- Raises awareness and changes perceptions of water and the environment
- Facilitates social benefits towards communities, showing that people cannot reduce damage to their environment when they cannot take care of themselves
- Provides an avenue for corporate social responsibility and, hence, marketing for companies
- Is financially or economically viable
- Provides an avenue to express and implement IWRM principles locally such that it has become the implementation arm or 'hands and feet' of the IWRM process

The First AAR Project: Guanapo Experience (Mahabir, 2004)

The Guanapo watershed was first adopted by the WASA as part of the Adopt-A-River Programme. This is an initiative that incorporates community and corporate entities in the improvement of watersheds in Trinidad and Tobago. Guanapo was selected because of its status as a highly threatened watershed; a result of water pollution from the Guanapo landfill and quarries. Managing this watershed is of great importance because the polluted water from this area flows into the Caroni River above, which is the largest source of surface water for Trinidad and Tobago–the Caroni Water Treatment Plant. The first step towards addressing the Guanapo watershed issues was a meeting with community members to identify the main issues in the watershed. Twenty-five people interested in the initiative were selected to form a community organisation. WASA then offered training to these individuals to educate them on water resource supply issues and the use of water quality testing kits.

Researchers at the University of the West Indies (UWI) then conducted a project to assess the leachate and its impact on the natural environment. The Trinidad and Tobago Solid Waste Management Company (SWMCOL) worked together with UWI to improve the waste management strategy for the landfill. This initiative resulted in action to reduce the leachate runoff of the river, the addition of a second pond to increase the capacity of the watershed to hold a large amount of leachate arriving from the landfill and terracing on the landfill to improve drainage within and away from the site. The Guanapo Project transformed itself from a water training programme to multiple projects, coordinating several stakeholders successfully to implement an integrated approach to water resource management by addressing issues related to watersheds identified by the community.

Capacity Building of Watershed Management Stakeholders (CANARI, 2014)

The Caribbean Natural Resources Institute (CANARI) embarked on a project from 2012 to 2014 to improve community-based management of watersheds in Trinidad and Tobago by building the capacity of community groups involved in watershed management. Participants shared lessons and identified the best practices for communicating how their work contributes to clean, safe drinking water. The main objectives of this project were to build the capacity of community groups involved in watershed management in Trinidad and Tobago through sharing lessons learnt and the best approaches to watershed protection and restoration; to enhance the capacity of community groups involved in watershed management to communicate how their work contributes to improvement in freshwater quality and quantity; to improve the effectiveness of community-based management systems in Trinidad and Tobago; and lastly to enhance public education and awareness regarding watershed management in Trinidad and Tobago.

Key National Findings

Methodology

The analysis involved gathering and synthesising existing information, documents and data related to water resources, policies, institutions and practices. The methodology for conducting a desktop review included:

- Define Objectives and Scope: The specific goals and purposes of the desktop review were outlined by a team of consultants working for the GWP-C. These were used to guide the entire review process.
- Identify Information Sources
- Literature Search: A comprehensive search of academic databases, institutional repositories, government websites and international organisations' publications.
- Institutional Frameworks: Organisational structures, roles and responsibilities of institutions involved in water management.
- Policy and Legal Documents: Review national policies, laws, regulations and international agreements related to water resource management.
- Grey Literature: Reports, conference papers, technical documents and unpublished studies from relevant stakeholders.
- Data Collection and Synthesis
- Document Review: Systematically review documents for key themes, trends, challenges and best practices related to IWRM.
- Data Synthesis: Summarise findings, categorise information into themes (e.g., policy frameworks, institutional capacities and stakeholder engagement), and identify gaps.
- Analysis and Interpretation
    - Comparative Analysis: Compare findings across countries to understand variations in approaches, successes and challenges.
    - Gap Analysis: Identify gaps between current practices and desired outcomes in IWRM implementation. Assess the reasons for these gaps (e.g., policy constraints, institutional capacity).
- Dissemination and Stakeholder Engagement
    - Presentation: Present findings to relevant stakeholders, policymakers and practitioners through workshops.
    - Feedback: Solicit feedback to refine findings

Key Findings for Anguilla

- Anguilla, a small island, is characterised by its flat, low-lying features formed primarily by coral and limestones which makes it susceptible to water scarcity. The island has no rivers, but several surface water ponds located near the coast.
- Water sources for this island include rainwater catchments, groundwater aquifers, desalination and imported water.
- Water challenges are driven mostly by population growth, climate change, over-extraction, pollution, saltwater intrusion and land development activities.
- The economic mix of Anguilla, being mostly luxury tourism, offshore banking and lobster fishery, has been a driver to the island's focus on developing its water resources, but at the expense of increasing demand for limited resources. However, water availability and quality impose direct negative impacts on the country's major sectors, livelihoods and its residents.
- In 2017, Hurricane Irma, a Category 5 hurricane, caused significant damage to Anguilla resulting in losses accounting for around 97% of the island's GDP. In 2020, the COVID-19 pandemic caused the country's economy to shrink by 27.4%.
- Anguilla climate is described by erratic, unpredictable rainfall and protracted periods of droughts lasting up to 4 months at times. Average rainfall is 40 inches and evaporation rates can reach 70 inches per year during droughts, emphasising the critical losses of freshwater on the island.
- Anguilla relies on the groundwater derived from its underground freshwater reservoir, in the "Valley Area". This aquifer provides Aguilla's Water Department with an estimated 250,000 to 300,000 gallons of water per day for distribution.

Main Challenges

- The water quality of the main aquifer of the island is exposed to risks such as saltwater intrusion, pollution, improper water management practices and over-extraction.
- The public water utility of Anguilla, the Water Cooperation of Anguilla, entered a 10-year contract with Seven Seas Water for the production and supply of drinking water which is derived from reverse osmosis desalination of seawater. This source of water is supplementary to the island's freshwater resources and is contracted to provide

750,000 gallons per day. However, it is reported that 80% of the water being produced under this arrangement is being lost due to deteriorated supply pipes.

- Anguilla's water supply vulnerability is best emphasised by its dependence on imported water sources which is required during drought episodes and increased national demand periods. With tourism being the island's main economic sector, it also strains the national water supply as tourism is a water-intensive sector which drives the national demand up by four.
- Distribution of water is done by the Water Corporation of Anguilla (WCA), a government-owned utility. WCA, which manages the country's infrastructure, primarily only services the urban areas of the island, leaving rural areas to rely on privately owned cisterns, wells and other sources. Distribution is also supported by four private companies.
- Sustainable water resource use and management is not supported by an adequate legislative and policy framework. Several of the pertinent legal instruments that speak to environmental conservation, land use planning and sustainable development have yet to be enacted or put into practice. Further to this, the country has no policy to coordinate IWRM and remains fragmented in its approach to water resource management.
- Anguilla adopted the National Environmental Management Strategy and Action Plan (NEMS) in 2001 and revised it in 2005, which is a comprehensive and strategic approach to environmental management and sustainable development, including that of natural resources.
- The management of water resources is governed under the 2007 Water and Wells Acts but lacks regulations.
- Nitrate concentrations are increasing in most of the production and test wells connected to aquifers in Anguilla. Chemical pollution exists due to agricultural fertilisers, animal wastes and effluent runoff from domestic and commercial septic tanks. Only a few systems in Anguilla have proper tile drain fields and the absence of adequate soil cover limits the natural filtration of pathogens. This poor water quality poses negative impacts on the tourism sector, which turns the wheels on other industries such as banking.
- Chronic illnesses have increased due to poor water quality, with nitrate concentrations in underground water exceeding the maximum acceptable limit for drinking water.

- The aquatic ecosystem of the island includes coral reefs, seagrass beds and few mangrove forests, salt ponds and white-sanded beaches. This ecosystem is at risk from chemical pollution spilling over into coastal ponds and phosphates from detergents resulting in algae blooms.
- Although Anguilla's agriculture sector is constrained by a shortage of farmland, this situation is further exacerbated by the limited and expensive water supply. This results in barriers to large-scale agricultural production, and consequently, the country currently imports all its supply for domestic and tourism needs.
- IWRM policy development received resistance from the island's residents who are of the impression that any regulations introduced by their governments serve as an instrument to remove their rights and personal sovereignty over private property.
- Anguilla is susceptible to the effect of climate change which impacts the quantity and quality of water resources and exacerbates water scarcity. Climate change has had the following impacts on the water resources of Anguilla:
    - Reduced rainfall and intense drought conditions resulted in reduced water availability, depletion of groundwater reserves and increased competition for limited water resources. Rising sea levels, in combination with increased groundwater extraction, have increased saltwater intrusion.
    - Damage to infrastructure from intense weather conditions in the form of higher temperatures, storms and floods.

Key Findings for Antigua and Barbuda

Antigua and Barbuda's geographic position and topographic features contribute to its water-scarce status. The low levels of rainfall combined with highly erratic rainfall distribution, high evaporation rates and porous limestone geology make the islands vulnerable to hydrological drought. There is also a shortage of suitable surface or groundwater storage areas.

- Water sources in Antigua and Barbuda are surface water, groundwater, rainwater harvesting and desalinated water. The total renewable water resources are estimated at 52 million cubic metres annually.
- Between 70% and 100% of Antigua's daily water supply during the wet years and the very dry periods respectively, is obtained from desalination water. Due to the

expensive nature of desalinated water, it is prioritised for domestic and tourism sectors while the agriculture sector is affected by limited supply for irrigation.

- In 2012, the municipal sector accounted for 63% of the water produced, followed by the industrial sector (22%) and the agricultural sector (15%). In 2012, 98% of the total population had access to improved water sources and 91% of the total population had access to improved sanitation.
- The Water Division of the Antigua Public Utilities Authority (APUA) is responsible for the country's water supply to the domestic and commercial sectors and controls the water systems throughout the entire country.
- In 2011, Antigua and Barbuda completed the preparation of an IWRM Policy and Roadmap. The policy document focused on coordination, cost reduction, increasing benefits across stakeholders and integrating strategies and activities to improve water, wastewater, land management and disaster preparedness. The IWRM Policy and Roadmap were further revised but are not presently in effect.
- The IWRM policy statement of Antigua and Barbuda also advocated the fundamental IWRM principles of participation, inclusion and gender equity. Specificities relating to gender mainstreaming were not elaborated in the policy statement. Nevertheless, the inclusion of multi-stakeholders and multi-sectors in all aspects of the IWRM process, including policy and plan development, watershed management, water resources monitoring and infrastructure funding was proposed.
- As part of the Disaster Risk Reduction Committee, APUA is the lead agency for IWRM. The Antigua Meteorological Service has increased the number of national weather stations network, which has improved the available data sets for the improvement forecasting capability; monitoring of drought and potential flash flood conditions in collaboration with the National Office of Disaster Services (NODS) and the Ministry of Agriculture.
- The Drought Management Plan from APUA leverages the existing coordination framework of the Disaster Committee to address droughts, which are classified as natural hazards. Additionally, a National Drought Mitigation System employs various mechanisms and media to deliver early warnings of low precipitation or drought conditions. The 2015–2020 National Action Plan proposed integrating these approaches into a comprehensive National Drought Mitigation System, to be overseen by the Disaster Management Council.

- District Disaster Committees function as volunteer arms of the national emergency organisation and are responsible for the coordination of community resources to meet the challenges of disaster management. District Disaster Coordinators trained in disaster management, oversee a committee of volunteers recruited from the various communities/villages in their district and trained through the national systems. Traditionally, 60% of the coordinators have been women.
- As part of the disaster risk reduction policy, there are plans for the development and application of standardised holistic and gender-sensitive community methodologies for natural and anthropogenic hazard identification and mapping; vulnerability and risk assessments; capacity assessments; and recovery and rehabilitation procedures in selected communities, along with contingency plans with gender sensitivities.

Main Challenges

- Some of the major challenges hindering the implementation of IWRM include interagency/intersectoral collaboration and coordination, a lack of human and financial resources, a lack of updated legislation and a proper implementation structure, overlaps in responsibilities of government organisations, access to sustainable financing, land use, land use change and land tenure issues, ageing infrastructure network and inadequate storage, vulnerability to the impacts of climate variability and change, and data collection and availability.
- Wastewater management is a major challenge for the country; particularly St. John's, where there is an urgent need to provide a proper sewerage system. The soil is incapable of handling the volume of septic tank effluent produced and the improper effluent disposal into the St. John's harbour, which has contributed to severe water pollution.
- Leveraging the human resources of non-governmental stakeholders is essential to address capacity gaps and enhance expertise. This involves utilizing technical resources that are both available and affordable for the tourism industry, as well as mobilizing voluntary contributions from educational institutions, community-based groups, and NGOs.
- Also given that the municipal sector accounts for most of the water demand, domestic activities, such as cooking, cleaning and childcare which are traditionally carried out by women, can be affected by inadequate water supply. Moreover, women, as the

main users of water in the household, (and particularly single-parent female-headed households) are impacted by the increased cost of water. Women and children (particularly female-headed households who are predominately the face of poverty in Antigua and Barbuda) depend heavily on public services such as community health clinics. During the extended drought period from 2013 to 2016, access to water became a problem for clinics, especially those serving rural communities.

- Antigua and Barbuda are considered to have a high rate of human development. However, economic activity has recently contracted due to the COVID-19 pandemic; particularly within the tourism sector, which is the country's highest revenue-earner.

The country's public debt-to-GDP ratio exceeds the Eastern Caribbean Central Bank's (ECCB) threshold. As a result, debt-reduction measures are likely to constrain the ability to obtain additional loan financing.

Key Findings for the Bahamas

- The Bahamas has limited freshwater availability from its primary water source, fresh groundwater supply, with no surface freshwater because no rivers or streams are located on the islands. With 700 islands and cays, only three have useable freshwater supplies and susceptibility to overexploitation and contamination. It heavily relies on fragile freshwater lenses within shallow limestone aquifers making water resource management a critical concern.
- Water Resource Management (IWRM) implementation indicates a medium-low level of progress, requiring significant institutional strengthening.
- Annual water losses are significant with high influxes of tourists and increased water demand.
- Irrigation is practised by only accounting for 8% of the available water sources because freshwater is limited.
- Water is transported to residents through pipe systems to 88% of the population and by watering trucks, with people who own private wells.
- Freshwater is also transported from Andros to the main island of New Providence in the Bahamas and is a crucial aspect of the country's water supply infrastructure. Residents not connected to the pipped system suffer significant water concerns.

- Industries such as Bacardi, hotels, electric companies, and private enterprises, including bottled water companies, utilise reverse osmosis (RO) to produce millions of gallons of potable water daily.
- Nationally, there are 34 National Acts and Policies that currently exist in the Bahamas that are related to IWRM, stemming back from 1993 to most recently in 2022. However, Complex legal frameworks exist, and 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 are out of date and need additional 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 with overlapping responsibilities and there is a fragmented regulatory environment.
- A comprehensive legislative framework for sustainable land use practices is needed, including a revision and updating of existing laws and regulations relating to water management.
- No singular environmental regulatory body exists, and it hinders the provision of regulations controlling groundwater use and abuse, crucial for safeguarding water resources.
- Sustainable practices and improved institutional arrangements are needed for IWRM. The transportation of water from other islands and 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.
- An estimated 30,000 unregulated private well systems exist. Geographical disparities lead to variations in piped water availability, with certain islands relying on brackish water sources.
- Large-scale groundwater extraction, particularly for agriculture and tourism, raises concerns about sustainability and ecosystem impacts. Piped water supply is primarily

concentrated in densely populated areas while small and remote communities may face water scarcity challenges.

- Insufficient water infrastructure in rural areas and Family Islands creates challenges in providing access to safe water and sanitation services.
- To achieve sustainable resource allocation and safeguarding the country's environmental integrity, a revision of the Bahamas' existing legislation, streamlining responsibilities and establishing a comprehensive regulatory framework is urgently needed.
- The country's financial position remains vulnerable due to its small size, lack of diversification and susceptibility to natural disasters.
- Finance and economic growth are not evenly distributed across the scattered islands and 31 districts. Financial vulnerabilities exist due to dependence on tourism and susceptibility to external shocks.

Main Challenges

- The Bahamas faces challenges such as economic disparities, vulnerability to climate change and significant dependence on tourism and agriculture. Global health risks associated with climate change, including the potential spread of diseases, pose development challenges.
- There are no rivers and streams located on the Island due to high soil permeability. Water supply is supplemented by desalination and rainfall catchment as inland water bodies are mostly saline or brackish.
- Salinization remains a concern despite having drainage systems in place.
- The manufacturing and industrial operations in and around Freeport in Grand Bahama contribute significantly to aquifer contamination, releasing nonaqueous phase liquids (NAPLs), heavy metals and other pollutants into the groundwater.
- Inadequate wastewater management, including the discharge of treated and untreated wastewater, contributes to pollution of terrestrial and aquatic environments.
- Sea level increases associated with increasing temperatures threaten the low-lying islands.
- Hurricane impacts, like those from Hurricane Dorian in 2019, contribute to annual losses of over 6% of the GDP.

- Water supply infrastructure is at risk of damage due to hurricanes. Addressing water losses and enhancing water supply infrastructure is essential for building resilience in the face of ongoing challenges.
- Regionally, there are six regional legal frameworks relating to IWRM for the Caribbean Region that influence the Bahamas' Water Resource Management.
- 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. Requires sustainable practices to ensure resource longevity of the country's financial resources.

Key Findings for Barbados

- Barbados is a small island that was formed when two sedimentary land masses along the subduction zone of the Caribbean and South American tectonics plates merged. Because of this fusion, Barbados' coralline geology has prohibited the formation of surface water features such as rivers, lakes and ponds.
- Potable water in Barbados is supplied from two springs namely, Codrington College Spring and Benn Spring, 22 groundwater wells, 17 sheet and five stream water wells, eight boreholes ranging in depth from 119.5 to 322 feet, and two desalination plants that employ the RO process. The extraction is done using groundwater abstractions from the aquifer and it supplies 98.6%of the island's potable water.
- Barbados' distribution network consists of nearly 2,000 miles of interconnected transmission and distribution mains plus service reservoirs. There are 22 pumping stations, 14 re-pumping stations and 27 reservoirs. The water supply system is subdivided into 19 sub-systems.
- The Barbados Water Authority (BWA) is responsible for the management of the island's water sector. The BWA supplies approximately 35 million gallons of water per day to just over 100,000 customers.
- Barbados' wastewater is treated onsite via package sewage systems or septic tank and soakaway systems or by one of its two sewerage treatment plants (i.e., the Bridgetown and South Coast treatment plants). The treatment plants employ different levels of wastewater treatment, however both plants discharge the effluent water directly into the sea.
- Sourcing and mobilising sustainable financing for capital-intensive investments in the

water sector has been prohibitive to its development. Revenues collected from the sale of water and sewerage services are channelled towards covering the operational costs of the BWA. This revenue is, however, inadequate due to the large number of customers who default on their water and sewage service payments.

- Barbados has a large body of legislation related to water resources and coastal area management. The legislative approach has been sector-specific in developing the legal and by extension the institutional frameworks that underpin water management. It has been recognised that harmonisation is required to promote and operationalise cross-sectoral coordination and integration.

Main Challenges

- A lack of formal mechanisms for cross-sector collaboration which would allow land, water and development issues to be coordinated.
- Using close to 100% of the country's available water resources. Barbados is already experiencing a gap between being able to supply water to meet the demand which further increases the vulnerability to periodic droughts.
- Land use and land use change (including illegal and unplanned developments) due to the increasing demand for space from the growing population and expansion of tourism and other economic sectors.
- Land-based sources of pollution (e.g., agro-chemicals, improper wastewater disposal, illegal dumping refuse).
- Vulnerability to the impacts of climate change including coastal inundation and sea level rise, an increase in tidal and storm surge levels, coastal erosion, rising temperatures, changes in rainfall patterns, and more frequent and severe weather events, including drought and tropical storms. The impacts of climate change also threaten to cause losses and damages to the existing ageing water infrastructure.
- A lack of trained technical personnel within the water sector.
- Inadequate Data and Information Management Infrastructure to support evidence-based decision-making in the water sector.

Key Findings for Belize

- Belize's temperature ranges from 22 to 31ºC on the coast and 16 to 18ºC in the mountains. Its annual precipitation varies 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.

- 99% of Belize's population has access to water.
- The National Hydrological Service (NHS) is pivotal as the lead agency for IWRM, operating under the National Integrated Water Resources Act (2010). The NHS functions as the Secretariat for the National Integrated Water Resources Authority, fostering cross-sector coordination through its board, which includes members from various sectors. Within the public sector, 16 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. Private sector entities like bottled water companies, well drilling operators, and agricultural industries and 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. 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.
- Belize's water resources are very dynamic, it has both surface and groundwater, with internal renewable surface water resources estimated at 15.258 km^3/year, complemented by groundwater resources at 7.51 km^3/year.
- The country maintains a very sustainable use of its water resources, where its water dependency ratio is at 30%.
- As of 2000, the total annual water withdrawal stood at 101 million m^3, with distinct allocations across key sectors. The primary consumer of water in Belize is the agriculture sector, which uses approximately 68% of the water while domestic water usage accounts for 11% and industries consume the remaining 21%.
- The irrigated area for Belize's agriculture sector was at 3,548 ha as of 2005, which was being used for crops such as rice, bananas, papayas and sugarcane.
- Belize has over 40 legislation or policies that influence the water resource management system in Belize. Further to this, Belize's institutional arrangements for water resource management are very far-reaching and involve several public and

private institutions addressing water resource management matters relating to water supply, sewage services, protection and conservation, water safety and water abstraction, among others.

- Belize is also a signatory to several regional agreements, satisfying the context of both Central America and the Caribbean regions.

Main Challenges

The following is a summary of the IWRM challenges faced in Belize.

- Annual precipitation variability and hurricanes have a significant impact on Belize's water resource management outlook.
- Water scarcity persists, even though Belize has abundant resources.
- Agriculture, being one of the main consumers of water resources and a primary industry for the country, poses water demand concerns for the future.
- Population growth due to immigration and birth rates raises concerns about water demand in the future.
- Water quality is important for the industries of Belize, especially agriculture and tourism.
- Belize has vulnerable communities that may have challenges in accessing sustained water supply.
- As urbanisation increases in Belize, the demand for water in urban areas will increase.

The outlook for Belize's IWRM depends on improved coordination and stakeholder participation. Vulnerable populations in Belize are disadvantaged due to their economic situation and healthcare issues. These issues may divert attention from active engagement in water management discussions. Belize, however, is advancing water infrastructure with the support of two IDB 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 programs focus on enhancing water quality, improving energy efficiency, and renovating infrastructure to strengthen Belize's water sector. They aim to increase women's representation on water boards and incorporate gender considerations into service delivery. By employing innovative technologies and behavior change campaigns, the programs seek to achieve sustainable and inclusive water management. The Nationally Determined Contribution (NDC) is expected to facilitate

stakeholder engagement in Integrated Water Resource Management (IWRM). Increased transparency, public consultation, and participation in water resource management decision-making will support the collaborative approaches needed for effective IWRM.

Key Finding for the British Virgin Islands

- BVI has no permanent natural bodies of freshwater and only has a few seasonal streams and springs occurring on one of its main islands, Tortola, during the rainy season.
- The island is exposed to hurricanes and tropical cyclones during the months of June to November, as its climate is described as tropical. Temperature variations are minimal throughout the year. Road Town, the capital city, experiences a daily maximum of around 32 in the summer and 29 °C in the winter. Rainfall averages are about 45.3 inches per year but is recorded as a variable.
- As of 2010, the population of the BVIs was 28,054 with Tortola being the most inhabited with 23,419 people.
- BVI's economy is driven mainly by tourism and international business and finance accounts. Agriculture accounts for less than 1% of the country's GDP which is because of the poor soil quality and steep slopes on the islands.
- The island attracts more than 900,000 tourists each year and tourism accounts for approximately one in every four jobs held by citizens of the BVI.
- Offshore registration to companies (incorporation fees) provides 51.4% of the government revenues.
- The island is characterised as a water-scarce territory due to its low rainfall averages, lack of permanent water sources and reliance on desalination sources. Further to this, critical metrics to estimate the country's total renewable water resources have significant gaps.
- Water is obtained in three ways: rainwater harvesting, wells and aquifers. Domestic water usage is provided primarily through abstraction from wells and rainwater harvesting, however; the island has no registry of the number of wells existing on the island. Households utilise private cisterns to capture and store rainwater. Rainwater harvesting is particularly used by rural islands.
- On Virgin Gorda, 19.9% of households utilise 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.

- There are two privately owned companies that provide piped water to the government for redistribution. These companies carry out RO to supply water to the four main islands of the BVI.
- Although the water that is distributed by the Water and Sewerage Department is metered, precise data to estimate water demand across sectors is currently unavailable.
- Piped water accounts for the highest percentage of water supplied to most households for the major islands and yachts based in BVI while people on the smaller islands obtain water through private cisterns. The BVI's only have two main irrigation systems that supply the department and 48 farmers of Tortola.
- Of the delineation systems reported on the islands, Jost Van Dyke is home to one desalination plant with a capacity of 60,000 gallons per day. This plant was commissioned in 2003 and was expanded in 2010 to accommodate the increase in tourism on the island.
- BVI has exposure to various Multilateral Environmental Agreements and is a part of CARICOM and the OECS which provide a strong basis to formulate policies intended to further the development of member states, including technical support, water resource management and environmental protection while the national context for IWRM falls on the responsibility of several agencies.
- Because a high percentage of BVI's population remains reliant on rainwater as a source of freshwater, the impacts of climate change have been very harsh on the island. The Caribbean region is projected to experience more intense drought periods and a reduction in rainfall during the wet season.

Main Challenges

- Like many of its Caribbean counterparts, the policy and institutional arrangements for BVI are constrained by inadequate legislation, fragmented coordination and a lack of relevant standard operating procedures.
- The BVIs are prone to the vulnerability of natural hazards and external shocks. Climate change and variability will continue to be a major challenge to the BVI because a reduction in rainfall and drought events will cause the island to be further vulnerable to water scarcity. Further to this, SLR is another source of concern for the

island's freshwater with the increase in saltwater intrusion.

- IWRM is also constrained by limited data availability to ascertain the island's overall water resources quality, quantity and distribution.
- The capacity to properly manage the water resources of the BVI is also a major challenge for the island. The Department of Agriculture, which is the authority to protect watersheds and water sources, is understaffed resulting in water management matters not being adequately addressed.
- Much of the population of BVI relies on septic tanks which has led to some environmental concerns as poor percolation has led to sewage disposal problems. In addition, the sewage treatment plants are susceptible to the impacts of storms and hurricanes which can leave these plants non-functional as experienced in 2017 with Hurricane Irma.

Key Findings for Cuba

- Rainwater is Cuba's main freshwater resource. Although there are differences in the amount of precipitation that falls within the country, the annual mean rainfall in Cuba is 1,335 mm which is higher than most Caribbean countries. Nevertheless, it is important to highlight that the country experienced a decline in precipitation of about 10% between 1960 and 2000.
- Cuba has one of the highest levels of access to water and sanitation in the Caribbean region. Water as a resource in Cuba is monitored and overseen by the National Water Resources Institute.
- Water use and distribution in Cuba seem to follow the trend of the Latin America and Caribbean Region, in which most of the freshwater is utilised for agriculture. According to the information available in the AQUASTAT data portal, the number one water user in Cuba is the agricultural sector, which withdraws almost 65% of available freshwater resources, followed by water for municipal use (human consumption) which accounts for 21% of the freshwater abstracted. Finally, the industrial sector accounts for approximately 12% of the freshwater extracted by users.
- Cuba has a strong policy framework established for water management. Administration of water resources is mainly public, with the integration of several national ministries (e.g., economy, construction and planning) and national agencies

such as the Institute of Hydraulic Resources.

- According to the 2017 SDG 6.5.1 assessment survey, Cuba scored high on the management of its water resources, scoring 80/100 overall. Although data suggests that most of the Cuban population has access to water services, water stress, aggravated by climate change, presents challenges to water availability in the future.

Main Challenges

- Although most of the Cuban population enjoys basic access to drinking water, literature reveals that a significant number of people are still not connected to the water grid. To access the resource, they must tap into other channels such as tanker trucks and other unreliable alternative sources. Cuba's water availability is 1,220 cubic metres per capita/per year, which is lower than the UN minimum suggested level of 1,500 cubic metres per capita/per year.
- Water scarcity problems are severely exacerbated by the lack of alternative water sources of adequate quality and quantity to match the increasing demand for human and productive activities.
- Approximately 35% of Cuba's land is used for agricultural purposes, mainly pasturage and crop production. 78% of this area is in the dry forest ecoregion. Although much of Cuba's land is dedicated to agriculture, the country still does not produce enough food to meet internal consumption.
- Although Cuba ranks among the best Latin American countries concerning gross domestic product (GDP) per capita and human development index (HDI), there is not much information indicative of the overall socioeconomic conditions of the population, and information about crosscutting issues. Indicators such as the poverty index are not easily accessible.
- Cuba's water sector is very vulnerable to climate variability. Agriculture and industry are expected to be affected by extreme weather events that might result in the reduced availability of the resource. There is evidence that other physical phenomena such as coastal floods and seawater inundations are leading to saline intrusion in the coastal aquifers. There is also concern that reduced water availability (because of climate change) might have a dire effect on public health.
- Cuba has an impressive disaster risk reduction governance approach, based on its socioeconomic model, that provides universal access to basic services. This approach

emphasises prevention and preparedness to minimise loss of life and resources. For instance, during the 16 major storms that struck Cuba and other Caribbean countries in the 2000s, only 30 fatalities were reported in Cuba, highlighting the effectiveness of these systems.

Key Findings for Dominica

- The country of Dominica has a humid tropical marine climate with minimal seasonal or diurnal fluctuations. Their dry season is from January to June and their wet season is from July to December. Annual rainfall is variable, 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.
- Dominica has 10 major rivers, namely: Indian, Picard, Layou, Roseau, Blenheim, Hampstead, Clyde, Pagua, Castle Bruce and Rosalie.
- The Dominica Water and Sewage Company Limited (DOWASCO) relies exclusively on surface water for its potable water supply, utilising strategically constructed dams along rivers for water storage and subsequent extraction.
- DOWASCO utilises approximately forty-five million litres of potable water daily from rivers. The rural areas of the country carry out rainwater harvesting, while groundwater sources are primarily utilised for bottling purposes from natural springs.
- Of the 3.24 million gallons per day water allocation, 2.5 is designated for the cruise ship demand.
- DOWASCO is designated as the agency responsible for water supply in Dominica through the Water and Sewage Act of 1991. They supply domestic, tourism, commercial, industrial agriculture and bulk water export. Large-scale agricultural activities are noted to extract substantial volumes of water from the country's rivers and streams, but there is no record of this extraction.
- DOWASCO manages more than 40 water systems across Dominica, organised into zones—North, South, East and West—each featuring multiple treatment plants for water treatment services. The primary focus of water treatment is the mitigation of bacteria, achieved through one of three chlorination methods. DOWASCO manages a network of forty-three catchment areas, with at least five sourced from springs

- Regarding sewage disposal, Roseau, the capital, is served by a sizeable, centralised sewerage system, while Cane Field and Jimmit have two smaller sewerage systems. Surface water undergoes chlorination treatment for use as a potable water supply. 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. DOWASCO manages a sewerage treatment facility responsible for processing over half a million gallons of wastewater daily.
- Cistern systems are used in communities without access to potable water because DOWASCO only serves approximately 80% of the country's population. Despite these measures, excessive turbidity occasionally poses a significant quality concern, exacerbated by the presence of agricultural runoff containing fertilisers, pesticides and insecticides.
- In Dominica, individuals seeking to extract and sell water must obtain licences, paying royalties and fees based on their intended use. The tariff structure for water supply and sewerage prioritises 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.
- Increases in temperature and decreases in rainfall are occurring in Dominica and projected to continue into the 2100s with climate change. Increasing trend of hotter nights and a decrease in the frequency of very cool days and nights due to increasing temperatures. A decrease in rainfall will occur after the stream flow of the rivers in Domina due to prolonged dry spells. The current and future temperature changes will have significant impacts on multiple sectors apart from water including biodiversity and species distribution, an increase in pests and diseases and a decrease in food supply for wildlife.
- Saltwater intrusion is a major factor affecting the coastal communities of Dominica and will increase with SLR and coastal inundation due to the increase in storms affecting the country, resulting in losses of agricultural lands, increased stress on the freshwater supply from contamination, erosion and flooding and damage to critical infrastructure such as pipelines from the water supply systems.
- Climate variability and change pose challenges in the design and management of water resource projects. Drought has been a major concern in recent decades and

resulted in numerous fires of scrublands and rainforests, particularly in the months of April and May.

- Dominica's IWRM policy remains outdated with the laws and policies governing IWRM in the country still under review and pending approval by the government. The Water Sewerage Act (1989) and Forest and Wildlife Act (1990) also remain outdated, but a TOR has been developed for the development of a Water Resources Master Plan and a Pilot Water Safety Plan to make progress towards IWRM.
- An IWRM Survey was initiated in 2020 to reveal a Water Sector Strategic Development Plan that will revise the existing policy frameworks and legislative structures within Dominica's water sectors and fine-tune the draft IWRM policy, it will also enhance the water supply network and wastewater infrastructure while optimising water resources and improving water quality.
- Several policies and regulations indirectly impact watershed management, leading to conflicts arising from inadequate enforcement. Instances include permitting agricultural activities that may detrimentally affect the water supply, even in violation of the rules for the Stewart Hall Catchment. The improper disposal of solid waste and effluent from commercial and industrial ventures, coupled with suboptimal land management and agricultural practices, significantly impacts watersheds and coastal areas.
- These rural areas lack a centralised waste collection system, leading to household garbage often being discarded into nearby streams.

Main Challenges

- The lack of enforcement by various authorities on policies related to water conservation, management, financing and monitoring has impacted the supply of water.
- With escalating demands and anticipated shifts in rainfall patterns due to climate change, even a minor decrease in precipitation signals challenges for water security. 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
- The country has significant capacity constraints for water resource management.
- 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. Decision makers, policymakers, technocrats, researchers and others need 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 needed by water managers and others in many sectors.

Key Findings for the Dominican Republic

- The biggest user of freshwater resources in the Dominican Republic is the agricultural sector, taking up approximately 80% of the freshwater available. The national area under irrigation is estimated at 300 thousand hectares. Irrigation efficiency is very low. The most common type of irrigation applied in 97.4% of the irrigated areas is flooding. Although over 80% of the population in both urban and rural settings have access to (at least) basic sanitation systems, and access to (at least) basic drinking water sources, the quality and supply of the service still greatly affects the health of the vulnerable population.
- A publication about the contrast of water availability and demand (a water balance assessment) in the 31 provinces of the Dominican Republic, displayed a positive balance in 25 provinces (for 2015). However, in 14 of these 25 provinces, demand was very close to availability. Furthermore, in 11 provinces the net balance was precarious, (between 500 and 1,000 Mm3/a). In the remaining six provinces the balance is negative. These figures predict an increase in competition for water between users as the demand increases and the resource availability and capability of supply diminishes.
- Disaster risk management in the Dominican Republic is coordinated through the National Emergency Commission (CNE) which is a dependency of the National Council for Prevention, Mitigation and Response to Disasters, coordinated and chaired by the Executive Director of Civil Defence.

Main Challenges

- For decades, the governmental management approach in the Dominican Republic has been based on creating institutions to execute specific isolated tasks. This has

hindered intersectionality in the current management approach.

- The legal and policy framework for water management in the Dominican Republic is outdated. Discussions about updating it have been held for over two decades. The Dominican Republic has an enabling environment rated as medium-low because although it has a national hydrological plan, it lacks IWRM explicit laws and related policies.
- There are important challenges in the sanitation sector. For instance, there is no policy for faecal sludge collection or safe use of wastewater.
- Roles and responsibilities for the safe management of excreta in communities served by non-sewered sanitation are also still unclear, even though over 60% of the population is not connected to public sewers and must rely on onsite sanitation.
- Although there is still no clear plan for cost-recovery and overall financing of the water sector, the country has been taking steps towards obtaining financially sustainable conservation of its natural resources, through payment for environmental or ecosystem services.
- Information sharing is another challenge identified. The country possesses a national information system, and although the National Office of Statistics (ONE) compiles and publishes data and information on water resources, the expansion of their coverage is necessary.
- Although it is made up of 34 institutions, through which it carries out its activities, their operative branches are the Civil Defence and the Emergency Operations Centre. This Commission was created by decree No. 2784 of October 6, 1981, and ratified in article 10 of Law 147-02.

Key Findings for Grenada

- With an average annual rainfall ranging between 1,000 mm and 1,500 mm along the coastal zone and approximately 4,000 mm in the interior, Grenada is prone to water supply shortfalls during the drier months of the year.
- Grenada is well-known for its multiple rivers, streams, and watershed areas that make up the 71 watershed areas in Grenada and 20 watershed units in Carriacou. The bulk of the water supplied on mainland Grenada comes from a mix of 23 surface sources, six groundwater sources and rainwater harvesting to augment supplies during shortfalls in the dry season.

- Grenada's water resource management framework is inefficient, resulting in water quality and management challenges.
- The agriculture and tourism sectors of Grenada rely heavily on the availability of water for their activities.

Main Challenges

- There is an increased demand for water during the dry season, as a result of increased tourist flow from the hospitality sector and an increase in irrigation for the agriculture sector. Groundwater sources are used to supplement surface water during the dry season. Pollution both from agricultural practices and neglect of infrastructure and unregulated sewage disposal affect the water quality.
- The National WASA (NAWASA) of Grenada has a lack of adequate water storage, resulting in recurring problems in the dry season.
- There is a need for a comprehensive water resource management plan evident from the lack of legislature and policies leading to degradation of water quality.
- Metering of household users has resulted in improvements in the efficiency of domestic water use.
- IWRM development depends on public awareness and participation, as well as stakeholder input.
- A serious issue for the water sector is the weakness of the domestic water governance arrangements and the inability of these governance structures to address the water challenges that they are facing, as well as multiple policy deficiencies.
- Infrastructure and institutional frameworks are more of a concern to Grenada than the availability of water.
- In Grenada, the absence of effective land use policies and capable, empowered water resource management entities, has resulted in the degradation of watersheds and the compromising of water sources. Poor public access to information is a critical obstacle to IWRM.

Key Findings for Guyana

- Guyana features four primary rivers—the Berbice, Corentyne, Demerara, and Essequibo—as well as numerous smaller waterways, including creeks and streams. The Essequibo River, which drains more than half of the country, is of notable

international significance. Additionally, Guyana has around 178 groundwater wells and eight surface water sources.

- Guyana is rich in both surface and groundwater resources that are strategically located near populated regions and serve 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 is mainly used to support agriculture. The country of Guyana receives groundwater from three aquifers, where its shallowest upper sand layer ranging from depths of 30 to 60 metres and thicknesses from 15 to 120 metres, is largely unused due to 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.
- Guyana has two rainy seasons, one from November to February and the other from May to August, except for the Savannahs, which only has one rainy season from May to August. Annual precipitation averages about 2,300mm in Guyana, varying from 1,800mm in the Savannahs to over 4,300mm in rainforest regions.
- Guyana manages its surface water runoff through conservancies. Conservancies are large shallow dams formed by earth embankments. These conservancies enable the country to have a water supply throughout the course of the year.
- Droughts are driven by erratic rainfall distribution. Guyana experiences several flooding events during the months of April to August.
- 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. Only the Georgetown area sources its water supply from the East-Demerara Conservancy's surface water, which provides around 30% of the nation's water supply.
- Health and sanitation concerns are primarily biological and chemical contamination, especially along the coast where sewage systems discharge into the Atlantic Ocean.

Main Challenges

- Guyana' water management is riddled with challenges, whereby; urban areas struggle with inadequate sewage systems, limited water purification and poorly maintained distribution networks and a growing reliance on groundwater is observed in Amerindian communities in the hinterland, though the sustainability and extent of

groundwater supplies remain uncertain.

- The entity responsible for water production and sewage management in Guyana is Guyana Water Incorporated (GWI). Guyana's sewage infrastructure is very poor and has many challenges, including insufficient to absent sewage systems, poor purification practices in Georgetown and a significant reliance on septic tanks in rural areas.
- Although Guyana remains historically safe from water-related disasters, the climate models forecast an upward trend for further drying across the country. Sea level rise presents a significant risk to the country with saltwater intrusion as a threat to the coastal regions which are situated as much as 2 metres below sea level. A further concern for the country is the intrusion of saltwater into the river system. In 2017, Guyana ranked low on its development of a national water resources policy and its major legislation, the Guyana Water and Sewage Act of 2002, lacks provisions for the equitable allocation of social and economic benefits and the inclusion of women and vulnerable groups. Furthermore, Guyana's technical capacity in some of its agencies is very weak. For example, the Hydro-Meteorological Department holds the responsibility for data collection, monitoring and licensing under the Water and Sewerage Act of 2002. However, the department faces constraints in 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. Nevertheless, 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 WASA responsible for water supply and sanitation services. The act also addresses issues related to water abstraction, pollution control and water quality standards
- The terrestrial ecosystem of Guyana is exposed to a discharge of approximately 17.7 million litres of untreated sewage daily into the Demerara River estuary and land water pollution is driven by inadequate monitoring, limited financial resources and weak enforcement of environmental regulations.

- The majority of 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.
- The following key agencies were identified to be included in stakeholder mapping: The Hydrometeorological Service of Guyana, the Environmental Protection Agency, the Guyana Geology and Mines Commission, GWI and the University of Guyana.
- The lack of comprehensive and integrated policies hampers coordination among government agencies, leading to inconsistencies in decision-making and implementation.
- Limited access to safe drinking water and sanitation facilities, particularly in rural and marginalised communities, further compounds the challenge of ensuring water security for all and further vulnerability to externalities from industries such as agriculture and mining.
- Insufficient human, technical and financial resources hinder the capacity of government agencies, civil society organisations and local communities to undertake comprehensive water resources assessments, implement water management strategies and enforce regulations.
- The lack of data and inadequate monitoring and data collection systems, as well as gaps in hydrological and meteorological data, hinder the assessment of water resources status, trends and vulnerabilities.

Key Findings for Haiti

- Haiti experiences a warm, humid tropical climate with diurnal temperature variations. The country's average temperatures range from the high 70s (°F) in January and February to the mid-80s (°F) in July and August. 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.
- The island has a very diverse water resource base, which is used for irrigation, hydropower generation and domestic use. Haiti has several challenges as it relates to its water resources, including water quality, quantity and distribution. The island has

30 river basins. The island's largest river basin, Artibonite, covers approximately a quarter of the country's land area. Other noteworthy water sources are Lake Péligre, Les Trois Rivières, Estère, Grande Rivière du Nord, Grande Rivière du Jacmel and Grand'Anse. Haiti also has groundwater sources. 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.

- Haiti has both surface and groundwater sources with enough water to support its national demand. The country also experiences significant precipitation which allows the country to have abundant surface water and groundwater recharge. Domestic uses rely primarily on groundwater while industries like agriculture rely on surface water.
- Before 2021, Haiti had significant challenges related to outdated in relevant laws and policies for water resource management. However, in 2021 there has been progress in the country's IWRM development. This included the establishment of a dedicated consultancy funded by international donors to develop a national water sector strategy (NWSS). The financial mechanisms for water management also received dedicated funding mechanism and resource mobilisation from international partners. The formal launch of the NWSS in 2022 marked a significant step forward in Haiti's IWRM journey. This strategic roadmap outlined priority areas for intervention, including improving water infrastructure, enhancing water quality monitoring and promoting sustainable water use practices.
- Haiti's main legal, policy and institutional framework that support IWRM are as follows:
    - The Water Resources Management Act fosters management of water supply, sanitation services and the establishment of regulatory bodies and authorities.
    - The National Water Policy includes principles and strategies for water resource management.
    - 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.

Main Challenges

- Only 62% of urban and 34% of rural residents have access to distributed water. The island has yet to adopt an adequate level of water treatment and almost 30% of the country's households consume 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.
- Water management responsibilities are fragmented among six national ministries, each operating under its own rules and budgetary constraints. Over 50 non-governmental organisations (NGOs) are involved in water and sanitation efforts, which adds to the level of complexity of water resource management for the country.
- The country faces significant challenges with its sewage infrastructure, with many areas lacking adequate sewage systems. In these regions, septic tanks are commonly used. Specifically in Port-au-Prince, water distribution systems are plagued by poor maintenance and reliability issues, causing many residents to rely on individual cisterns for water storage. In many urban areas of Haiti, canals are used both as water sources and sewers. Climate variability and change further exacerbate these challenges, including:
    - Shifting precipitation patterns and prolonged droughts affect water availability and quality.
    - Rising temperatures and altered precipitation impact groundwater sources, with increasing sea levels leading to saline intrusion into freshwater aquifers.
- 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.
- Urban areas grapple with inadequate sewage systems, limited water purification and poorly maintained distribution networks.
- The erratic distribution of rainfall throughout the year exacerbates water-related issues in Haiti.
- Groundwater supply remains a concern for rural communities that rely on it.
- Fragmented legal and institutional framework with unclear and unrealistic roles

assigned to subnational governments due to capacity challenges.

- 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.
- 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.

Key Findings for Jamaica

- Groundwater resources represent a major share of Jamaica's freshwater resources, accounting for 84%. The resource is demanded by many sectors: residential, commercial, industrial, agricultural irrigation and tourism. The share of surface water amounts to 16%.
- Jamaica has sufficient freshwater resources to meet overall demand but suffers from uneven distribution and over-allocation.
- A vast majority (i.e., 92%) of the Jamaican population has access to reliable drinking water. Approximately 70 %% have access to piped water via connections to the delivery system as provided by the central provider, the NWC, which is responsible for the collection, treatment and disposal of sewage (provision of rural water is shared across NWC and Parish councils).
- Based on the Tracking progress on SDG 6.5.1, Jamaica ranked medium-low overall for IWRM implementation, ranking medium-high in three IWRM dimensions and low in the funding dimension.
- Drinking/potable water is monitored by the Ministry of Health with a shared harmonisation and interagency responsibility with the Water Resources Authority (WRA), the National Environment and Planning Agency (NEPA), and the Natural Resources Conservation Authority (NRCA).
- There was a significant amount of non-revenue water (NRW), leading to significant financial losses for both the National Water Commission (NWC) and the Government of Jamaica (GOJ).
- Jamaica's water resource management framework is replete with policies, legislations

and institutions which govern the water resource but lack intersectoral coordination.

- Widespread monitoring of the water resource occurs, and there is evidence of a National Ambient Water Quality Standard.
- Notable case studies have been conducted on IWRM in Jamaica with an expansive scope as seen in the Rio Minho Watershed and extreme success as seen in Eastern Portland, with other notable projects having occurred.
- Evidence of attempts at mainstreaming IWRM into policies, legislation, and institutional frameworks was noted in numerous instances and provides a base of leading examples for the region.

Main Challenges

- Major challenges to IWRM include lack of intersectoral coordination, lack of funding, high levels of NRW, non-establishment of the Water Resources Advisory Committee (WRAC), and inadequate enforcement.

Key Findings for Montserrat

- Montserrat has a tropical climate characterised by warm temperatures, high humidity and wet and dry seasons. The average annual temperature is 21 to 24°C (70°F to 76°F) during its low-temperature periods and highs of 27 to 30°C (80 to 86°F). The average annual rainfall is around 57 inches, and December to May is the island's dry season.
- Water sources are primarily springs and groundwater aquifers because Montserrat is a volcanic island. The island has a large supply of natural spring water, which is used for domestic and commercial purposes.
- The island has multiple watersheds including ghauts, rivers and streams which deposit into the sea at the island's coastline. The island, however, has no lakes and its rivers do not have a continuous supply of water throughout the year. Water supply is solely sourced from a network of springs located in the Centre Hills, which is recharged by rainfall.
- There are six springs in Montserrat (i.e., Killiecrankie, Hope, Olveston, Quashie, Lawyers and Forgathy springs) and one well that supplies water to 4096 connections in the piped water system around the island. Water is gravity-fed, disinfected and distributed across the island. The island has 11 reservoirs which combined has a

capacity of 1,665,000 gallons of water. A majority of the water sourced from these springs comes from Killiecrakie.

- Montserrat's water quality testing is carried out by CARPHA's Environmental Laboratory in St. Lucia. Tests are done for bacteria and chemicals.
- Water management is done by Montserrat Utilities Limited (MUL), which is governed under the Utilities Act of 2007. MUL has the responsibility to supply water to the entire nation. The Environment Department, however, is overall responsible for environmental issues.
- Being a biodiversity hotspot, having three important bird areas and two proposed Ramsar Sites, supporting four plants, one reptile, one amphibian, four bat, four turtle and two bird species, excessive water extraction is of concern for habitat degradation which may affect these important species. Furthermore, inadequate wastewater management practices signal a potential threat to soil and water quality.
- Currently, Montserrat has 20 km² of cultivated land, constituting 20% of the country's total territory. Although the agriculture sector is no longer well-developed on the island, it has become a focus of the Montserrat government for revitalisation. Within this strategic pathway, Montserrat plans to increase water use efficiency and decrease the impact of hydroclimatic hazards.
- MUL treats approximately 60,000 gallons of sewage every day. Wastewater and water quality data are not readily available.
- Each year, Montserrat allocates USD 2.3 million for water distribution, but this budget is not enough to carry out all the components of IWRM. Revenues from the island's water usage form part of the Country's Consolidated Fund and, therefore, lack specialised purposes for IWRM.
- Montserrat is a member state of the OECS and the 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.
- Agencies that play a role in water resource management for Montserrat are Monserrat Utilities Limited, the Department of Agriculture, Physical Planning and Development Services, the Department of Environment and Lands and the Survey Department.

Main Challenges

- Inadequate wastewater treatment and contaminated runoff pose a threat also to the marine environment of Montserrat. Coral reefs and mangroves of Montserrat require sustainable water use and comprehensive wastewater management to mitigate adverse impacts.
- MUL has weak financial resilience and may experience difficulties recovering from any external shocks such as natural disasters
- Infrastructure is dated and may cause significant inefficiencies in water distribution.
- The island has an inadequate amount of water storage infrastructure, which has led to instances where the level of water supply fell below the three-day standard level and as a result, water rationing was required by the government.
- The operational efficiency of the MUL is hindered by the agency's institutional capacity, primarily in the training gaps of its officers.
- Policies and Laws of the Island relating to water resource management are outdated.
- The current 20% overflow of the Olevston Mountain springs may be at risk of becoming over-extracted due to domestic demand.

Key Findings for Saint Kitts and Nevis

- Saint Kitts and Nevis is a water-scarce country, and the main water sources are surface water and groundwater. The total renewable water resources are estimated at 23.6 million cubic metres annually and the majority of water supplied is sourced from groundwater.
- Rainwater harvesting is commonly practised in Nevis, but it is limited in its use on Saint Kitts. Desalination is not widely used on both islands.
- Approximately 99% of the water produced is used for municipal purposes with a small volume used for irrigation. In 2012, 98% of the total population had access to improved water sources and, in 2007, 87% of the total population had access to improved sanitation.
- Surface water resources are threatened by rising sea levels and increasing temperature causing higher evaporation rates. Also, the groundwater aquifers are being impacted by sea level rises and will eventually be negatively impacted by saline intrusion due to climate change.

- The Water Service Departments on Saint Kitts and Nevis manage the water resources on the respective islands and are responsible for the identification, upkeep and protection of water supply sources for human consumption. The Department of Agriculture has the responsibility for the preservation of the forest, which serves for the protection of surface and groundwater resources. In addition, the Conservation Commission under the National Conservation and Environmental Protection Act has the responsibility for the efficient management of watersheds in Saint Kitts and Nevis.
- The need for a water policy and a revamp of the institutional arrangements was identified as a priority for the country to address the vulnerability of aquifers on both islands to pollution and seawater intrusion, inadequate wastewater management, water infrastructure and institutional and regulatory capacities. A strategic plan was developed for the Water Resources Management Agency. However, it has made little progress in implementing the provisions.
- Pressure for agricultural land has caused small farmers to clear forested plots along slopes for farming, causing deforestation, soil erosion and water pollution. Beach erosion and waste disposal have been recurring challenges in Saint Kitts and Nevis.
- The National Emergency Management Agency (NEMA) was established in 1995 under the National Disaster Management Act (1998) and is responsible for the coordination of pre- and post-disaster management activities. The Saint Kitts-Nevis National Disaster Mitigation Council was established in 1999 and comprises government- and NGOs. The Council provides general oversight and related policy guidance. The Nevis Disaster Management Department is responsible for disaster management activities in Nevis.
- As part of the National Climate Change Adaptation Strategy for Saint Kitts and Nevis, adaptation actions include the following:
    - Strengthening mechanisms for the application of science and technology for climate-smart solutions, including drought-resistant species and use of aquaponics and aquaculture.
    - Integrating climate-proofing considerations, including ecosystem-based solutions that maintain natural defences against coastal erosion, flooding, drought and heat stress, in the design and construction of new physical infrastructure and encourage the private sector and communities to retrofit

existing buildings through tax breaks and other incentives.

- Revising and enforcing building codes and standards, such as coastal setbacks, to climate-proof any new tourism-related infrastructure, including through ecosystem-based solutions that maintain natural defences against coastal erosion, flooding, drought and heat stress.
- Establishing and maintaining early warning systems for hazards, including droughts, floods, heatwaves, hurricanes and storm surges that are climate-related, to enable effective disaster preparedness and response with a focus on vulnerable communities and sectors.

- The Intended Nationally Determined Contributions of Saint Kitts and Nevis included measures to increase water availability such as rainwater harvesting, deep-well drilling, construction of dams and desalination plants, and measures to reduce water demand such as replacement of inefficient devices, education and public awareness, reduce non-revenue losses and metering of government and public institutions.
- Drought conditions related to the effects of El Niño in 2015–2016 put pressure on drinking water resources and agricultural production. Given that the municipal sector accounts for most of the water demand, domestic activities, such as cooking, cleaning and childcare which are traditionally carried out by women, can be affected by inadequate water supply and water restrictions due to droughts or extreme weather events. Moreover, women, as the main users of water in the household (particularly in single-parent female-headed households) are impacted by the increased cost of water.
- During times of water scarcity or drought, when water must be accessed from community faucets, water trucks, irrigation ditches, rivers and wells, women's responsibilities in sourcing and allocating water for domestic use tend to be significantly increased. For Saint Kitts and Nevis, resilience in the water sector should support rural women and their access to potable water and be based on the gender dynamics associated with disaster preparedness and the impacts of natural hazards and extreme weather events.
- Gender was not identified as a cross-cutting issue. However, the IWRM framework captures the need for effective coordination among wide-ranging and diverse stakeholders which could establish avenues for gender mainstreaming.
- Saint Kitts and Nevis is considered to have a high rate of human development.

However, economic activity has recently contracted due to the COVID-19 pandemic, particularly within the tourism sector which is the country's highest revenue-earner.

Main Challenges

- Outdated legislation, need for new institutional arrangements, a lack of human and financial resources, overlaps in responsibilities of government organisations, limited public funding and access to long-term loan financing, land use changes, vulnerability to the impacts of climate variability and change and data collection and availability.

Key Findings for Saint Lucia

- Saint Lucia's volcanic origins and geophysical characteristics greatly influence its relief and expose it to the impacts of severe hydrometeorological events. The island is considered to have a high rate of human development. However, due to the COVID-19 pandemic, the economy has recently contracted, particularly within the tourism sector. This signals social problems such as a high rate of unemployment and weakened access to goods and services.
- Saint Lucia currently has four major water supply systems (WSS) and 19 minor supply systems. The average daily demand for water in Saint Lucia is roughly 60,000 m3. Approximately 53% of the water produced for the municipal supply originates from the John Compton [Roseau] Dam/Theobalds Plant WSS which supplies the north of the island.
- The southern regions of the island are considered water-scarce, particularly in the dry season. The largest water consumers are the Domestic Sector and the Hotel Sector.
- Saint Lucia's water sector is governed by the Water and Sewerage Act and the National Water Policy. However, there are several other pieces of legislation and policy documents which provide guidance for IWRM.
- The country has also developed a draft National Policy on Wastewater Management.
- Through the support of the World Bank, an ongoing review of the 2004 National Water Policy has resulted in the preparation of a Water Policy Update for Saint Lucia: Strategic Water Sector Review (part 1) and Policy Proposal and Implementation Strategy (part 2) has been developed. Although these documents are currently still in draft, they provide a comprehensive assessment of IWRM in Saint

Lucia and propose key actions to address shortcomings within the sector.

- Wastewater management is sorely lacking. In 2016 it was estimated that Saint Lucia had a water supply deficit of 35% and sanitation levels at only 74.3%. About 7% of the population is currently connected to one of the three public sewer systems. There is currently only one wastewater treatment facility on the island, and effluent collected from other areas of the island is released directly into the sea.
- In recognition of the detrimental impacts of past extreme hydrometeorological conditions on the island and the propensity for intensification due to climate change, several national management and response plans have been developed. These include but are not limited to the National Water Management Plan for Drought Conditions and Floodplain Management and Flood Response Plan.

Main Challenges

- Minimal studies have been done into groundwater exploration, and those that have been completed agree that the island's groundwater resources are negligible or have quality issues. Surface water abstraction remains the main source of municipal water.
- The disjointed nature of the legal, policy and institutional environment presents challenges to the implementation of IWRM. The Water Resources Management Agency (WRMA) was established to be the lead agency for the implementation of IWRM. The Water and Sewerage Company (WASCO) is mandated to manage the provision of the municipal water supply. Additionally, the mandate for forest/watershed protection, conservation and development falls to the Forestry Department.
- Other challenges hindering the implementation of IWRM include access to sustainable financing, a deficit in technical, personnel and equipment requirements, land use, land use change and land tenure issues, data collection and availability, and interagency/intersectoral collaboration and communication.

Key findings for Saint Vincent and the Grenadines

- Surface water represents the major source on the mainland with multiple competing uses including domestic and commercial consumption, tourism, agriculture and hydroelectricity. These uses have influenced not only water yield and discharge rates but also water and watershed quality. There is no surface water in the Grenadines.

- About 90 % of the population is connected to the central delivery system managed by the Central WASA (CWSA), which also manages sewerage collection, treatment and disposal for a limited number of connected customers near the capital city.
- Potable water quality is monitored by the Public Health Department, but source water quality is not routinely assessed, as responsibility is not properly assigned. Data on source water quality is not readily available. There is a requirement for coordination and harmonisation among the actors, all of which are public.
- St. Vincent and the Grenadines have had several successful local and community project experiences with IWRM but have failed to up-scale these successes to national-level interventions.

Main Challenges

- There is no water policy, water resource management policy or legislation defining and elaborating on the management of water resources. The CWSA Act provides the CWSA with powers over the supply and distribution of water. No management structure exists for water resource management, although there are complementary policies and legislation that cover forest management and environmental management.
- Groundwater exploration has been minimal on the mainland although the authors of some reports suggest that quantities may be adequate to consider it a reliable source. This source has been exploited on the Grenadines, but its small size limits the reserve and makes contamination easier.
- Sewerage is mainly disposed offshore; a possible environmental concern, as the infrastructure has been reported to be losing integrity.

Key Findings for Suriname

- Suriname's Internal Renewable Water Resource (IRWR) is about 99 km³ annually and water wealth contributes to economic activities but less than 1% is used due to efficient water use. The Country has both ground and surface freshwater sources.
- Domestic access to water remains critical, with reliance on rainwater in rural areas and groundwater contributing significantly.
- Major river basins like Maroni and Corentyne are pivotal, collectively constituting 152 km³ 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 km³ in 2010.

- Water extraction is used to support agricultural needs, municipal usage, and industrial activities with 70% of 615.9 million m³ used for agriculture.
- Disparities in water access contribute to social tensions and security concerns. A 20% increase in social conflicts linked to water access disparities, posing security risks.
- Suriname has issues in wells from saltwater intrusion due to overpumping. Drainage poses a significant challenge to irrigation in Suriname. brackish water encroachment in certain areas, such as Nickerie, Paramaribo's north and Commewijne.
- 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. Climate change has affected the country in the following ways:
    - Annual flooding causes significant damage to water infrastructure.
    - Salt intrusion stresses the need for costly purification techniques.
    - Salt intrusion reduces the availability of fresh surface water, affecting agriculture.
    - Sea level rise endangers the coastal zone, increasing flooding risks.
    - Coastal areas are at risk of extensive flooding due to rising sea levels.
- Suriname signed the Amazon Cooperation Treaty (TCA) in 1978, joined by Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname and Venezuela, to signify Suriname's dedication to fostering harmonious development in the broader Amazon region. Participation in the Ramsar convention in 1971 highlights the significance of the country's wetlands. The key legislative, policy and institutional considerations for Suriname are as follows:
    - Suriname's IRWR is about 99 km³ annually and water wealth contributes to economic activities but less than 1% is used due to efficient water use. The country has both ground and surface freshwater sources.
    - Domestic access to water remains critical, with reliance on rainwater in rural areas and groundwater contributing significantly.
    - Major river basins like Maroni and Corentyne are pivotal, collectively constituting 152 km³ 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 km³ in

2010.

- Water extraction is used to support agricultural needs, municipal usage, and industrial activities with 70% of 615.9 million m^3 used for agriculture.
- Disparities in water access contribute to social tensions and security concerns. A 20% increase in social conflicts was linked to water access disparities, posing security risks.
- Suriname has issues in wells from saltwater intrusion due to overpumping. Drainage poses a significant challenge to irrigation in Suriname. brackish water encroachment in certain areas, such as Nickerie, Paramaribo's north and Commewijne. The stakeholder mapping resulting from the consultations held is as follows:

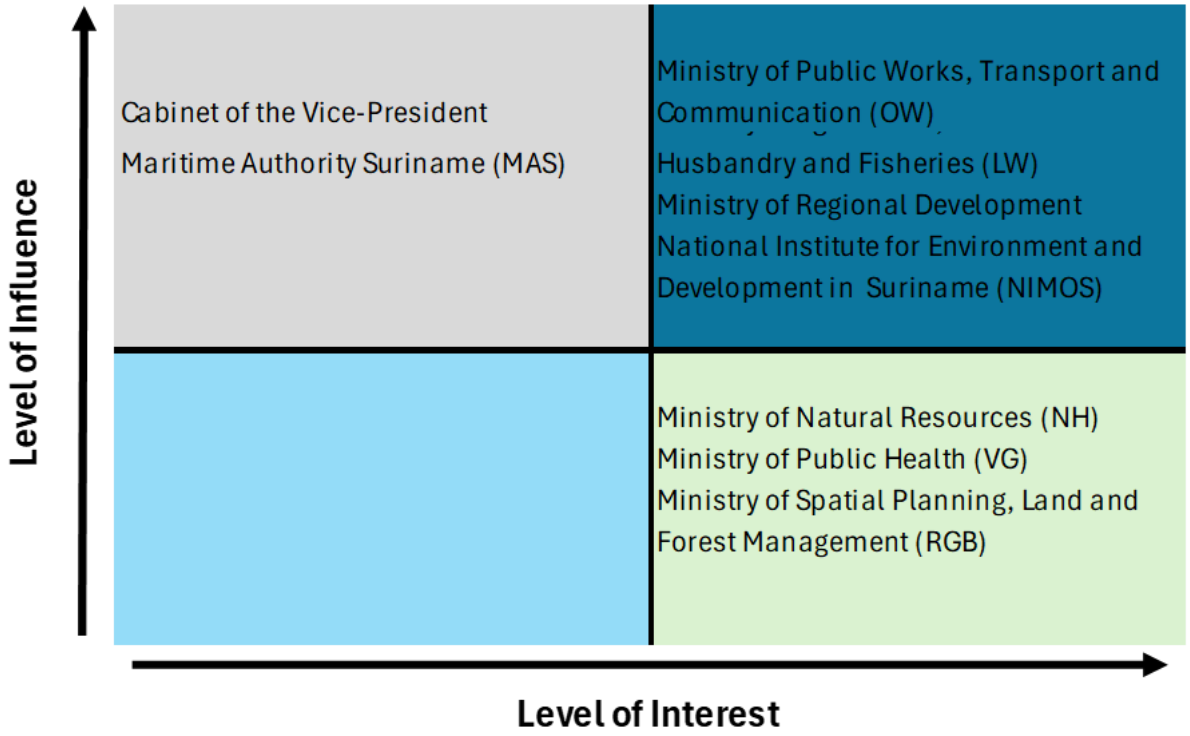

Figure 2. Stakeholder Map

- In addition to these agencies listed in the stakeholder mapping exercises, stakeholders recommended that the National Coordination Center for Disaster Relief be added as a stakeholder with high influence and high interest. The Stichting Water Forum Suriname was also recommended as a stakeholder with low influence and high interest.
- The industrial sector heavily depends on water resources, particularly mining and emerging oil activities. Suriname faces complex water management issues,

necessitating an IWRM strategy to address challenges such as climate change, legislative gaps and outdated infrastructure. Significant obstacles to efficient water management exist in the form of legislative loopholes in current water-related regulations. Matters for institutional strengthening are as follows:

  - 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.
  - Establishing mechanisms for regular private sector involvement and partnership is proposed.
  - Institutionalising stakeholder consultation and increasing public engagement initiatives are suggested.
  - Long-term capacity development initiatives have been pursued through international collaborations. However ongoing efforts require increased financial resources and broader jurisdiction to ensure sustained progress in building the capacity of the staff and key stakeholders.

- Have issues ensuring safe drinking water and dealing with climate change. These difficulties include the need for centralised monitoring systems, wasteful water consumption and antiquated infrastructure.
- 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.
- 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.
- The economy of Suriname is driven by mining (gold and bauxite), agriculture, oil and fisheries. Ample freshwater forms a solid foundation for economic development and underscores Suriname's potential for sustainable agricultural practices and other economic activities reliant on water.
- Suriname's long-term economic outlook is optimistic, with the discovery of offshore oil deposits expected to contribute to fiscal prospects. Effective governance,

institutional strengthening and addressing environmental consequences are essential for ensuring sustainable and inclusive economic growth.

- Sustainable water use supports ecotourism.
- Relating the development of a regional IWRM framework for the CARICOM Region, the following were recommended by the Suriname stakeholders who attended the consultations:
    - The recommended institution to host the CWP is the Ministry of Natural Resources (NH).
    - Potential sources of financial support for the establishment of a CWP in Suriname are the UNDP, UNEP/CTCN, GEF and the Surinamese government.
    - A current measure that has been identified to address climate-resilient infrastructure by stakeholders is the Mangrove Rehabilitation Project.
    - Suriname has prioritised policy development in its national agenda.
    - A successful example of investments in the water sector for Suriname is the Suriname Global Climate Change Alliance Project.
    - Stakeholders have identified the following sectors as the high-demand sectors of water in Suriname: Extraction of raw materials, farming/fishing. utilities, health and the public sector.

Main Challenges

- The following are the reasons identified that limit or hinder water investment in Suriname: political constraints, lack of public awareness, competing agendas among water users, lack of capacity at different management levels, and lack of legal/policy framework.
- Wastewater issues experienced by Suriname are as follows:
    - A 25% increase in water wastage due to inefficient infrastructure contributes to resource depletion.
    - 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.
    - Loss of water quality and erected barriers threaten ecosystems.
    - As it relates to climate change/DRR policy in Suriname only draft versions of

flood warning systems exist. However; this requires updating.

- Limited research on the water problem hinders effective solutions.
- Inefficient water uses due to old infrastructure impact sustainability.

Key Findings for Trinidad and Tobago

- The long-term average annual renewable groundwater resources for Trinidad and Tobago are an estimated 614 million cubic metres (MCM). Long-term average annual renewable surface water resources are estimated at 3,740 MCM. The total IRWR are 3840 MCM per year.
- The three major groups of abstractors are the WASA (96%); the industrial/commercial sector (3%); and the agriculture sector (1%). In 2015, approximately 382 MCM of public water was supplied per year, with estimates of 60% surface water, 23% groundwater and 17% desalination.
- There are four surface water reservoirs found in Trinidad and Tobago. These dams have a capacity of 72 million m3. The largest of these dams on the Caroni River has a capacity of 46.6 million m3 and is the main supplier to central Trinidad.
- The water quality in Trinidad and Tobago is considered to be good; however, pollution from sewage and industrial effluents combined with soil erosion and unplanned developments; high levels of biological oxygen demand, bacterial content, turbidity, and the presence of chemical pollutants in rivers is a concern; groundwater systems are also polluted from hazardous waste dumps, underground fuel storage tanks, untreated sewage; finally, industrial effluents pose a considerable threat to raw water quality.
- Water resource management is a critical development issue for Trinidad and Tobago. The government of the Republic of Trinidad and Tobago is currently aiming at first-world status by 2030 using five strategic themes related to the Vision 2020 pillars, National Policy Framework and the Global Development Agenda.
- There are several systems that are interrelated with IWRM in Trinidad and Tobago. These are terrestrial ecosystems that are affected by changes to land use that have negatively affected water resources, through forest fires, quarrying, slash and burn agriculture, increase in demand for development and improper land use practices; freshwater systems that provide habitats for various species that are crucial to human livelihoods and are affected by pollution especially from sewage and industrial

effluents; agriculture which requires water resources to ensure food security and rural development. A lack of proper agricultural practices affects the quality and quantity of available water resources; human health and sanitisation require that the government place focus on improving the quality of wastewater effluent to minimise negative effects on humans and the environment.

- The government of Trinidad and Tobago has identified the need for legislative reform to allow for effective management of the water and wastewater sector and has developed the National Integrated Water Resources Management Policy (NIWRMP) to do so.
- There are several agencies and institutions involved in the planning, management and execution of water resource management functions. These include the Environmental Management Authority (EMA), Ministry of Health (MoH), Ministry of Agriculture Land and Fisheries (MoALF), Tobago House of Assembly (THA), Town and Country Planning Division (T&CPD), WASA, Drainage Division (DD), Water Resources Agency (WRA) and the Institute of Marine Affairs (IMA). The main legislative instruments are the Water Sewerage Act (1980 Revised), the Waterworks and Water Conservation Act (1980 Revised), the Environmental Management Act (2000 Revised) and the Public Health Ordinance (1950).
- The water management policies implemented in Trinidad are the NIWRMP, which is supported by the National Development Strategy and the International Conference on Water and the Environment; National Policy and Programmes on Wetland Conservation for Trinidad and Tobago (2001); the National Environmental Policy (2006); the National Programme of Action for the Protection of the Coastal and Marine Environment from Pollution from Land Based Sources and Activities 2008–2013; the National Action Programme to Combat Land Degradation and to Mitigate the effects of Droughts in Trinidad and Tobago 2013–2017 and the National Climate Change Policy (2011).

Main Challenges

- The main challenges that exist for IWRM are policy and institutional challenges from delays in enforcing new policies, a lack of policies ensuring sustainable use of resources, outdated policies and disparities and sectoral approaches to water resource management. The water supply system in Trinidad and Tobago faces significant

issues, including uneven distribution and deteriorating infrastructure, which negatively impact customer services, water supply reliability, and water quality. The country's small size exacerbates these challenges, as it complicates the management of demand, conflicts, and competition for resources, further intensified by climate change. Inappropriate actions, such as deforestation, unplanned and improper housing development, and unsuitable agricultural practices in the upper regions of watersheds, contribute to these challenges. The increase in population and socioeconomic activities has led to heightened pressure on water resources, resulting in increased pollution that threatens the availability of these resources. Additionally, data constraints, such as the lack of necessary data for the application of water resource management tools, further complicate the situation.