

Chapter 5 Commonwealth of Dominica

5.1 Basic information

5.1.1 Outline of the country

The Commonwealth of Dominica (hereafter referred to as “Dominica”) is located near 15 degrees 30 minutes north and 61 degrees 20 minutes west, the northernmost part of the Windward Islands, and is a small island country with an area of approximately 750km².

The capital is the Roseau, located in the southwestern part of the island, and the population composition is made up of Africans (84.5%), mixed race (9%), indigenous people (3.8%), and others. It is considered one of the poorest countries in the Eastern Caribbean, and although social indicators such as poverty and literacy are higher than those of developing countries with the same income level, they are lower than those of other Caribbean countries.¹

5.1.2 Socio-economic conditions

(1) Population dynamics

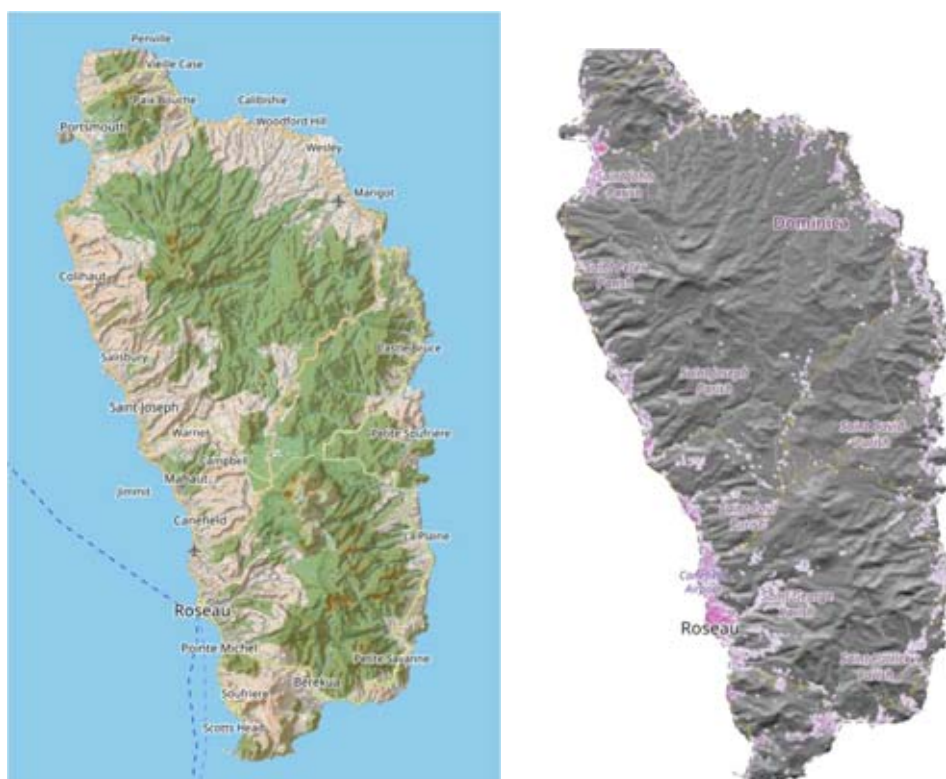
Population dynamics in 2010 are shown in the table below, with a population growth rate of 0.4%. The population is distributed in the coastal area including the capital from the steep topographic condition spreading in the central part of the island.

Table 5-1 Demographic and Economic Status of Dominica

	Items	Unit	2010	2015	2020
Basic info.	Total population	inhab	70,880	71,180	71,990
	Urban population	inhab	48,650	50,910	53,350
	Rural population	inhab	22,790	22,260	21,700
	Population density	inhab/km ²	95	95	96
Economics	Gross Domestic Product (GDP)	current US\$	493,825,926	540,737,037	506,614,815
	Agriculture	value added to GDP	X	56,622,222	76,000,000
	Industry	value added to GDP	X	38,600,000	45,577,778
	Services	value added to GDP	X	316,962,964	339,418,518
	GDP per capita	current US\$/inhab	6,967	7,596	7,038

Source: FAO AQUASTAT

¹ Source: Overview of Dominica (2024) by the Embassy of Japan in Trinidad and Tobago



Source: (Left) OpenStreetMap, (Right) EU, Global Human Settlement Layer

Figure 5-1 Population distribution of Dominica (2020)

(2) Macroeconomics

Key economic indicators are shown in Table 5-2. The GNI per capita in 2022 is USD 8,430, which leaves DOM as a DAC listed country. Since GDP per capita is USD 8,351 and the GDP per capita growth rate is 5.65% per year, GDP per capita in 2027 would be USD 10,992 if this growth rate continues for five years.

The economy of DOM was once dependent on agriculture represented by bananas, but its focus on tourism has gradually increased, making the government eager to invite ecotourism. They also worked on policies to promote offshore finance, and began developing geothermal energy sources together with the private sector. In September 2017, however, the Hurricane Maria caused severe damage on agricultural production and all of transportation and physical infrastructure. Dominica is one of the five Eastern Caribbean countries that have introduced the Economic Citizenship Programme, which allows foreign investors to obtain citizenship by making a certain financial contribution.

Table 5-2 Key Economic Indicators of Dominica

GNI (in USD million)	GNI per capita (USD)	GNI growth rate (%/year)	GNI per capita growth rate (%/year)	Inflation rate (%/year)	Trade balance (in USD million)
606	8,430	No data	No data	7.8	-209.1
GDP (in USD million)	GDP per capita (USD)	GDP growth rate (%/year)	GDP per capita growth rate (%/year)	Unemployment rate (%)	Service revenues and expenditures (in USD million)
607	8,351	5.65	5.18	No data	No data

Source: World Bank (2022) World Development Indicators, Moody's (2022) Economic Indicators, CDB (2022) Dominica Economic Brief

(3) Financial Position

The central government's current account balance recorded a surplus of approximately USD 74 million in FY 2022, with revenues of USD 304 million and expenditures of USD 230 million, growing to a surplus USD 143 million in FY 2023, with revenues of USD 383 million and expenditures of USD 240 million. A surplus of USD 156 million is projected for FY 2024. On the other hand, the ratio of public debt to GDP remains high at just under 100%.

Table 5-3 Current Accounts and Public Debt in Dominica

Current revenue (in USD million)		Current expenditure (in USD million)		Outstanding public debt (in USD million)		Outstanding public debt percentage by GDP	
FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast
304	383	230	240	592	598	97.7	98.4

Source: Government of Dominica BUDGET ADDRESS 2023-2024 (2023), BUDGET ADDRESS 2022-2023 (2022), Debt Portfolio Review, Statista 2024 (2023)

(4) Business environment

The Ease of Doing Business Index is 60.5 (2020). This ranks 111th out of 190 countries, in the middle of the international rankings, but exceeds the 59.1 in Latin America and the Caribbean region, which is the second highest among the six countries surveyed. The Corruption Perceptions Index is 56, which ranks 42nd out of 180 countries surveyed in the world and second among the countries covered in this survey.

(5) National Development Plans

In Dominica, where Hurricane Maria had an extremely adverse impact on the economy and society, the National Resilience Development Strategy 2030 was developed by the Ministry of Finance, Economic Development, Climate Resilience and Social Security. Water resources management is identified as a priority for "Environmental Management," one of the three categories of sectoral strategies. The strategy designs a framework; in

the event of a disaster, under the objective of "managing a safe, affordable and reliable water system", three outcomes: sustainable and resilient alternative to existing water intake method adopted; maximum 50% of intakes disrupted with restoration within 2 weeks; and more than 60% of the population receiving water within a week, are supposed to be evaluated through monitoring indicators.

(6) Outline of electric power business operation

The electricity business is operated by DOMLEC (Dominica Electricity Services Limited). In 2022, the government purchased the company's shares from EMERA, the largest shareholder at the time, for a 52% stake. Presumably the company will be affected more by the government's energy policies. The company is expected to make a loss despite a 20% increase in the metered electricity tariff after fuel cost adjustment due to the recent sharp rise in fuel costs. However, the electricity rate as of 2022 was 1.2567 XCD (approximately 72.8 JPY; May 2024 rate) per kWh, which is the highest among the Eastern Caribbean countries, and is a burden on the country's population².

(7) Power infrastructure development status³

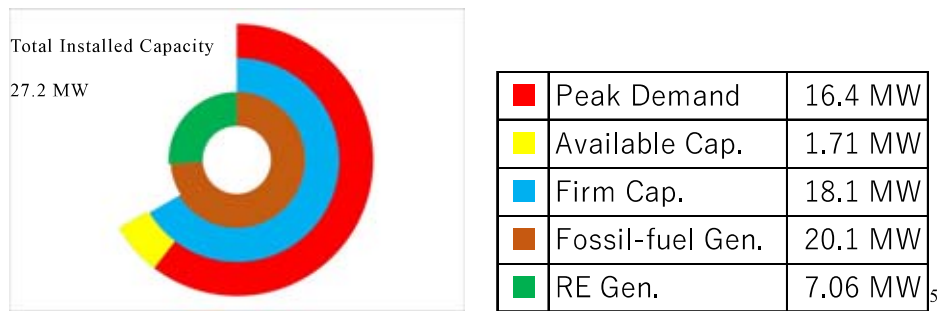
With regard to the supply-demand balance in DOM, the peak demand is 16.4 MW while the firm capacity is 18.1 MW during the drought period when hydropower generation is limited. It can be said that the redundancy of 9.5% is secured. In 2023, however, load shedding was implemented from August to November due to power shortage caused by simultaneous failure of diesel generators and hydroelectric power plants.⁴

In 2021, the country's electricity generation consists of thermal power (installed capacity 18.9 MW) and hydropower (installed capacity 6.64 MW), and small to medium scale solar power generation (total installed capacity 0.42 MW) for the private sector, as shown on Figure 5-2. Like other Eastern Caribbean countries, the country relies solely on imported fuel for its thermal power generation. Hydropower plants in the country have been constructed from the 1950s to the 1990s, and a decline of power generation capacity has been observed due to the aging and damages caused by natural disasters. For the time being, the rehabilitation of PADU Hydropower Station has been completed in 2022, but the further rehabilitation of other hydropower plants will be required in the future.

² Annual Report 2022; DOMLEC, 2023. An average electricity tariff of targeted countries (including fuel surcharge) is 1.051XCD. (Excluding ANU where the fuel surcharge is not publicized.)

³ Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022
Annual Report 2022; DOMLEC, 2023

⁴ As of February 2024, the above-mentioned failures were repaired and no load limitation due to power shortage was implemented.



Source: Prepared by JST

Figure 5-2 Outline of electric power situation of Dominica

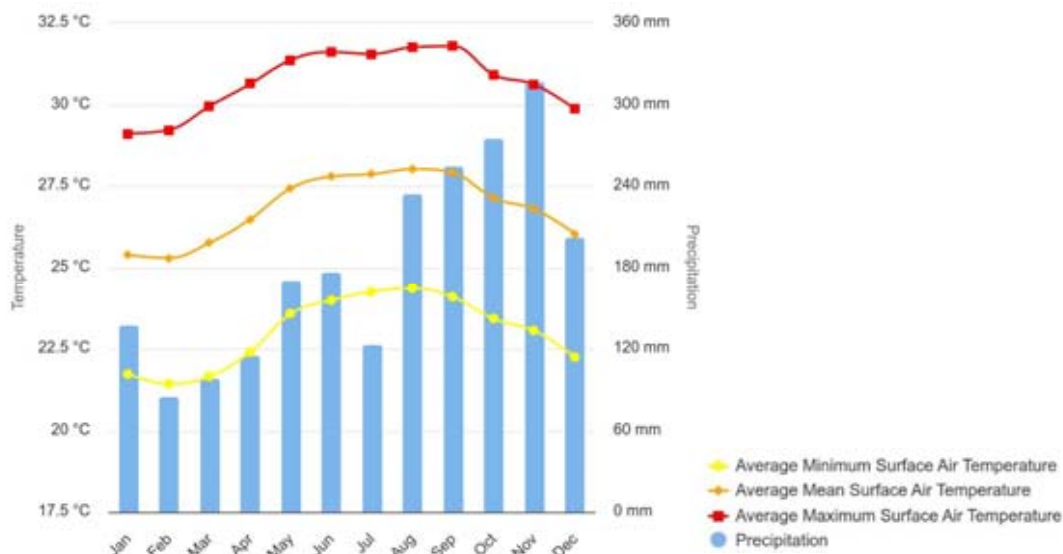
The ongoing renewable energy programs includes constructing a 10 MW geothermal power plant, which is expected to be completed in 2025. It is estimated that the country has a potential of 1,390 MW for geothermal power generation. If the geothermal power generation business, which is not affected by the weather, goes on track, it will be realistic to replace 100% of renewable energy in the near future and to make financial contributions to the country’s economy by exporting energy.

⁵ Peak Demand: Demand electricity, Available Cap.: reserve capacity, Firm Cap.: feed-in capacity, Fossil-fuel Gen.: thermal power plant capacity, RE Gen.: renewable energy plant capacity

5.1.3 Natural conditions

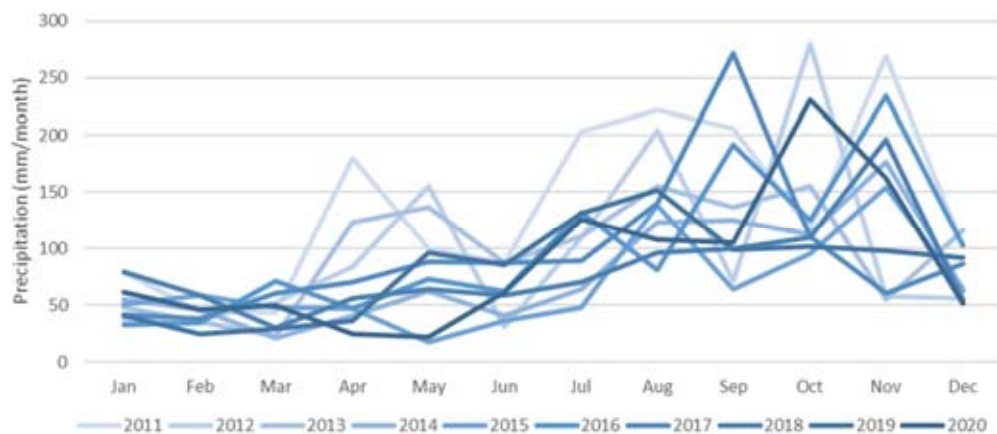
(1) Weather conditions

Dominica has a tropical climate with average temperatures of around 25-27°C, dry seasons from December to April, and rainy seasons from May to November, of which June to October are hurricane seasons. Figure 5-4 shows the monthly precipitation for 10 years. During the dry season, rainfall is particularly low between January and March. Normally, the rainy season starts in May, but recently the rainy season has tended to be delayed.



Source: World Bank Climate Change Knowledge Portal
 Note: Average data for 1991-2022

Figure 5-3 Average temperature and precipitation in Dominica



Source: Prepared by JST based on World Bank Climate Change Knowledge Portal
 Note: Monthly data for 2011-2020

Figure 5-4 Monthly precipitation in Dominica

Table 5-4 Monthly Precipitation in Dominica

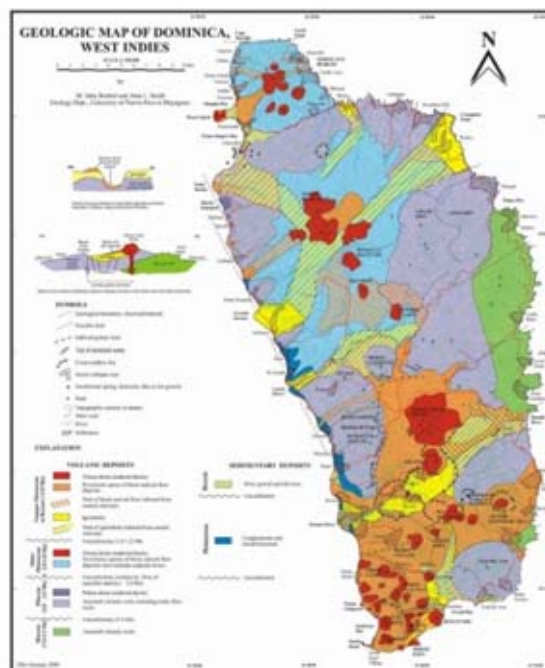
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	79	44	43	179	100	87	203	222	206	116	269	102	1,650
2012	37	38	52	84	154	31	110	204	71	280	58	56	1,174
2013	47	35	23	122	136	87	110	155	136	155	55	115	1,178
2014	55	46	21	40	62	40	64	122	125	112	176	64	929
2015	50	59	48	47	18	37	48	138	64	95	154	62	820
2016	33	35	71	47	73	62	132	81	192	125	234	103	1,186
2017	41	38	60	70	88	87	89	140	271	110	61	86	1,141
2018	79	58	30	55	64	59	70	96	100	109	196	54	970
2019	41	24	29	37	96	85	131	151	99	101	97	92	983
2020	61	46	50	24	22	61	126	108	105	230	162	52	1,047

Source: Prepared by JST based on World Bank Climate Change Knowledge Portal

Annotation: mm/month

(2) Topographical and geological conditions

Dominica has the most mountainous regions among the Lesser Antilles, and 62% of the land area is known as a greenery-rich country covered with tropical lowland forests. The highest point is Morne Diablotins (altitude 1,447 m), and there are mountains such as Towa Piton (altitude 1,342m) in the southern part of the island. The Dominica has two volcanoes in the northern part and three volcanoes in the southern part, and the Morne Watt recently experienced a small eruption in 1997. For this reason, the southwestern part with the same volcano is new as a geological age, and it is a national land composed of volcanic rocks and volcanic sediments on the whole except limestone locally found on the west coast.



Source: Seismic Research Unit, The University of the West Indies, Trinidad and Tobago

Figure 5-5 Saint Lucia topographic and geological distribution maps

5.2 Policy and legal framework related to the water sector

5.2.1 National water policy

In 2011, the National Integrated Water Resources Management Policy was enacted as a basic national water policy for Dominica. The table below shows its main components.

Table 5-5 Goals, Objectives, and Guiding Principles of National Integrated Water Resources Management Policy for Dominica

<p>Goals:</p> <ul style="list-style-type: none"> ✓ Ensure a sustainable, adequate and secure water supply for the Commonwealth of Dominica and guide the development of public policies across all sectors that promote efficient use and equitable distribution of water in an environmentally and economically sound manner. ✓ Assure the orderly and coordinated development and use of Dominica's water resources ✓ Value, protect and conserve such resources for the optimal socio-economic benefit of present and future generations of Dominicans ✓ Provide the Dominican population with a safe, adequate and reliable supply of water and dependable public sewerage services.
<p>Objectives:</p> <ul style="list-style-type: none"> ✓ Ensure long term sustainability of the country's water resources for the benefit of all. ✓ Promote the adoption of integrated water resources management. ✓ Develop and manage the country's water resources wisely and efficiently to ensure the availability of a continuous supply of water to meet all needs and uses including that of the ecosystems. ✓ Implement measures to protect and enhance the water systems so that the water quality is adequate for all designated uses. ✓ Ensure that the present and future generations have access to a proper standard of sanitation. ✓ Minimize and protect against water crises whether caused by climate change and climate variability, man-made or other natural causes. ✓ Foster joint ownership and partnerships among the Government, private sector and the people of Dominica in managing the country's water resources. ✓ Enhance education, awareness and knowledge of Dominica's water resources.
<p>Guiding Principles:</p> <ul style="list-style-type: none"> ✓ Water is a finite and vulnerable resource that has social and economic value and is essential for life. ✓ All water resources of the Commonwealth of Dominica are owned by the State for the common good. ✓ Water resources planning and management should be based on a participatory approach involving all key stakeholders. ✓ Watershed management and coastal zone management should be undertaken in an integrated manner taking into consideration the LBS Protocol. ✓ Water as an economic good should take into account affordability and equity. ✓ All water use should be sustainable. ✓ Water resources management should be demand driven rather than supply driven.

- ✓ Measures must be implemented to avert and minimize risks to human health and the ecosystems.
- ✓ The polluter pays principle must apply.
- ✓ Management of water resources should allow for multiple uses of water giving priority to water use with the highest socio-economic benefits but giving priority to human consumption and the watering of animals in times of water shortage.
- ✓ Water should be priced in order to encourage judicious use.
- ✓ Everybody has a responsibility in water management.

Source: Created by the survey team using the Dominican Government (2011) National Integrated Water Resources Management (IWRM) Policy

Currently, the Water Sector Strategy Development Plan is underway with the support of CDB to revise the National Water Policy.

5.2.2 Related organizations

(1) Ministry of Public Works, Public Utilities and Digital Economy (MPWPUDE)

It is a central government agency that oversees the management of water supply in Dominica. The Ministry formulates and promotes water policy and oversees the operations of DOWASCO, primarily through the appointment of directors. However, according to the Ministry's website, there is no internal department responsible for water supply administration, while the Technical Services Department is responsible for the development, planning and formulation of technical matters related to flood control and bridge construction in rivers and coastal areas. The Minister may invite the Water and Sewerage Advisory Council to give its opinion on the implementation of, or changes in, water and sewerage policy.

(2) Dominican Water and Sewerage Company (DOWASCO)

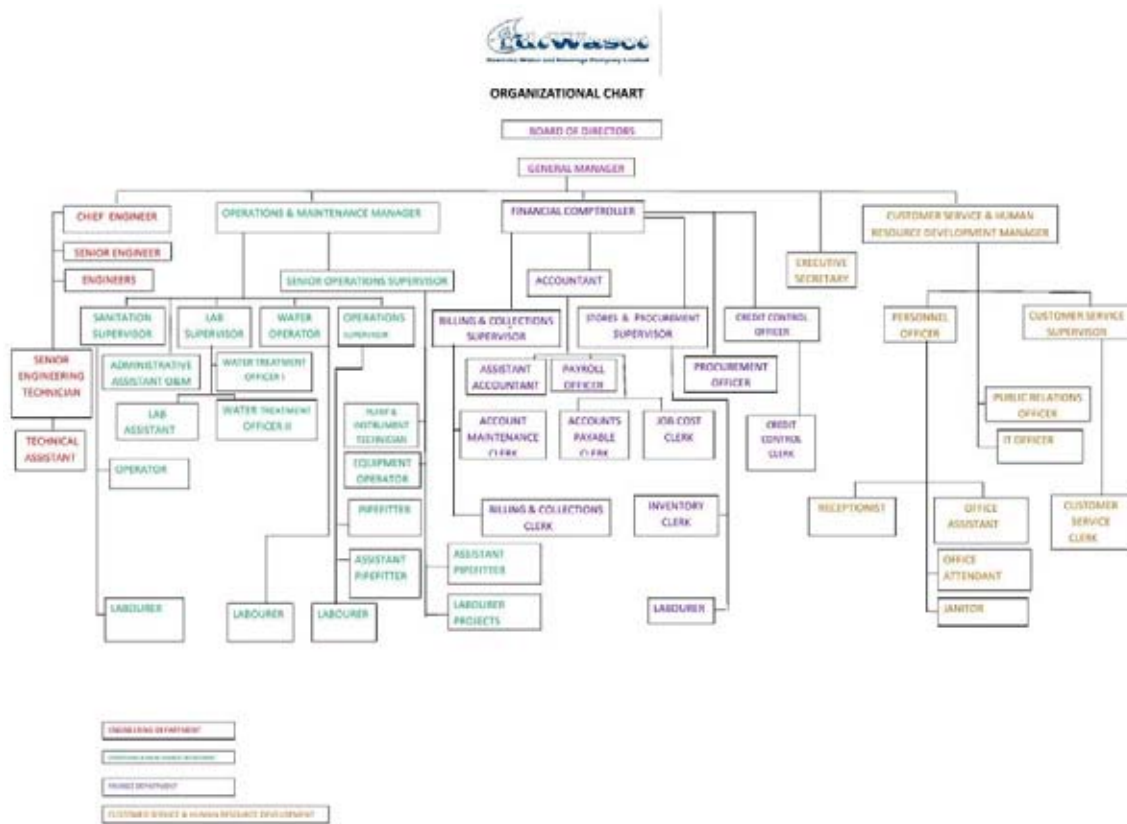
DOWASCO is a water utility established in 1989 under the Water and Sewerage Act 17 as a 100% state-owned enterprise of the central government to provide water and sewerage services as well as water resources and waste management.

DOWASCO has a governance system in which the Board of Directors, composed of directors from the public and private sectors appointed by the Minister of Public Works, Public Utilities and Digital Economy, is placed at the top. Operations are overseen by the General Manager, assisted by the managers of DOWASCO's four divisions (Finance, Engineering, Customer Service & Human Resources, Operations & Maintenance).

While budget planning and execution are independent, the operation relies on financial support from the government.

The above-mentioned water strategy and development plan proposes, after the separation of water resources and waste management from water supply and sewerage

services, the establishment of a government organization responsible for water resources and waste management apart from DOWASCO.



Source: DOWASCO provided

Figure 5-6 Organizational chart of DOWASCO

(3) Public Utilities Commission

The commission develops economic and technical standards for public utility services, including tariffs, based on ministerial regulations issued from time to time by MPWPUDE. Although it is the ministry organization that essentially oversees DOWASCO’s operations, the composition and appointment procedures of its members are not clearly defined.

5.2.3 Related laws and regulations

(1) Water and Sewerage Act

This is a law enacted in 1989 that constitutes the basis of the water service of Dominica and includes provisions that allow DOWASCO to exclusively develop and manage water and sewerage facilities. The composition of the Act, which consists of 72 articles, is as follows.

- ✓ Preliminary (Articles 1 to 2)
- ✓ National Policy and Licensing of the Company (Articles 3 to 7)
- ✓ Vesting of Property in the Company (Article 8)

- ✓ Functions, Powers and Duties of the Company (Articles 9 to 26)
- ✓ Financial Provisions (Articles 27 to 39)
- ✓ Control of Water Abstraction and Use (Articles 40 to 51)
- ✓ Water Pollution Control (Articles 52 to 63)
- ✓ General and Miscellaneous Provisions (Articles 64 to 72)

(2) Public Utilities Commission Act

This law stipulates the establishment of a commission to deal with matters relating to the regulation and management of public utilities. It was enacted in 1972 and revised in 1989. The composition of the Act, which consists of 42 Articles, is as follows.

- ✓ Preliminary (Articles 1 to 2)
- ✓ Establishment of Commission, Function and Powers (Articles 3 to 7)
- ✓ Rates and Rate-making, and Reviews of Rates (Articles 8 to 23)
- ✓ Services and Facilities (Articles 24 to 27)
- ✓ Offences and Penalties (Articles 28 to 29)
- ✓ Research Inquiries and Advice (Sections 30-35)
- ✓ Miscellaneous Provisions (Articles 36 to 42)
- ✓ Schedule

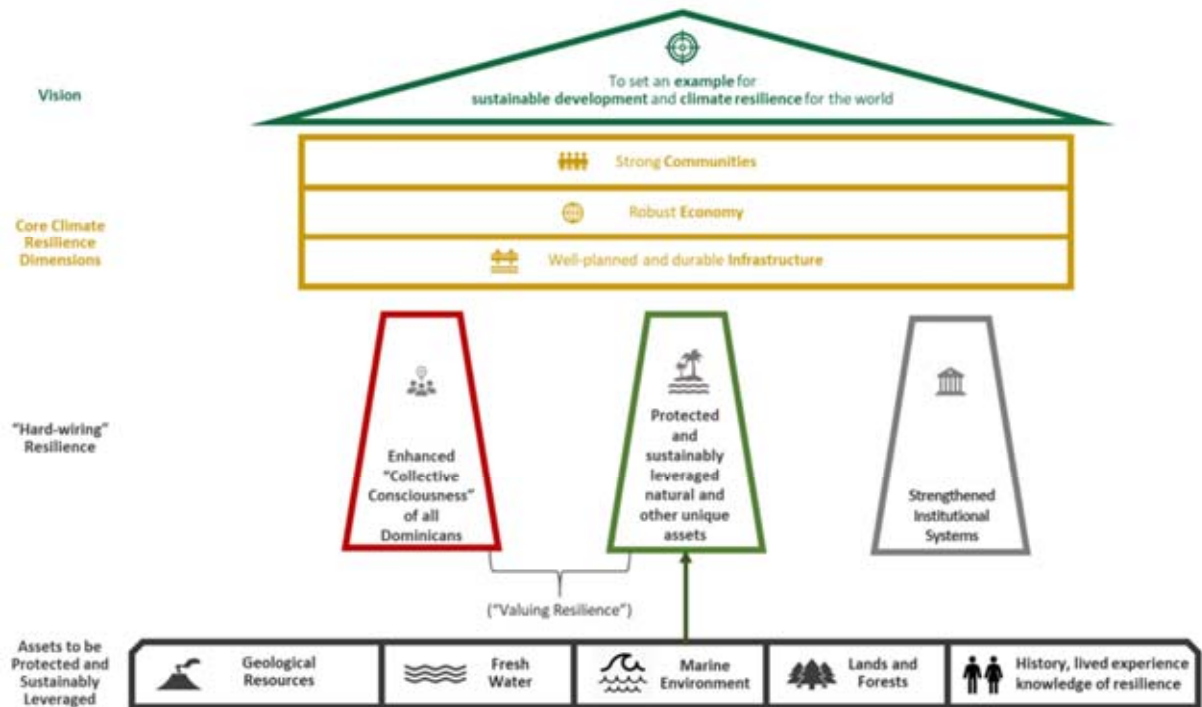
(3) Water and Sewerage Order

This is a short ordinance composed of two articles issued by MPWPUDE on January 1, 2022, which allows DOWASCO to provide water supply and sewerage services for the next 10 years and has consequently provided a legal basis for DOWASCO as the sole water service provider.

5.2.4 Related plan

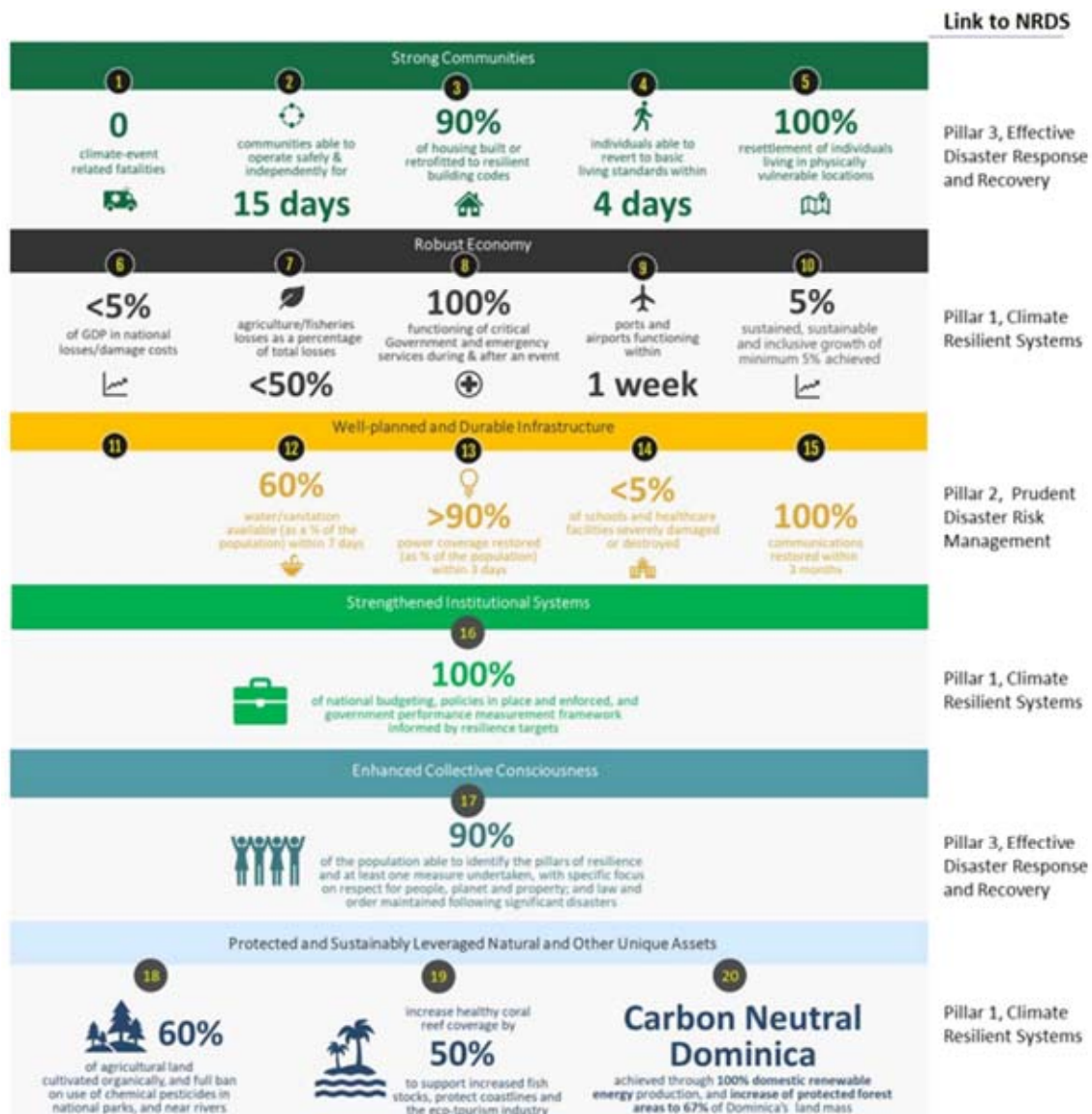
(1) Dominica Climate Resilience and Recovery Plan 2020-2030

This plan was developed in 2020 for the purpose of strengthening climate resilience, primarily through the Climate Resilience Execution Agency in Dominica, which was established in the Climate Resilience Act of 2018. It consists of six result areas and 20 targets, as shown in the figure below.



Source: Dominican Governments (2020) Dominica Climate Resilience and Recovery Plan 2020-2030

Figure 5-7 A Framework for Dominica’s Climate Resilience Six Result Areas



Source: Dominican Governments (2020) Dominica Climate Resilience and Recovery Plan 2020-2030)

Figure 5-8 Dominica’s Twenty Climate Resilience Targets

5.3 Status of water resources

5.3.1 Water resource use

(1) Water source

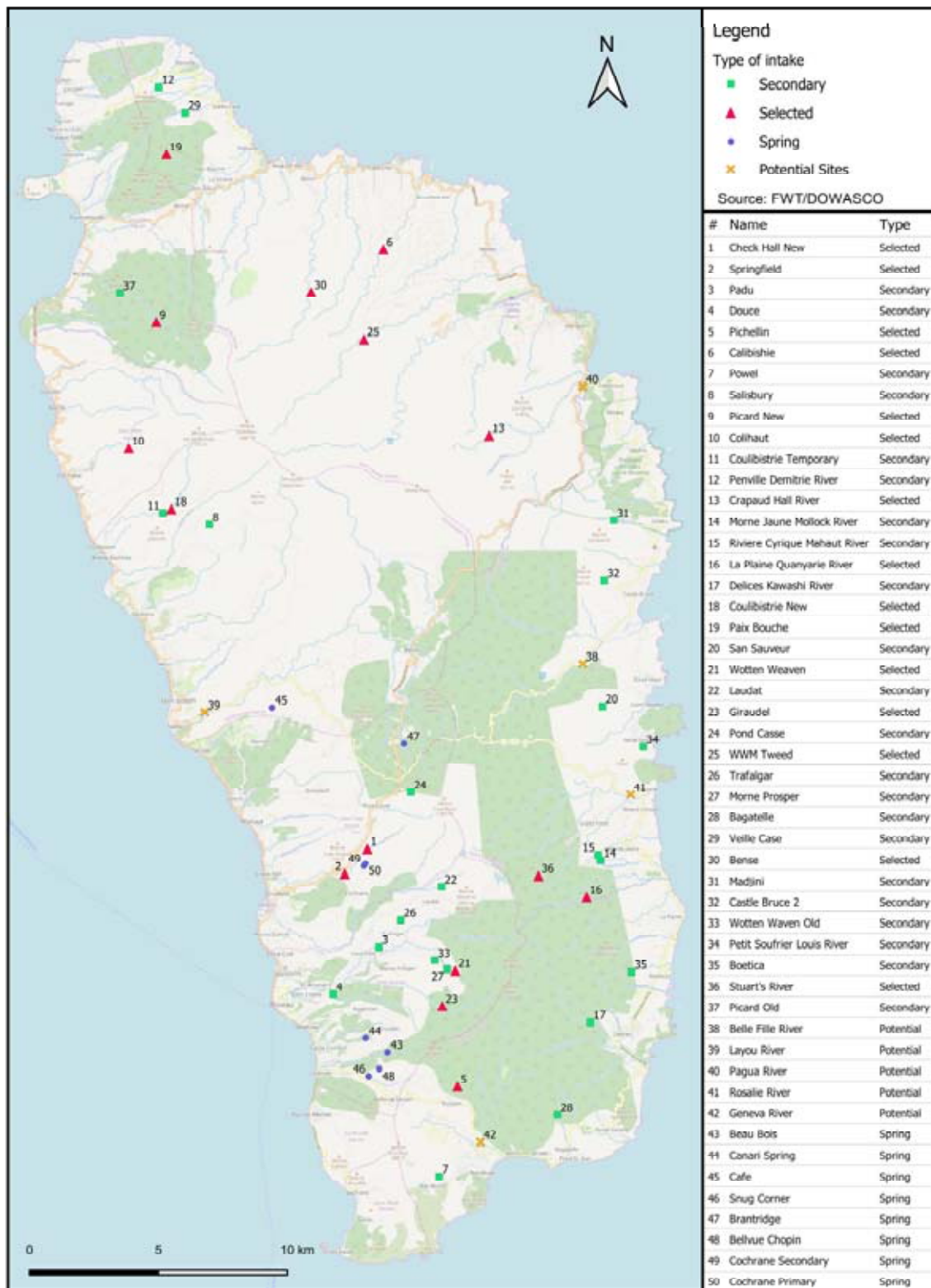
The country has a large number of rivers on the island and relies entirely on surface water, including some springs. Although the river levels are low during the dry season, this does not significantly affect the water supply system.

On the other hand, since some rivers have high turbidity during the rainy season, it is forced to take measures to stop water intake to avoid deterioration of tap water quality. As a result, DOWASCO is interested in developing groundwater sources as a means of expanding water storage systems and ensuring a stable water source for water quality.



Source: FAO AQUASTAT (2015)

Figure 5-9 Water source locations in Dominica (major rivers)



Source: DOWASCO (2019)

Figure 5-10 Water intake points in DOWASCO water supply schemes

(2) Utilization of rainwater and recycled water

The government discourages the use of rainwater because of the health risks associated with the inability to control water quality, such as the occurrence of epidemics, however, inhabitants in some mountainous areas use rainwater sources. DOWASCO also recommends the installation of water storage tanks in households to be prepared for disasters and water interruptions.

5.3.2 Implementation status of integrated water resources management

(1) Implementation organization of water resources management

IWRM in Dominica is now under the jurisdiction of DOWASCO, but there is no dedicated IWRM department within the organization. The Operation and Maintenance Department is working to fulfill its functions. A draft policy proposing the establishment of an organization to officially take charge of IWRM was submitted in 2011, but it was rejected by the Cabinet at the time. The reason for this was that the government at the time decided that the current situation, in which DOWASCO is responsible for both water supply and water resource management, would require a change in the current legislation to reorganize the organization that divides and manages each area of responsibility. It was also decided to transfer the management of water resources to MPWPUDE in 2018, but this has not yet been implemented.

(2) Integrated Water Resources Management Plan

It is still a draft plan, and a revised draft plan of IWRM policy was proposed for WSSDP in 2021 to be implemented with the support of CDB.

(3) Status of implementation of water source monitoring

In DOWASCO, their river flow monitoring was done manually and a lot of labor was spent on the repetitive operation. Recently, with the support of CDB, they have started to measure the water level near the intake points with water gauges installed in five different rivers, but this is for estimating the water production from the WTP at the downstream of the river, and water resource control has not yet been achieved.

A rain gauge and an automatic meteorological observation station have been installed to integrate the system with this water level gauge, and data collection will begin in the future. The collected data are transmitted to the servers of the Dominica Meteorological Service and will be managed by personnel familiar with hydrology.

5.3.3 Challenges in water resources management

(1) Issues in water resources development

River sources are abundant, and DOWASCO believes that there is no need to develop new sources at this time. Although some communities using small river sources have suffered from reduced flows during the dry season, they are now responding by expanding their water supply systems from areas using relatively abundant water sources to the areas with water shortages.

Although newly developed residential communities tend to be located in high-altitude areas, the additional water demand is by no means high because the population in these areas is small. Even if new communities at high altitudes need to be equipped with additional distribution pumping facilities, the additional demand will not affect the current use of water resources, but will be sufficient for water distribution from existing water systems.

However, there is concern about the impact of climate change on water resources in the future. In the absence of data such as long-term river flow history, which is necessary to analyze such problems, we believe that a water resources management plan will be necessary in the future for the efficient use of limited water resources. As mentioned at the beginning of this section, DOWASCO also considers the development of groundwater sources as an option for future water source development, and it recognizes that a comprehensive survey of groundwater sources will be required in the future.

(2) Impacts on agriculture and tourism

DOWASCO does not provide agricultural water, but small farmers use tap water from them. Although there are a few irrigation systems developed by the Ministry of Agriculture, rain-fed agriculture is the predominant system in Dominica, and such irrigation systems are used only during the dry season. Although there is currently no significant impact of water scarcity on agriculture at this time, it has been pointed out that the construction of new irrigation systems is costly when developing agricultural land in new regions, and therefore, crop yields have not increased in the country as a whole in recent years.

There is no significant negative impact on the tourism sector. Most hotels have tanks of the same size as the tap water supply, and remote hotels may have their own water supply systems or rainwater storage systems. Thus, Dominica does not have its own desalination plant due to the abundance of surface water sources.

(3) Issues in Integrated Water Resources Management

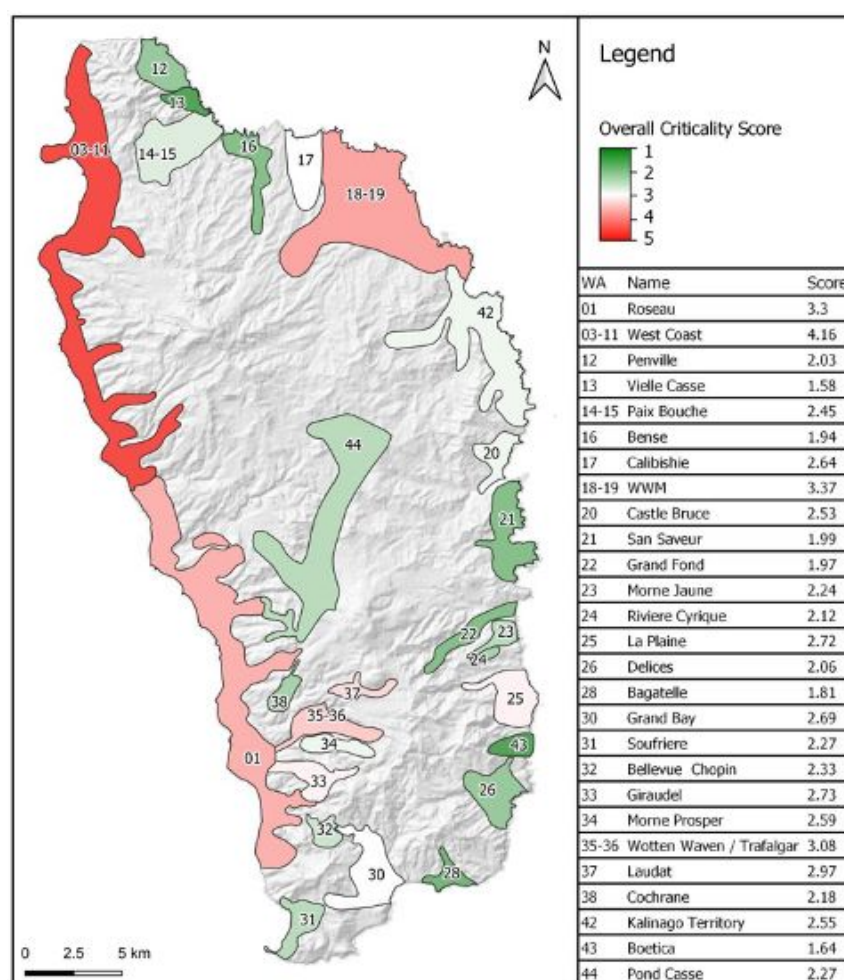
In DOWASCO, staff is allocated to water supply and sewerage operations, and there is a lack of staff to focus on water resources management. In addition, even if a water resource management department were established, it would not generate the increased

revenue that water supply operations do, and there are likely to be concerns about budget shortfalls related to staffing and equipment needed for water resources management.

5.4 Status of water supply

5.4.1 General condition of water supply

DOWASCO is responsible for water supply in Dominica. DOWASCO supplies water to approximately 72,000 people, with approximately 24,000 connections, and the water supply coverage is 98.5%, achieving water supply 24 hours a day, 7 days a week. DOWASCO's water supply relies 100% on the surface water source and has 44 water distribution areas (distribution systems). However, the water distribution areas have recently been consolidated to improve operational efficiency and are currently shown in Figure 5-11. Of these, Water Area 1 (WA01), which covers the capital city of Roseau and located on the west coast, has the largest water demand. Most of the intake facilities are located at high elevations, and the water is distributed by gravity flow.



Source: DOWASCO (2020) Water Sector Strategic Development Plan, Diagnosis of the Water Supply System

Figure 5-11 DOWASCO's Distribution System⁶

⁶ Notes: Under the CDB support, each WA was assessed for vulnerability to natural hazards, water supply population, reliability of services, and economic importance. Figure 5-11 shows that the higher the scores, the higher the priority of interventions.

5.4.2 Water supply facilities

(1) Water intake and water treatment facilities

The Antrim water treatment plant (WTP), the largest WTP in Dominica, was constructed in 2011 and was fully upgraded by the WSSDP with support from the CDB in 2019 with a treatment unit consisting of a mixing basin, flocculator, and clarifier with tube settler (Figure 5-12) and a rapid filtration unit, followed by two additional rapid filtration units in 2023.

Raw water is taken from the Check Hall River at the Springfield Intake, which was constructed in 1971 (Figure 5-12). However, the intake facility and the raw water pipeline were damaged by Hurricane Maria (2017). The New Check Hall Intake is being constructed 1 km upstream of the existing intake in the WSSDP with CDB support. The raw water inflow to the WTP is currently 16,800 m³/day, but once the New Check Hall Intake is operational, the Antrim WTP is expected to operate at its maximum water production capacity of 20,160 m³/day. The river water flow is sufficient even during the dry season, as it flows over the spillway after the intake.



Date: February 2024

Figure 5-12 Treatment Unit of Antrim WTP and Spring Field Intake

The water treatment process is rapid mixing → coagulation and sedimentation → rapid filtration, and finally post-chlorination is carried out. Polyaluminum chloride (PAC) is used as a flocculant, soda lime is used for pH adjustment, and chlorine gas is used for disinfection.

DOWASCO has two other WTPs with clarifiers and upflow granular filtration which are located at New Picard and WWM Intakes, respectively. Both are currently performing only the sedimentation process, and the filtration process has been bypassed due to malfunctions caused by lack of maintenance.



Date: February 2024

Figure 5-13 Water Quality Measuring Instruments and SCADA in Antrim WTP

(2) Water transmission and distribution facilities

As mentioned above, water distribution areas have been established; however, there is no coordination among distribution areas, and each area operates independently. Therefore, when the pipeline is damaged, the impact of water suspension becomes significant. In the past, when water pipelines were damaged by floods, water trucks were used to deal with the problem. In response to this situation, ductile iron (DI) pipes have been mainly used as pipe material until now, but recently, high-density polyethylene (HDPE) has been adopted to strengthen the resilience.

The district meter areas (DMAs) in the water distribution pipe network have not been constructed, but are planned to be constructed in four (4) areas under the WSSDP, and as of February 2024, the construction bidding process is underway.

With regard to water transmission, the highest hydrostatic pressure is 2.7 MPa at the lowest point of the water transmission pipeline, compared to the elevation of 989 feet (301m) at the Antrim WTP. In WA01, water is transmitted from the Antrim WTP to each of the distribution reservoirs and is not depressurized because a residual water head is required to deliver water to the higher elevation reservoirs.

5.4.3 Water Supply Operation

(1) Operation and maintenance of facilities

Although the Operation and Maintenance Department is the largest department with 93 employees, it is still in a situation where the daily leakage repair work is carried out. Although a draft operation and maintenance (O&M) manual was prepared in 2003, it remains incomplete and unused, and the O&M work is based on the experience of skilled employees. Although the history of leakage repair is recorded on paper, there is no documentation such as a list of daily tasks to be performed, resulting in inefficient work management due to unclear priorities of work.

SCADA has been installed at the Antrim WTPs under the CDB-supported WSSDP, and turbidity, pH, and residual chlorine levels are automatically measured in addition to

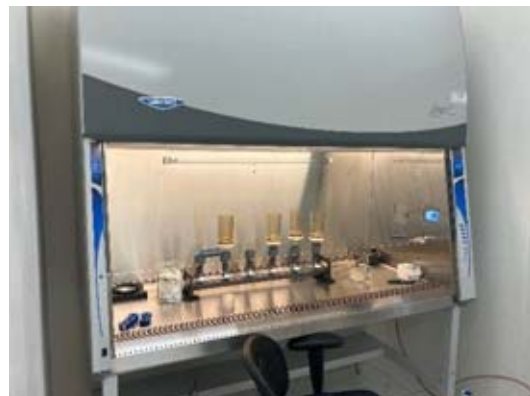
equipment control at the plant (Figure 5-13). It should be noted that the intake valves are not remotely controlled, and when the turbidity of river water becomes high due to heavy rainfall, it is necessary to go to the intake, which is inaccessible even at night, to close the valves, which poses a maintenance risk. In addition, the transmission pipelines from the Antrim WTP and several distribution reservoirs are equipped with flow meters, but many of them are not used on a daily basis and their condition is unknown. In addition, because flow meters are not installed in the distribution pipelines, the actual volume of water distributed is not managed, and the volume of water is only managed based on the volume of water billed. Therefore, the need for water distribution monitoring and control is high, and support for installation of instrumentation and SCADA for this purpose is desired.

The CDB-supported WSSDP has created a database using QGIS and registered information on the location of facilities such as water sources, WTPs, water distribution reservoirs, pumping stations, and transmission pipelines has been registered. However, information on the water distribution pipelines has not been registered.

There were needs such as asset management system, customer database, field data entry system, training support system, etc. at the personnel level. In addition, there was great interest in implementing an integrated management system that includes water flow management, customer management system, etc.

(2) Water quality management

Water quality testing is conducted by the Operation and Maintenance Department in the laboratory (Figure 5-14) constructed at the Antrim WTP under the CDB-supported WSSDP. Water samples from water sources and treated water are tested annually for all water quality elements according to WHO standards. Each distribution area is also sampled from the taps once a week and tested in the laboratory. Tap water is tested for: total bacteria, E. coli, coliform groups, free chlorine, residual chlorine, pH, water temperature, turbidity, and electrical conductivity. Water quality test data is maintained on an Excel basis. The laboratory also accepts outside requests for water quality testing, with fees established for each test item.



Date: February 2024

Figure 5-14 Water Quality Testing Laboratory at the Antrim WTP

(3) Status of non-revenue water (NRW)

Under the CDB-supported Third Water Supply Project-Water Area 1 (WA1)-Network Upgrade, the non-revenue water (NRW) was estimated in 2016, and the NRW rate in the country is about 58.5%, of which about 30% is physical leakage. Since then, there has been no study of the NRW rate.

Leaks occurs mainly in distribution pipelines in lowland areas with uneven terrain. Since water is transmitted from the WTP to distribution tanks at higher elevations by gravity flow, the water cannot be depressurized in lowland areas along the way, resulting in water leaks. In addition, water has been stolen and measures have been taken to disconnect connections as soon as they are found.

(4) Water rates and collection status

Figure 5-15 shows the current water tariff table of DOWASCO. Based on the table, the billing rate per 20 m³ for domestic use is calculated to be EC\$ 56.02, which is the average level for the countries surveyed. (See Section 2.4.2 for comparisons of water rates between countries). There are four categories of water rates by use: domestic, commercial and industrial, cruise, and standpipes, with a minimum rate of up to 1,000 imperial gallons and a metered rate based on water consumption. The central government pays for standpipes. In Dominica, there are approximately 3,300 sewerage customers, with flat rates for residential use and manufacturing customers, and metered rates for commercial and industrial customers.

To update water tariffs, DOWASCO drafts the proposal, which is then approved by the central government. DOWASCO has planned to increase water tariffs by 15% for two consecutive years from 2010 to 2013, for a total increase of 30%. However, the second increase failed, resulting in only a 15% increase.

Due to the stagnant economy and lack of long-term wage growth in Dominica, the public is reluctant to increase water rates. DOWASCO believes that without an increase in water rates, it would be difficult to secure a budget to train staff and to improve productivity.

TARIFF STRUCTURES

- **Domestic:** this applies to all domestic dwelling, schools, hospitals and health centers island wide.
- **Commercial:** this rate applies to all commercial institutions (non-government and government), and the construction industry including new dwelling homes under construction.
- **Industrial:** this rate applies to all manufacturing and industrial institutions (non-government and government).
- **Unmetered:** one fixture (no meter). Customers with one tap serving the property.
- **Unmetered:** multiple fixtures (no meter). Customers with more than one tap serving the property.
- **Bulk Water Sales:** rate used for water sold to cruise ships.
- **Sewerage:** flat rate used to bill all customers connected to the newly constructed sewer lines.

METERED SUPPLY	UNMETERED SUPPLY
<p>DOMESTIC: For 0 – 1000 gallons per month \$21.62 For more than 1000 gallons per month \$10.12 per 1000 gals.</p> <p>COMMERCIAL & INDUSTRIAL: For 0 – 1000 gallons per month \$36.57 For more than 1000 gallons per month \$13.57 per 1000 gals.</p> <p>STANDPIPES: Flat Rate per standpipe per month \$290.00</p>	<p>Monthly Service charge (one fixture) \$28.75 Monthly Service charge (multiple fixtures) \$48.30</p>
SEWERAGE	BULK WATER SHIPMENT
<p>Flat rate – Domestic \$20.30 Commercial & Industrial 45% of total water charges Minimum charge – \$45.00 Maximum charge – \$3,000.00 Monthly flat rate for manufacturing companies which use water as a factor of production – \$250.00</p>	<p>Delivery to ships \$20.00 per 1000 gals. Delivery to bulk carriers \$10.00 per 1000 gals.</p>
CONNECTION FEES	RECONNECTION FEES
<p>Water Connection \$450.00 Minimum Fee \$240.00 Sewer Connection \$850.00 Minimum Fee \$500.00</p>	<p>Water \$100.00</p>

Source: DOWASCO's website

Figure 5-15 Water Rate of DOWASCO

(5) Status of customer management

Dominica has achieved 24-hour water supply, seven days a week, and customer complaints about water service have been few. The management of water meters and meter reading is under the control of the financial department, which is also coordinating the smart meter pilot project. The financial department used to do the meter reading, but this has now been outsourced to a private company. DOWASCO also has a customer management and billing system.

Currently, DOWASCO has 530 standpipes. Although the government is obligated to pay the water consumption fees for the standpipes, it has not made the payments in a timely and appropriate manner. Therefore, DOWASCO is considering reducing the number of standpipes in the future.

5.4.4 Technical training system

Internal training is provided by the Customer Service and Human Resources Departments. External training programs include the operation and maintenance certification program offered by Water Professionals International of the United States and Water Loss Specialist Group webinars sponsored by CWWA. In addition, DOWASCO

employees are required to attend workshops held by the ministries, and there are opportunities to share their achievements.

DOWASCO staff have also participated in overseas training programs sponsored by JICA and other donors. Since the disaster caused by Hurricane Maria in 2017, DOWASCO's operations have been busy and sluggish, but in recent years the dispatch of staff has resumed. Training needs include courses on project management, NRW countermeasures, and equipment maintenance.

5.4.5 Trends in the private sector

Replacement and repair of the pipelines are contracted out to private companies. Meter reading was previously done by the Financial Department of DOWASCO, but is now outsourced to a private company.

5.4.6 Situation of NRW reduction

(1) NRW reduction plan

Although there is currently no NRW reduction plan in place, the implementation of a NRW reduction program is proposed in the concept note already submitted to the GCF fund.

(2) Implementation of NRW reduction

A NRW reduction unit has not been established, and leak repair work is limited to responding to reports of water leaks. Water distribution leaks occur on a daily basis, and the Operation and Maintenance Department staff spend a large portion of their time for leak repair work. In addition to aging pipes, the lack of uniformity in pipe materials and standards has been a cause of leaks, making repair work difficult.

Leakage repairs records are still being managed in a paper-based system with handwriting. To address the NRW issue, it is necessary to strengthen the capacity of staff in addition to correlating leak repair records with location information in the GIS system.

(3) Pilot project for the introduction of smart meters

The quality of the existing water meter is not bad, and it can be used for 10 to 15 years. However, it is said that the meter reading accuracy is reduced due to aging. DOWASCO bears the cost of replacing the failed meter.

DOWASCO is planning to replace all mechanical meters with smart meters, and has already implemented two pilot projects (10 and 50 meters, respectively) and is currently in the process of compiling the verification results.

5.4.7 Facility development plan

(1) Water demand forecasting

Water demand forecasts have been prepared by consultants under the CDB-supported WSSDP, and water demand is expected to be 33,732 m³/day (7.42 million imperial gallons/day) in 2019 and 35,424 m³/day (7.79 million imperial gallons/day) in 2049. As the current water supply capacity is 32,500 m³/day (7.15 imperial gallons per day), the capacity may be insufficient.⁷

(2) Ongoing projects

With the support of CDB, several projects such as Third Water Supply Project, WSSDP have been proposed and implemented. Under the Third Water Supply Project, the following works were undertaken to strengthen WA01 of the water distribution area: Construction of New Check Hall River Intake, renewal of the Antrim WTP and installation of SCADA system, and construction of the water quality testing laboratory. In addition, the WSSDP will develop DMAs for four hurricane-prone water distribution areas. The WSSDP project was co-financed by the CDB and the Government of the United Kingdom through UKCIF and will be completed by 2025.

The CAMS (Critical Asset Management System) project planned by CREAD (Climate Resilience Execution Agency of Dominica) aims to improve system management by creating a shared database of assets from multiple organizations and analyzing interdependencies (e.g., water supply will be shut off if there is a power outage in the pumped water distribution areas). On the other hand, the progress has not been confirmed since the initial discussion, and the asset management system is still in the planning stage.

(3) Planned project

DOWASCO is in the process of applying to the GCF Fund to develop resilience enhancing facilities, and has submitted a Concept Note in December 2020 (first draft), which was prepared prior to the Funding Proposal. This concept note has been resubmitted several times for comments by the accredited entities, the Caribbean Community Climate Change Centre (CCCCC), and is currently being finalized. The contents of the proposal include improved water resources management, including the introduction of integrated water resources management tools, reduction of NRW, and facility developments such as upgrading the pipe network and increasing the capacity of water distribution reservoirs.

⁷ WSSDP Deliverable No.1 Diagnosis of the Water Supply System; Fichtner, 2022

5.5 Wastewater treatment status

5.5.1 Development status of sewerage system

(1) Overview of the sewerage system

Sewage treatment is limited to the single Baytown STP in Roseau, which was built in 2003 with the support of the Canadian and Quebec governments. This is a separate sewerage system, and the sewage collected consists only of sewage and urine sewage, and the gray water is discharged without treatment. The sewerage coverage rate in Roseau is approximately 99%, and it is connected to approximately 3,300 households, and the sewerage pipe is gravity fed to the STP, except for pumping from a pumping station.⁸

Except for the area with the sewerage system, the treatment is done by the septic tank, and in some places there are community scale septic tanks. The septic tank is not operated by DOWASCO, but by the Ministry of Health, Wellness and Social Services. Sludge collection is done by a private company and the sludge is taken to the STP to be treated with the sewage.

(2) Operation status of STP

The STP treats a maximum of 2,300 m³/day with a process of screening → sedimentation → scum removal → aeration. Treated effluent is discharged into the ocean at a depth of approximately 60m at a point 1500 ft (approximately 460 m) away from shore. In the event of an emergency, such as a treatment plant shutdown or malfunction, the effluent is discharged in front of the influent dock.

In DOWASCO, there are O&M manuals corresponding to the sewage treatment, and they are used in the maintenance.

The generated sludge is collected from the sedimentation tank by a vacuum truck, transported to a waste disposal site, and disposed of in landfills. The landfill is under the jurisdiction of the Ministry of Agriculture, Fisheries, Blue and Green Economy. The landfill site was designed with a capacity of 10 years, but it has been in operation for 18 years, and it is in a saturated state. Gas is also being generated, increasing the risk of fire. Although combustibles, non-combustibles and sludge are not separated, a pilot project for separate collection is being implemented.

⁸ DOWASCO officials consider that the reason why gray water was not included in the scope of sewage treatment in the original design of the STP at that time was due to the lack of funding and/or the available land area. Although there is a margin in the processing capacity from the inflow situation, the acceptability of the total volume of gray water is uncertain, and even if it is accepted, the validity of the existing sewer pipe diameter should be examined. There is no such movement within DOWASCO as there is no serious water pollution condition at present.



Date: April 2024

Figure 5-16 Baytown sewage treatment plant in Roseau City

5.5.2 Pollution status of public water bodies

DOWASCO monitors the raw water quality at the intake points, while the Environmental Health Unit (EHU) monitors the quality of DOWASCO's tap water, the quality of treated wastewater, and the quality of water in public water bodies once every three months. If there is a problem with the water quality, DOWASCO is notified by EHU.

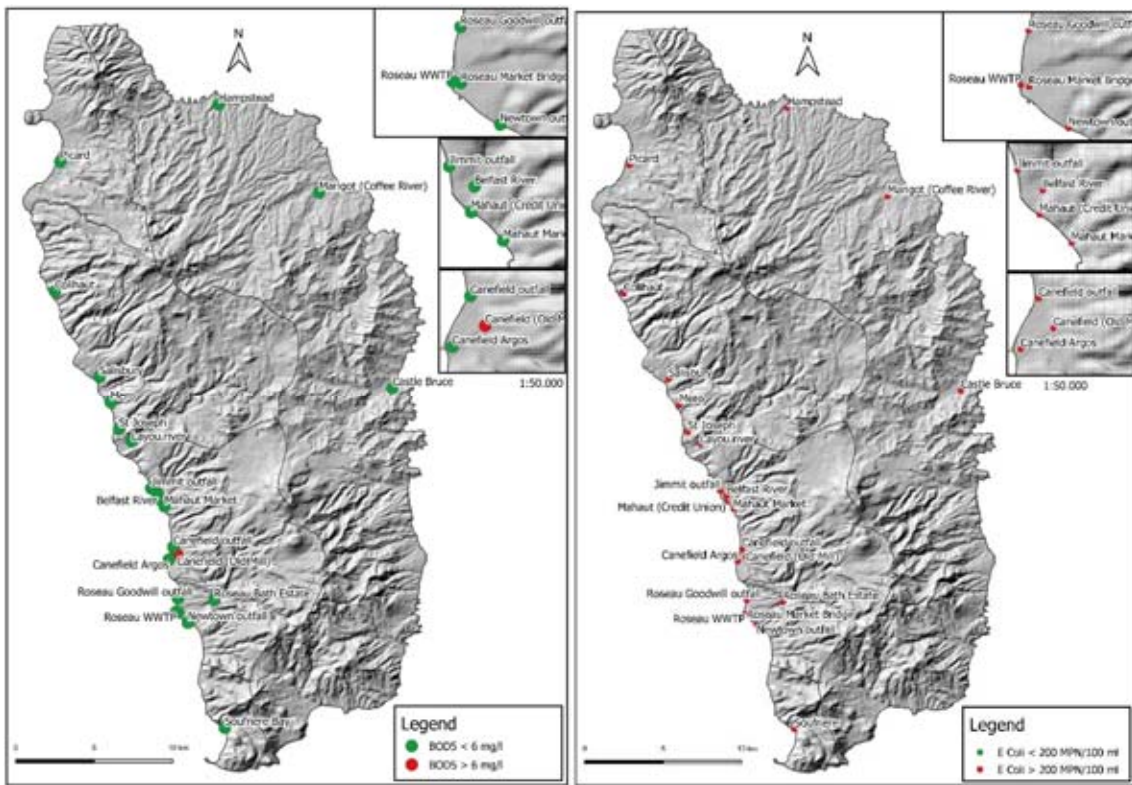
Although the roadside ditch in Roseau shows graywater runoff, the municipal river, which has water quantity in the dry season, is comparatively clear. On the other hand, water quality maps of river estuaries have been prepared in recent years with the support of CDB, and the BOD₅ density tends to be relatively higher in the Roseau metropolitan area and Kaen-Field district on the west coast, and E.coli detection situation is similar (200MPN/100ml for E.coli is higher than the standard value set in all places).⁹



Date: April 2024

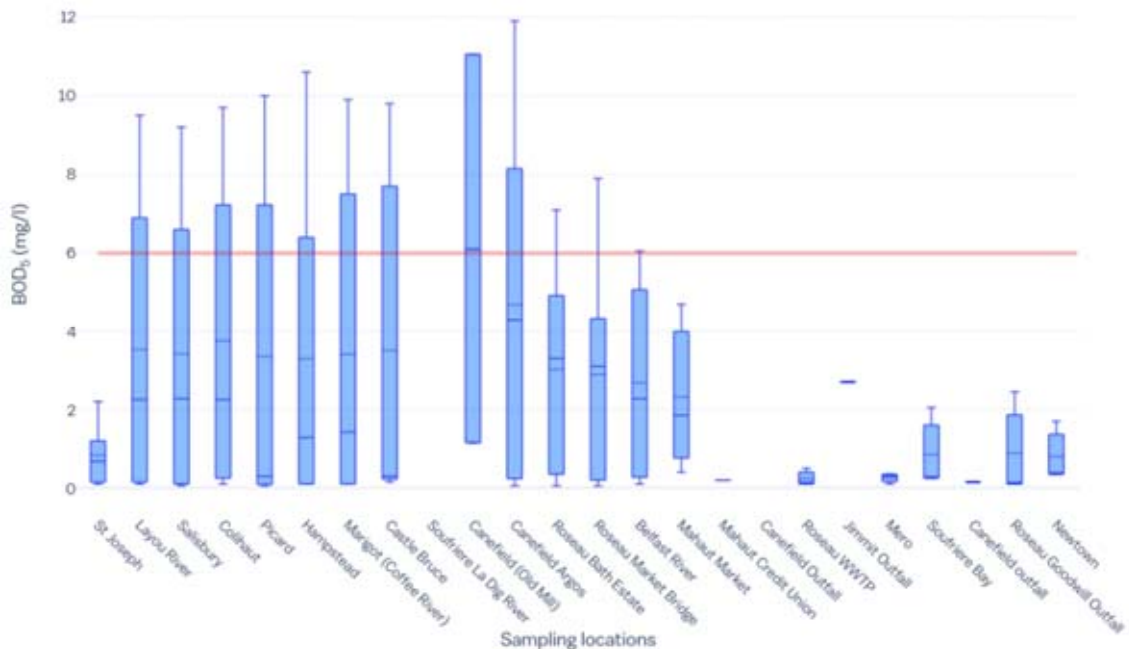
Figure 5-17 Situation of roadside ditch and Roseau River

⁹ Note: Since no water quality standards have been established in Dominica, BOD₅ level is set to 200MPN/100ml in 6mg/L, E.coli based on the standards of the United States and Europe.



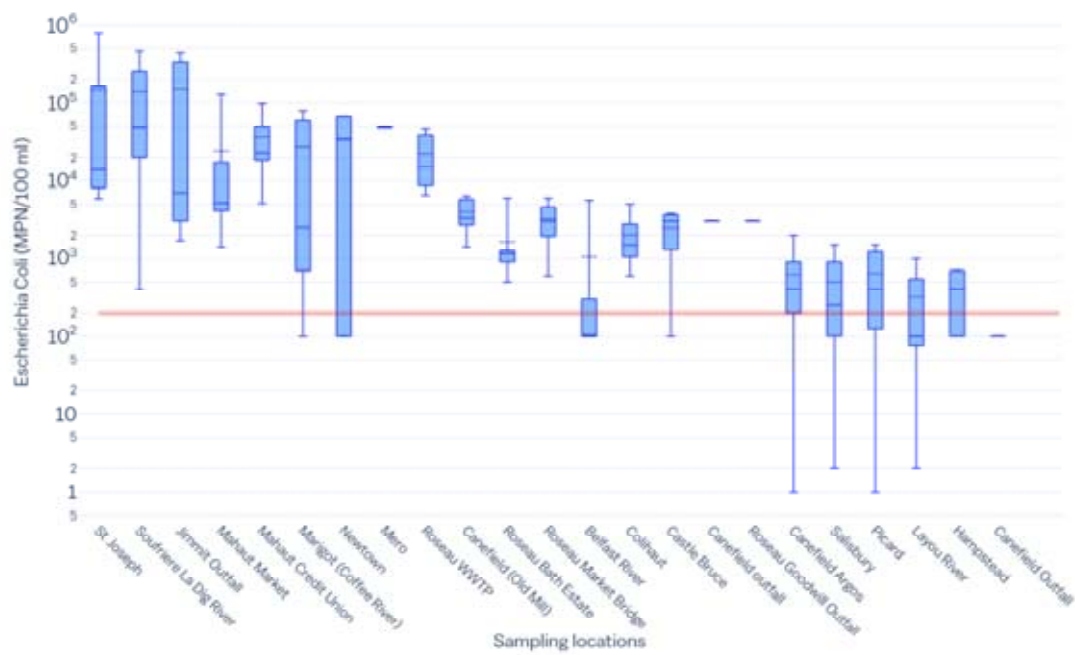
Source: DOWASCO (2020) Water Sector Strategic Development Plan, Water pollution vulnerability Assessment

Figure 5-18 Detected status of BOD₅ and E.coli in rivers in the coastal area



Source: DOWASCO (2020) Water Sector Strategic Development Plan, Water pollution vulnerability Assessment

Figure 5-19 BOD concentration in rivers in the coastal area of Dominica



Source: DOWASCO (2020) Water Sector Strategic Development Plan, Water pollution vulnerability Assessment

Figure 5-20 E.coli in rivers at the coastal areas of Dominica

5.6 Financial position

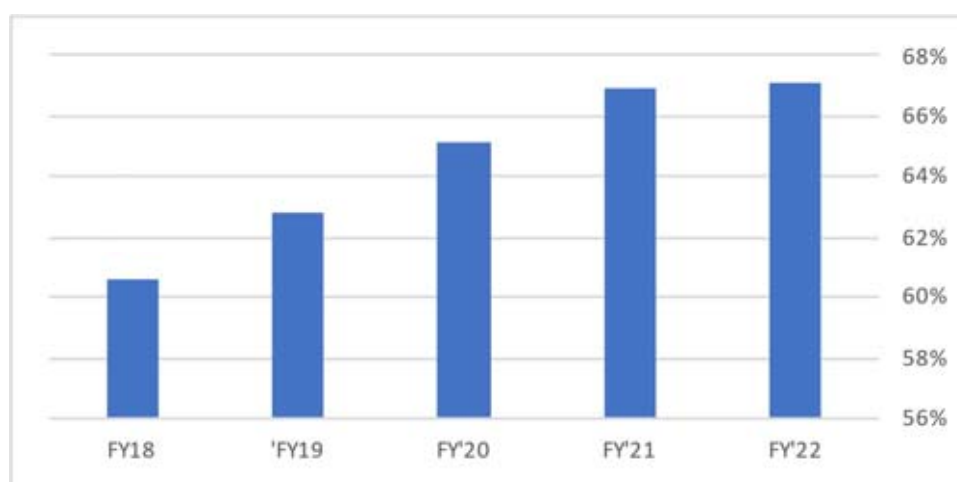
DOWASCO's fiscal year runs from July to June of the following year¹⁰. Its externally audited financial statements are submitted to MPWPUDE and the Parliament, but are not available on the website due to lack of public disclosure requirements.

5.6.1 Key financial indicators

The following analyses were performed using the DOWASCO financial tables obtained from the survey.

(1) Stability

DOWASCO's debt ratio is in the range of 60% to 70%. This figure is higher than that of other water utilities in the Eastern Caribbean countries¹¹ and is rising. If this trend continues, financial stability concerns may increase.



Source: Created by the survey team using DOWASCO financial statements

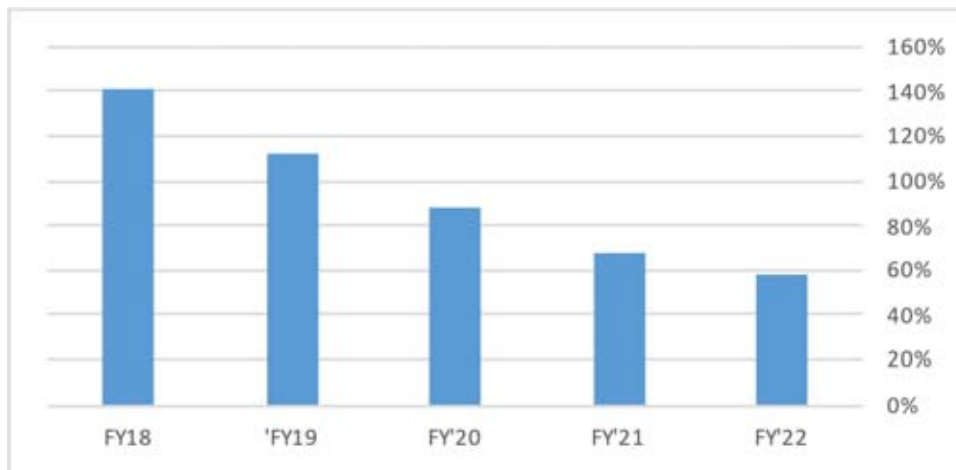
Figure 5-21 DOWASCO debt ratio

(2) Liquidity

The current ratio has decreased significantly. In the most recent fiscal year, current assets are calculated to cover only a little more than half of current liabilities, which implies that DOWASCO is inevitably in a position to increase its dependence on borrowings or government subsidies.

¹⁰ The same applies to the central government fiscal year.

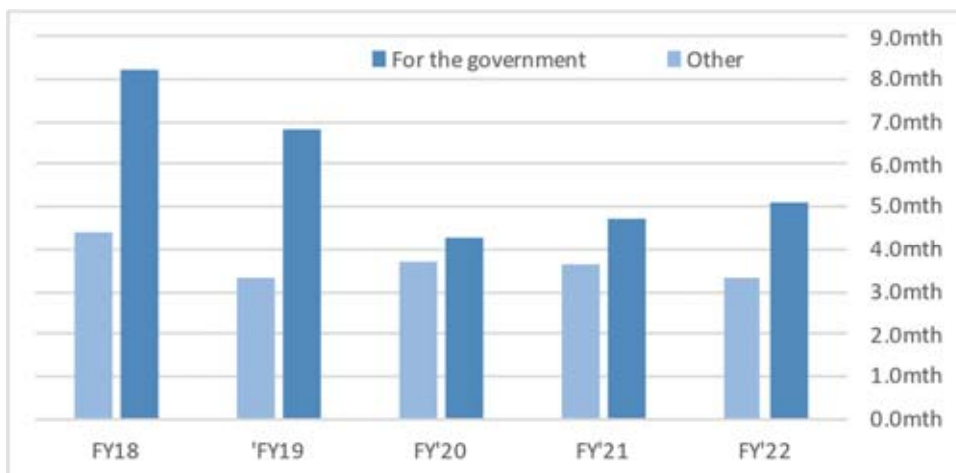
¹¹ St. Lucia, St. Vincent and the Grenadines, and Grenada in the countries surveyed.



Source: Created by the survey team using DOWASCO financial statements

Figure 5-22 DOWASCO current ratio

The accounts receivable collection period was calculated for the government and others. The collection period of the service for the government exceeded the others in both fiscal years. It suggests the need to check whether there is a structural factor that increases the collection period of water charges for the government.

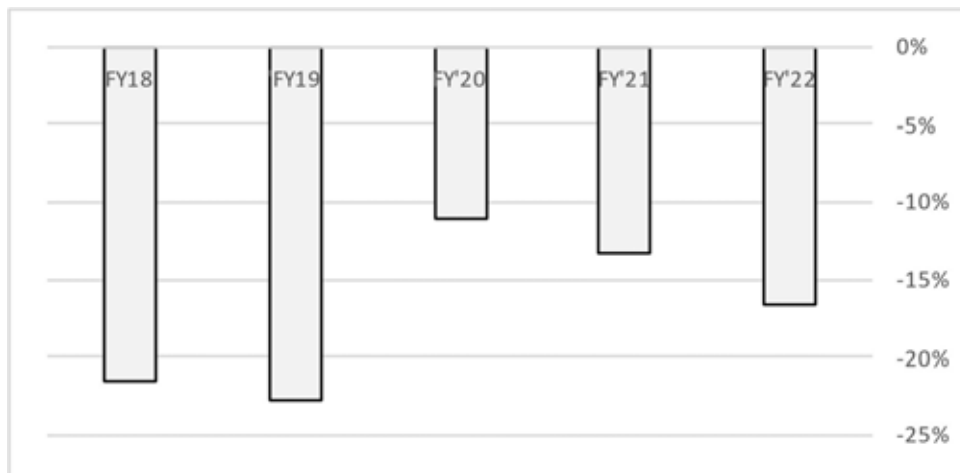


Source: Created by the survey team using DOWASCO financial statements

Figure 5-22 DOWASCO accounts receivable collection period

(3) Profitability

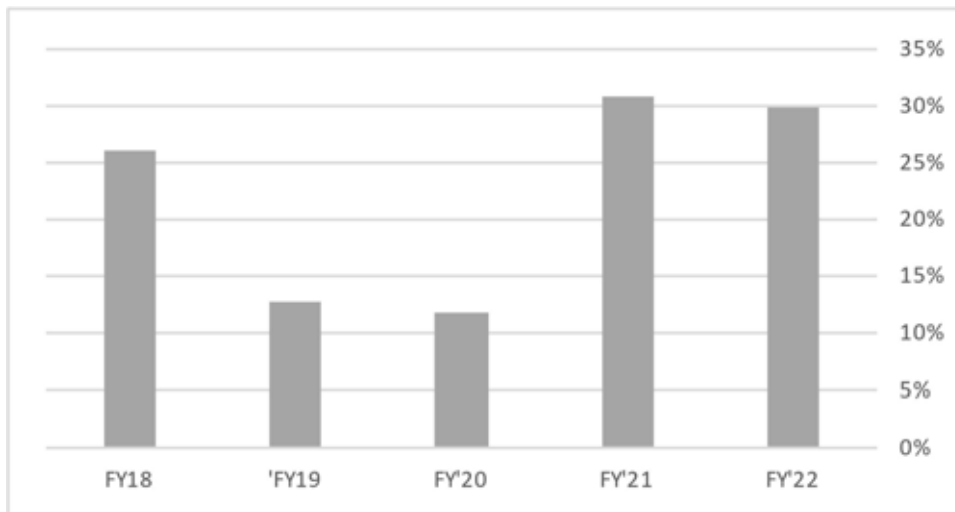
The historical change in the net profit margin on sales has been analyzed. DOWASCO's financial position is characterized by a high depreciation of the water installations, which causes a constant deficit in the net profit.



Source: Created by the survey team using DOWASCO financial statements

Figure 5-23 DOWASCO net income margin on sales

For reference, the figure below shows the development of EBITDA margins excluding the impact of the depreciation burden.

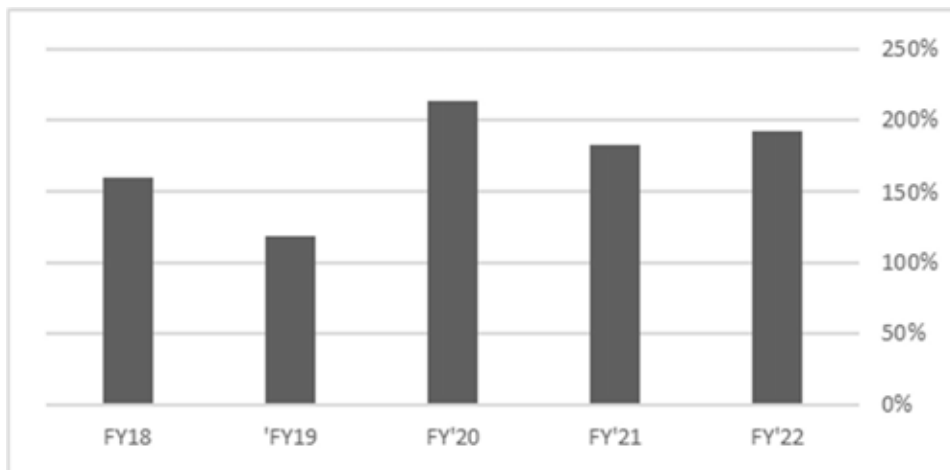


Source: Created by the survey team using DOWASCO financial statements

Figure 5-24 DOWASCO EBITDA margin

(4) Interest payment capacity

In recent years, operating profits have been approximately twice the amount of interest payments. The ICR is lower due to higher debt ratios compared to water utilities in other countries, and at levels that would raise concerns about the ability to pay interest on borrowings if profits decline due to the occurrence of risk events such as disasters.



Source: Created by the survey team using DOWASCO financial statements

5-26 DOWASCO ICR

5.6.2 Financing and investment plans

DOWASCO does not prepare pro forma financial statements or investment plans. Capacity development to formulate and implement medium- to long-term financing and investment plans would be required to ensure a stable water supply for the population and to continue water services that are resilient to climate change and natural disasters.

Chapter 6 Saint Christopher and Nevis

6.1 Basic information

6.1.1 Outline of the country

Saint Christopher and Nevis is a small island country consisting of St. Christopher, which is located in the northern part of the Leeward Islands, at around 17 degrees 10 minutes north and 62 degrees 48 minutes west, and is located in the northernmost part of the target countries in this study, with an area of approximately 179 km², and the Nevis with an area of approximately 93km². The capital is Basseterre in center of the St. Christopher, and the population composition is African system (92.5%), mixed race (3%), Caucasian (2.1%), etc.¹

6.1.2 Socio-economic conditions

(1) Population dynamics

The population dynamics from 2010 to 2020 are shown in the table below, with a population growth rate of 0.7%.

Table 6-1 Demographic and economic conditions of St. Christopher and Nevis

Items		Unit	2010	2015	2020
Basic info.	Total population	inhab	49,020	51,200	53,200
	Urban population	inhab	16,110	16,740	17,520
	Rural population	inhab	35,330	37,550	39,290
	Population density	inhab/km2	189	197	205
Economics	Gross Domestic Product (GDP)	current US\$	760,170,370	923,155,556	927,451,852
	Agriculture	value added to GDP	X	9,877,778	9,507,407
	Industry	value added to GDP	X	165,470,370	206,855,556
	Services	value added to GDP	X	522,503,704	618,951,850
	GDP per capita	current US\$/inhab	15,509	18,029	17,434

Source: FAO AQUASTAT

¹ Source: Overview of St. Christopher and Nevis (2022) by the Embassy of Japan in Trinidad and Tobago



Source: (Top) OpenStreetMap, (Bottom) EU, Global Human Settlement Layer

Figure 6-1 St. Christopher and Nevis population distribution in 2020

(2) Macroeconomics

The key economic indicators are shown in Table 6-2. The GNI per capita in 2022 is USD 20,020, which puts SKB outside the DAC list. Since the GDP per capita is USD 20,262 and the GDP per capita growth rate is 8.7% per year, assuming this growth rate continues for five years, the GDP per capita in 2027 will be USD 30,792.

In the 1970s, tourism became the central industry instead of sugar refining which was terminated in 2005 by government policy. Around 0.2 million tourists visited the country in 2009, but in 2009-2013 foreign tourists and investments stagnated in the aftermath of the financial crisis. The economy has finally shown signs of recovery since 2014. Like

other Caribbean countries, the economy of St. Christopher and Nevis is highly dependent on natural disasters and tourism.

To address the unemployment associated with the 2005 policy, the government promoted programs to diversify agricultural production and promote export manufacturing and offshore finance. Recently, driven by strong tourism, the economy has experienced positive growth. The growth in the number of tourists from Europe and the United States, especially by cruise ships, has been strong, exceeding 1 million for two consecutive years in 2018 and 2019. In this trend, the port's new terminal, which opened in November 2019, increased the number of large cruise ships that can call at the same time from three to five. However, in 2020, the impact of the spread of COVID-19 resulted in a negative growth of 10.7%.

St. Christopher and Nevis is one of the five Eastern Caribbean countries that have introduced the Economic Citizenship Program which allows foreign investors to obtain citizenship by making a certain amount of financial contribution.

Table 6-2 Key Economic Indicators of St. Christopher and Nevis

GNI (in USD million)	GNI per capita (USD)	GNI growth rate (%/year)	GNI per capita growth rate (%/year)	Inflation rate (%/year)	Trade balance (in USD million)
927	20,020	No data	No data	2.7	-302.3
GDP (in USD million)	GDP per capita (USD)	GDP growth rate (%/year)	GDP per capita growth rate (%/year)	Unemployment rate (%)	Service revenues and expenditures (in USD million)
966	20,262	8.8	8.7	No data	No data

Source: World Bank (2022) World Development Indicators, Moody's (2022) Economic Indicators

(3) Financial Position

St. Christopher and Nevis' public debt was chronically high due to the adverse effects, including the loss of public enterprises, but has been declining as a result of government efforts. In FY 2022, the central government's current account had revenues of USD 407 million, but expenditures reached USD 444 million, a deficit of about USD 37 million. In FY2023, however, revenues are expected to remain stable at USD 407 million, while expenditures are expected to decline to USD 329 million, resulting in a surplus of USD 78 million.

Table 6-3 Current Accounts and Public Debt in St. Christopher and Nevis

Current revenue (in USD million)		Current expenditure (in USD million)		Outstanding public debt (in USD million)		Outstanding public debt percentage by GDP	
FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast
407	407	444	329	593	593	60.2	55.1

Source: Government of St. Christopher and Nevis (2023) 2024 Budget Address

(4) Business environment

The Ease of Doing Business Index is 54.6 (2020). This ranks the country 139th out of 190 countries at a lower level internationally and lower than 59.1 in Latin America and the Caribbean region as well, followed by Grenada in the six countries surveyed. On the other hand, the Corruption Perceptions Index does not cover SKB.

(5) National Development Plan

The St. Christopher and Nevis' National Development Planning Framework (2023-2037), which outlines the long-term development plan for St. Christopher and Nevis, has been developed, which is seen as a key mechanism for the government to realize its intention to lead a sustainable island nation that values the SDGs.

(6) Outline of electric power business operation

The electric power business in St. Christopher is carried out by SKELEC (St. Kitts Electricity Company Limited, a government-owned company established in 2011 by taking over the business of the government's electricity sector². In Nevis, the business is carried out by NEVLEC (Nevis Electricity Company Limited, owned by the Nevis Island Administration).

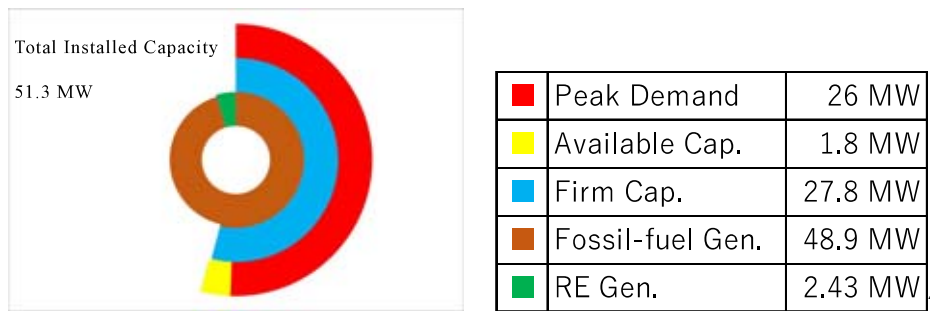
(7) Power infrastructure development status

In terms of supply-demand balances in St. Christopher, the peak demand is 26 MW while the installed thermal power capacity is 48.9 MW. Despite the apparently high redundancy, the availability of the generators is low due to breakdowns and maintenance of the facilities due to deterioration. The actual firm capacity is only 27.8 MW, and the frequent load shedding are carried out in order to maintain the supply-demand balance, as shown in Figure 6-2.³

In 2021, in addition to thermal power generation, small-scale solar and wind power generation (Nevis) were installed in SKE, but they accounted for only 5% or less of the total installed capacity. Like other Eastern Caribbean countries, they rely solely on imported fuel for thermal power generation.

² SKELEC website; <https://www.skelec.kn/#>, 2024

³ Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022



Source: Prepared by JST

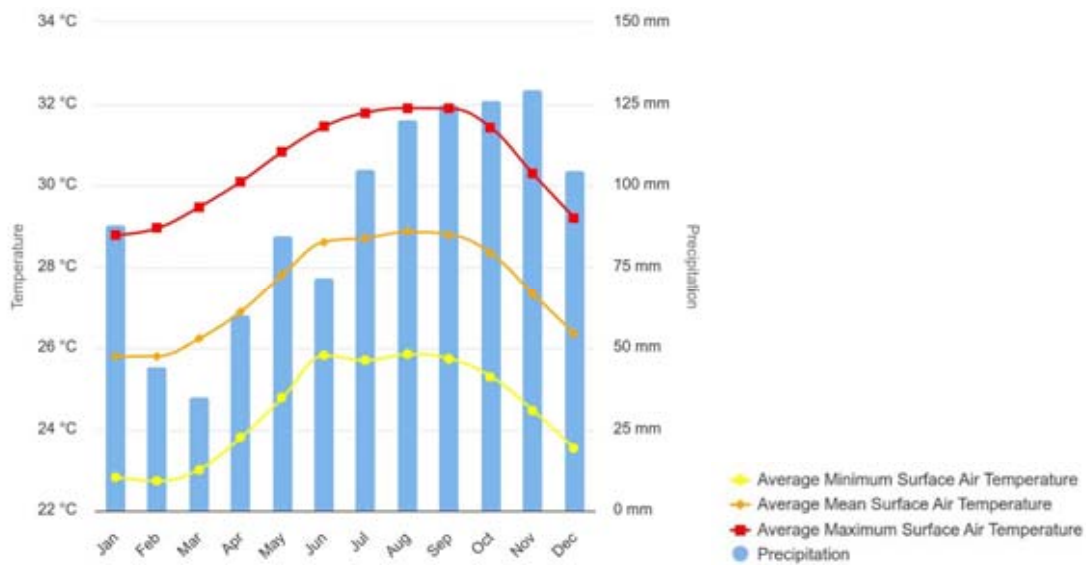
Figure 6-2 Outline of Electricity Situation in St. Christopher

In 2024, projects for solar power generation of 35.7 MW and the energy storage of 43.6 MWh are underway on the St. Christopher and will start supplying power in 2025. In addition, the implementation of geothermal power generation of 10 MW under PPP is planned in Nevis, but the details of the scheme are yet to be decided. The final phase of this geothermal power project is planned to have a capacity of 90 MW. If the project goes ahead, it will far exceed the country's demand electricity, so the possibility of energy export is also being expected. It can contribute to the improvement of the country's electric power situation and also to the economic situation.

⁴ Peak Demand: Demand electricity, Available Cap.: reserve capacity, Firm Cap.: feed-in capacity, Fossil-fuel Gen.: thermal power plant capacity, RE Gen.: renewable energy plant capacity

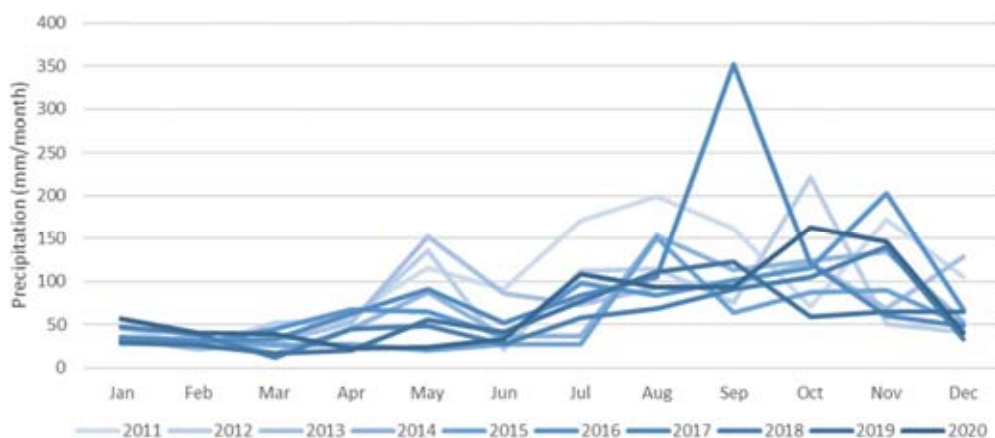
6.1.3 Natural condition

St. Christopher and Nevis has a tropical climate with average temperatures of around 26-29°C, dry seasons from January to April, rainy seasons from May to December, and hurricane seasons from June to October. Figure 6-4 shows the monthly rainfall for 10 years. In the dry season, the rainfall is less than 50mm from January to March. Among the countries covered this time, it can be said that the area with low rainfall especially with Antigua and Barbuda.



Source: World Bank Climate Change Knowledge Portal
 Note: Average for 1991-2022

Figure 6-3 Average temperature and precipitation for St. Christopher and Nevis



Source: Prepared by JST based on World Bank Climate Change Knowledge Portal
 Note: Monthly data for 2011-2020. Outlook for 2017 are the effects of hurricane Irma.

Figure 6-4 Monthly precipitation for St. Christopher and Nevis

Table 6-4 Monthly precipitation for St. Christopher and Nevis

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	45	27	30	61	116	90	171	200	162	71	172	106	1,251
2012	48	25	53	54	135	22	112	115	76	222	51	42	954
2013	35	22	29	52	153	86	74	93	97	122	69	129	961
2014	31	36	17	45	88	37	36	153	113	123	134	54	867
2015	31	32	27	28	20	27	27	151	63	87	90	50	635
2016	28	28	45	67	65	37	98	84	101	115	203	68	939
2017	36	31	33	63	92	52	84	105	352	120	61	48	1,077
2018	48	39	12	45	49	27	58	68	91	105	140	33	715
2019	29	26	17	21	55	42	77	111	123	59	66	65	691
2020	56	41	39	22	23	33	109	93	93	163	147	40	859

Source: Prepared by JST based on World Bank Climate Change Knowledge Portal

Annotation: mm/month

6.2 Policy and legal framework related to the water sector

6.2.1 National water policy

Although there is no comprehensive policy for the water sector in St. Christopher and Nevis, the Department of Environment of the Ministry of Agriculture, Marine Resources, Cooperatives, Environment and Human Settlement^{5,6} developed the "National Climate Change Adaptation Strategy" in 2018 with funding from the European Union, where the water sector is considered one of the priority areas. The strategy identifies the water sector objective: to provide a safe and reliable water supply for St. Christopher and Nevis and to ensure efficient water use to build resilience to climate variability and change, and the priority adaptation actions: to revise legislation, regulations, policies and plans to support integrated water resources management; to promote integrated water resources management through investments in data management, capacity building and improved implementation; and to enable the participation of civil society, communities and the private sector in integrated water resources management.

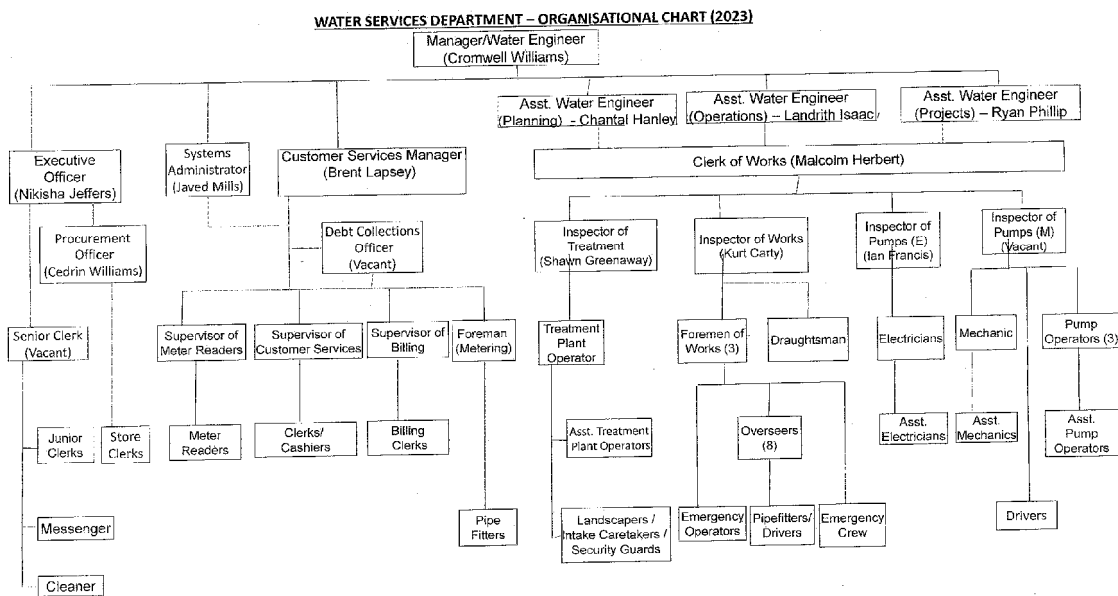
6.2.2 Related organizations

In St. Christopher and Nevis, water services are provided by the Water Services Department (SKWSD), which is part of the Ministry of Public Infrastructure and Utilities, Domestic Transport, Information, Communication and Technology and Post.

SKWSD was established in early 2000 and currently has 129 employees (123 regular and 6 contract), and the organizational structure is shown in Figure 6-5. SKWSD, as mentioned later in 6.4.3(6), does not have autonomy in several important operations and is managed by other government departments and agencies, operating the water supply business under various constraints. Previously, water supply and electricity were operated by a single government organization, but the electricity service is now incorporated. SKWSD intends to proceed with the corporatization in order to have autonomy in the water supply operation. This also affects the tariff system. While electricity tariffs are paid by government agencies, water tariffs are not paid by public institutions, such as the government, schools, hospitals, and prisons, which also encourages the corporatization of SKWSD.

⁵ This is the name of the ministry at that time. At present, the Ministry responsible for environmental administration is the Ministry of Sustainable Development, Environment, Climate Action, and Constituency Empowerment.

⁶ The St. Christopher and Nevis NDC was updated in October 2021.



Source: Received from SKWSD

Figure 6-5 SKWSD Organizational Chart

6.2.3 Related laws and regulations

In St. Christopher and Nevis, the Watercourses and Waterworks Act, which consists of 26 articles, has been enacted as the basic law governing the water sector. In addition, regulations under the Act, such as the Watercourses and Waterworks Regulations and Water Service Rates, stipulate details.

6.2.4 Related plan

The St. Kitts and Nevis Agricultural Transformation and Growth Strategy 2022-2031, adopted in June 2022, consists of 4 outcomes and 15 associated outputs, including items related to the water sector. A total budget of USD 25.6 million has been allocated to the strategy in total, including the allocation to the water sector, which consists mainly of USD 1.5 million for the outcome: land tenure, water and fisheries legislation and property rights reviewed and amended, and USD 2.5 million for the outcome: integrated management of land, soil, water and coastal ecosystems.

6.3 Status of water resources

6.3.1 Use of water resources

(1) Water source utilization status

In the St. Christopher, surface water and groundwater from 28 wells account for 30% and 70% of the water sources respectively. On the Nevis, the water source is more dependent on groundwater with 90% of the total sources. Groundwater from wells maintained by SKWSD is used for irrigation water, and water charges are paid according to the usage.

Precipitation has been decreasing in recent years due to the effect of climate change, and the distribution reservoirs are not full in the dry season compared to the previous situation. On the other hand, the groundwater aquifer is stable, and several pumps are in constant operation, and no tendency of seawater intrusion into the aquifer is observed by the water quality test that is conducted once a month.



Source: FAO AQUASTAT (2015)

Figure 6-6 Water source location of St. Christopher and Nevis (major rivers)

(2) Use of Rainwater

The use of rainwater is not common on the St. Christopher, but SKWSD encourages the use of rainwater. Rainwater is actively used in Frigate Bay and “Half Moon and South East Peninsula”, and it is also used by farmers.

While the Government provides some rainwater storage tanks in areas where water is scarce, installation is the responsibility of the homeowners with their own budgets. In addition, the amount of rainwater collected is not sufficient, so there is little incentive for St. Christopher residents to actively use rainwater.

The Nevis, on the other hand, requires the installation of rainwater harvesting systems in the construction of new buildings. Rainwater is generally used for irrigation water, showers, washing water, and car washing in each household after filtration and chlorination. As for public facilities, rainwater is mainly used for washing water and landscaping water in schools.

(3) Recycled water use

No sewerage system is developed in St. Christopher and Nevis; Therefore, the use of recycled water has not been implemented.

6.3.2 Implementation status of integrated water resources management

(1) Implementation organization of water resources management

Organizations involved in integrated water resources management will be SKWSD boards and Ministry of Agriculture, CIMH. For example, since there is no organization in the country to manage meteorological and hydrological information, information is obtained from CIMH.

While SKWSD is responsible for water resources management, there is no clear division of duties or job definitions, and no specific water resources management department has been established. At present, an assistant engineer works on such management, and there are no staff with academic knowledge or hydrological specialists.⁷

Although SKWSD is working with NEMA to reduce the damage caused by natural disasters by conducting training and seminars on how to respond to natural disasters, at the moment, there are currently no BCPs and operational manuals for emergencies.⁸

(2) Integrated water resources management plan

There are no current plans or significant initiatives for integrated water resources management. Although there are penalties for illegal water users under the Water Law, the legal system for water rights has not been developed.

⁷ They have previously participated in a groundwater source control training in Taiwan and an IWRM training to be held in Singapore at the end of February 2024.

⁸ National Urgent Control Organization in National Emergency Management Agency: SKD

(3) Status of implementation of water source monitoring

Since there is no major river as a water source, river flow monitoring has not been implemented, but a remote monitoring system has been installed to monitor the water level in the water distribution reservoirs so that the water level can be checked at any time using smart phones. As for groundwater sources, water level gauges are installed at each well site in the same way.

Even during hurricanes, there were no major disasters such as landslides, and no major damage has occurred to water supply facilities such as pipelines. The extent to which the personnel can move to remove the debris is limited because the underflow, such as branches, is clogged in the water intake facility.

6.3.3 Challenges in water resources management

(1) Challenges in water resource development

Although the groundwater source survey was conducted by U.S. consultants, a new water source development plan has not been developed. Budget constraints and staff shortages are problems in implementing the development project.

(2) Impacts on agriculture and tourism

Although SKWSD also provides irrigation water to farmers, there are many areas where adequate water supply is not available. At present, the government is discussing with the Ministry of Agriculture what kind of support methods can be used to ensure irrigation for farmers in certain areas, and is looking for measures. Water supply services for cruise ships and yachts to country's ports had been practiced in the past, but they have now been discontinued due to the lack of water. Large accommodations, such as the Marriott Hotel, have freshwater facilities. In order to be able to supply water from these facilities to be provided to neighboring areas during droughts, water supply contracts are signed with SKWSD to pay tariffs to the operators according to amount of water supplied.

(3) Issues in integrated water resources management

There are no plans for integrated water resources management, and there is a lack of human resources, and a delay in efforts to address such challenges compared to other countries. And, from the perspective of disaster management, this paper mentions that there is no budget for strengthening the resilience of the water supply system, that there are no human resources and no training for disaster management.

6.4 Status of water supply

6.4.1 General condition of water supply

In the early 1970s, St. Christopher and Nevis relied on surface water for its water supply, with a water demand of approximately 13,600 m³/day (3 million gallons/day). Subsequently, as the population increased, the groundwater source was also used. At present, the St. Christopher's water supply is operated by SKWSD, and the population is approximately 45,000 and the water supply coverage is approximately 99%, and the number of customers is approximately 18,000. It is divided into three operation zones: East, West, and the capital Basseterre. The total water demand is approximately 29,500 m³/day (6.5 million imperial gallons/day) and the water supply capacity of the current facilities is approximately 31,800 m³/day (7 million imperial gallons/day). In the rainy season, water is supplied 24 hours /7 days. However, in the dry season, the influx of tourists during the drought and carnival seasons may overlap, so water supply restrictions are implemented from 9:00 p.m. to 5:00 a.m. for 80% of the population.

6.4.2 Water supply systems

SKWSD's water supply source is spring water and groundwater, and the only water treatment plant is the La Guerite WTP. According to interviews with staff members, the year of construction of the WTP is estimated to be in the 1940s, and approximately 80 years have passed since the construction, and deterioration has progressed.

The WTP relies on three springs as water sources and has a supply capacity of approximately 4,500 m³/day (one million imperial gallons per day). It uses a sedimentation tank and rapid filtration. The treated water, after disinfection with chlorine gas, is distributed by gravity.



Date: February 2024

Figure 6-7 La Guerite WTP (left: sedimentation tank, right: clear water reservoir)

DI pipes are used for well pumping lines and distribution trunk mains, but the distribution mains and supply mains are made of PVC pipes, and DMA has not yet been constructed. The pipeline network is a mix of new and old, and the raw water transmission mains are approximately 50 years old after installation, and there are concerns about pipe deterioration.

The main challenges in developing the water supply system are as follows: (1) SKWSD does not have a GIS system, and basic facility information is not managed in conjunction with location data; (2) there are constraints on the annual budget from the Ministry of Finance; and (3) there are only three engineers capable of planning and designing water supply facilities.

6.4.3 Water supply operation

(1) Operation and maintenance of facilities

Operation and maintenance manuals and SOPs for the water facilities have not yet been developed, and operation and maintenance is currently based on staff experience. The water source monitoring system is also undeveloped, with staff making daily visual observations and managing data using Excel. Operation and management of the La Guerite WTP is on a 24-hour, three shift system, with an on-site management office. The influent volume is measured at the weir, and the effluent volume is measured hourly with a mechanical flow meter and recorded in a notebook. Of the 28 distribution reservoirs, 21 are equipped with water level sensors that allow real-time monitoring via smart phones, but flow meters are not installed, and water volume management is based on billed water consumption. In rural areas, power outages occur once or twice a month, but self-generating equipment for pump operation is in place to run the pumps, ensuring that the water supply is not affected.

Currently, the SCADA system is not in place, but there are plans to introduce it in 2024 to strengthen water supply management. The government budget for the implementation has already been secured, and the preparation of tender documents has been completed.

In SKWSD, GIS has not been introduced, and basic facility information such as the location of water sources and water facilities has not been organized. At present, the Department of Physical Planning under the Ministry of Sustainable Development centrally manages GIS data for water supply, electricity, and communications, and SKWSD cannot access the GIS data, and it is not available for facility planning and operation/maintenance. When registering information, SKWSD makes a request to the department, and when they need any information from the system, SKWSD staff have to visit the Department to get the data.

At the time of our first survey, and JST recommended the need to introduce GIS in SKWSD. After the first survey team returned to Japan, progress has been made at SKWSD, and the introduction of Q-GIS and the establishment of a GIS unit are currently underway.

In addition, six SKWSD staff members are currently taking an online GIS-related training course provided by CIMH.

From the above, the main challenges of their operation and maintenance are the lack of development of facility management systems such as SCADA and GIS, and as a result, insufficient accumulation of information and inability to use data effectively.

(2) Water quality management

The water quality standard is WHO compliant, and the tap water quality is tested in a laboratory operated by the Ministry of Health. SKWSD also has a laboratory that tests raw and treated water. However, it remains in the position of internal water quality control for unauthorized laboratories (this water quality data is not submitted to the Ministry of Health).

If an abnormality is detected in the water quality, SKWSD receives a letter with instructions for action. In response, SKWSD takes measures such as shutting off the water supply and providing chlorine disinfection. Water quality data, including such cases, is generally not made available to the public.



Date: February 2024

Water Quality Testing Laboratory established in 6-8 SKWSD Division01

(3) Status of non-revenue water (NRW)

The NRW rate on St. Christopher is currently estimated to be around 50%⁹, which is one of the factors contributing to the water shortage. Although the exact breakdown is unknown, the causes include water leakage, water theft, and the free use of water by government agencies. In addition, according to interviews, the failure rate of water meters is high at approximately 20%, which could lead to commercial losses. The existing water meters are impeller type, procured from Europe, and are of good quality and typically last 20 to 25 years unless they fail and need to be replaced. However, due to budget

⁹ Note: NRW was estimated from the difference between the amount of water produced and the amount of water billed, and it is necessary to keep the NRW as a reference value because the analysis of the amount of water delivered has not been done.

constraints, there is an insufficient stock of water meters, which contributes to the high failure rate.

To address the water shortage, SKWSD is planning to install a desalination plant, which will incur significant costs in the future. Therefore, reducing NRW is likely to become an even more critical challenge from a financial perspective.

(4) Water rates and collection status

Figure 6-8 shows the current water rate system of SKWSD. Based on this data, the water rate per 20 m³ for domestic supply is the cheapest at EC\$ 33.65 and among the target countries in this survey, which is one-third of that of Antigua and Barbuda, where desalination is the mainstream. There are three categories of water rates for domestic, non-domestic, and agricultural use, and the rate is based solely on metered usage. Tap water is not supplied to cruise ships and yachts.

SKWSD's water rates have not been revised since 2001, when they were increased by 50%, and are among the lowest in the Caribbean. The Cabinet approves SKWSD's proposal to increase water rates. Proposals for water rate increases are made by SKWSD to the Cabinet, which then approves them. Although SKWSD has proposed rate increases on several occasions, the Ministry of Public Infrastructure prioritizes the achievement of 24-hour water supply and does not participate in discussions on rate increases. In addition, there is a cultural expectation that water rates should be low, making it even more difficult to implement tariff increases.

In addition, the water tariff collection rate is as low as 72%, and public institutions such as government, schools, hospitals, and prisons (which account for 1.6% of the total water consumption) are not required to pay water tariffs.

As described above, SKWSD's water supply business is at a low level in terms of both water tariffs and collection rates. However, since the Ministry of Finance is responsible for the financial management of water supply projects as a project of some central government agencies, their incentives to improve profitability may not work structurally.

The Water Service Rates payable on premises within the distribution area with effect from 1st day of January, 2001 are as follows:

A. Where a water meter is installed -

- Domestic Supply

Water Usage (Imperial Gallons per Month)	Rate (EC Dollars)
0 - 5,000	\$0.72 per 100 gallons
5,001-7,000	\$0.96 per 100 gallons
Greater than 7,001	\$1.20 per 100 gallons

Provided that in no case shall the sum payable in respect of any month be less than EC\$18.00.

(2) Non-Domestic Supply

Flat rate of EC\$1.50 per 100 gallons or part thereof per month. Provided that in no case shall the sum payable be less than EC\$37.50 per month.

- Agricultural

Flat rate of EC\$0.80 per 100 gallons or part thereof per month. Provided that in no case shall the sum payable be less than EC\$37.50 per month.

B. Where no water meter is installed -

- Domestic Supply

EC\$0.75 on every EC\$5.00 of the annual assessed rental value of the premises.

Provided that in no case shall the sum payable be less than EC\$18.00 per month.

- Non-Domestic Supply

EC\$1.25 on every EC\$5.00 of the annual assessed rental value of the premises.

Provided that in no case shall the sum payable be less than EC\$37.50 per month.

C. The rental charge for all meters shall be EC\$2.00 per month.

Source: Quoted from SKWSD's website

Figure 6-8 SKWSD water rate system

(5) Issues related to customer management

Of the approximately 18,000 customers, 17,505 are currently in operation, including 16,014 domestic, 1,201 commercial, 179 agricultural, and 111 government.

Customer complaints include: 1) 80% of the water supply hour (water supply is turned off between 9:00 p.m. and 5:00 a.m., depending on location), 2) 15% of the low water pressure (especially for homes located at high elevations), 3) 5% of the taste and color (air gets into tap water and it appears white and cloudy), and as a small number of other items related to meter reading (overbilling due to meter misreading, meter malfunction).

SKWSD responds to these complaints and disseminates information about water supply rationing via radios, Facebook, and bulletin boards.

In addition, raising awareness of water conservation among citizens is an issue, and SKWSD considers the problem of not being able to educate citizens about the importance of protecting water resources and making them aware of the possibility of water resource depletion. In the past, there were public stands, but many wasted water, and they had have eliminated them, and they recognize that raising the water rates is also necessary to promote public understanding of the value of water.

(6) Organizational challenges

SKWSD lacks independence in several critical areas such as those listed below, is managed by other government sectors and organizations, and operates its water supply systems under various constraints.

- 1) The Ministry of ICT owns the SKWSD website, and important information has not been posted on the website due to SKWSD's limited editorial authority.
- 2) The finances of some government agencies, including SKWSD, are managed centrally by the Ministry of Finance. For this reason, SKWSD only provides financial data to the Ministry of Finance, and it is not possible to determine the financial status of its own organization.
- 3) The Department of Physical Planning under the Ministry of Sustainable Development has built and manages SKWSD's GIS systems. SKWSD does not have access to the GIS of its own water supply facilities. When they need information, it is necessary to visit the station to request information.

SKWSD also suffers from the following staffing problems.

- Due to staff shortages, many employees holds several different jobs concurrently..
- There are only three engineers, including the General Manager, who can plan and design water facilities, and they are now being supported by the Ministry of Public Infrastructure support.
- There is no personnel decision-making for new hires. SKWSD conducts the interviews and recommends candidates to the Minister, who then makes the final decision.
- There are no qualified people in the country to fill the required positions. In addition to the need to go to foreign universities for engineering education, it is difficult to establish a clear career path within the country. As a result, there is a tendency for individuals to prefer to work abroad in search of growth opportunities and better compensation.

6.4.4 Technical training system

In SKWSD, the internal training system has not been developed, and human resource development is a major issue. Although there is an environment in which the qualification certification program for facility operation and maintenance offered by a U.S. company through CAWASA can be taken, no one has participated in it for more than 10 years. The reasons include a lack of staff for daily operations and the fact that participation does not lead to rewards or promotions, making staff reluctant to participate. In addition, the Director of the Water Department mentioned that while CAWASA's program is helpful in establishing a common understanding with other regional water utilities, it is not necessarily aligned with SKWSD's current situation and needs. Besides, the lectures are delivered online, and participants receive a certificate upon passing the exam at the end of the course. However, the certificate is only valid for two years, and renewal fees are required to maintain its validity. Participants feel that the two-year validity period is too short.

When participating in overseas training, the training report is submitted to the supervising manager, human resources officer, and the Ministry of Public Infrastructure upon return, but these reports are not archived within SKWSD. The manager asks the participants if they are interested in the training details, but there are no internal training courses held, and there is no system to store the training materials in the department's server.

Their training needs include public utility management, distribution system operation and maintenance, water treatment plant operation, and health and safety. Key challenges include not meeting the required educational standards, lack of experience, and budget constraints for training.

6.4.5 Trends in the private sector

There are bottled water companies, but there is no private water supplier other than SKWSD. Examples of PPPs include water supply contracts with the Marriott Hotel. During the dry season, water is supplied to the surrounding areas from the hotel's desalination plant, and SKWSD pays water fees based on the volume supplied.

6.4.6 Situation of NRW reduction

(1) NRW reduction plan

Currently, no NRW reduction plans have been established, and no NRW projects have been implemented in recent years. On the other hand, SKWSD is currently receiving a proposal from Miya Water to implement a program to reduce NRW.¹⁰

(2) Implementation of NRW reduction

The number of water leakage is approximately 700 per year. There are three operational zones under the Inspection of Works for leak repair, each of which is supported by personnel in each zone. The leakage repair history is recorded on a specified form and then copied to Word.

The main problems related to water management were: 1) lack of data needed for NRW management due to lack of GIS systems. 2) lack of project units to reduce NRW; and 3) lack of training in the use of water leakage detectors.

(3) Pilot project of smart meter introduction

A smart meter pilot project will be launched in 25 locations. Currently, the billing rate is high at approximately 90%, but the accuracy of meter reading is low. While the introduction of smart meters is expected to improve accuracy, there are challenges associated with their implementation. These challenges, as identified by SKWSD, include: (1) the need to establish a separate network within the department specifically for the smart meter system, independent of the government network¹¹; (2) the investment risk associated with the introduction of smart meters; and (3) the need to address the 30% of customers who currently do not pay their bills.

6.4.7 Facility development plan

(1) Ongoing projects

The main development projects currently being implemented are as follows.

- A desalination plant with a capacity of approximately 9,100 m³/day (2 million imperial gallons per day) will be constructed in Basseterre by December 2024. Land acquisition and procurement of materials have been completed, and the construction is scheduled to begin as soon as the materials arrive. Once this facility is operational, the current water supply contract with the Marriott Hotel is expected to be terminated.

¹⁰ In the Caribbean Sea, Miya Water has concluded a performance-based contract (PBC) with a water utility in the Bahamas and Jamaica to reduce non-revenue water (NRW). According to the company's website, it has achieved a significant reduction in NRW from 60% to 17% in the Bahamas and from 64% to 39% in Jamaica.

¹¹ As a precondition, government agencies, including SKWSD, are required to use government networks with limited Internet access.

- The Cayon region has experienced severe water shortages for decades, and the construction of deep wells with a capacity of approximately 4,500 m³/day (million imperial gallons per day) is scheduled to begin in March 2024.
- With the support of the United Arab Emirates, a 136 m³/day (30,000 imperial gallons per day) solar-powered desalination plant will be built in two locations, St. Christopher and Nevis, with construction to be completed in the coming months.
- A small-scale sewage treatment pilot plant is being demonstrated as part of CReW+: An Integrated Approach to Water and Wastewater Management Using Innovative Solutions and Promoting Financing Mechanisms in the Wider Caribbean Region, which is being implemented through GEF Trust Fund loans, and is expected to be completed within this fiscal year.

(2) Planned project

The water coverage rate has already reached 99%, and although there is no master plan for the development of the water supply system, a strategic plan is prepared each fiscal year, and budgets are set for each project.

The main project in the pipeline is "Transitioning the Water Supply in St. Christopher and Nevis to a Low Carbon, Climate Resilient Sector (SKN TransWater Project". SKWSD submitted the Project Preparation Funding Application to the GCF Fund with the accredited entity of CCCCC, and it was approved at the end of last year, and a feasibility study will be carried out for the procurement of funds in the next two years. It is expected to be developed up to Funding Proposal in the project.

6.5 Status of wastewater treatment

6.5.1 Development status of sewerage system

Currently, there is no sewerage system in the country and septic tanks are used for black water treatment. The management of septic tanks is the responsibility of the Ministry of Sustainable Development, but the Solid Waste Management Corporation, a semi-governmental, semi-private company under the Ministry of Infrastructure, handles the various issues related to the installation of septic tanks, sludge collection and treatment.

6.5.2 Pollution status of public waters

Since the sewage from the septic tanks and the gray water are discharged through soil infiltration at each household, there is no discharge to the sewers or rivers, and no water pollution is observed (therefore, only the rainwater gutter is prepared next to the road). In addition to the small population and the small amount of sewage generated, the groundwater comes from deep wells, so there is no impact on the quality of the groundwater source through soil infiltration.

6.6 Financial position

As described above in Section 6.2.2, "Related organizations", SKWSD, a water supply organization of St. Christopher and Nevis, is a part of the Central Government's Ministry and does not prepare any financial statements. Because the financial data that could be useful for financial analysis is not publicly available and financial information from SKWSD could not be obtained, the survey does not provide an analysis of the financial condition of the water utility of St. Christopher and Nevis.

Chapter 7 Saint Vincent and the Grenadines

7.1 Basic information

7.1.1 Outline of the target country

The St. Vincent and the Grenadines are small islands with a total area of approximately 390km², consisting of more than 30 islands and coral reefs located between 13 degrees 15 minutes north and 61 degrees 15 minutes west of the southern Windward Islands.

The capital is Kingstown in the southern part of the St. Vincent, and the population composition consists of Africans (71.2%), mixed race (23.0%), indigenous people (3.0%), etc.¹

7.1.2 Socio-economic conditions

(1) Population dynamics

The population dynamics from 2010 to 2020 are shown in the table below, and the latest population growth rate is -0.4%, which shows a declining trend. In the northern part of the St. Vincent, the active volcano La Soufrière rises, and the population is mainly distributed in the coastal areas at the foot of the volcano and near the capital in the south.

Table 7-1 Demographic and economic conditions of the St. Vincent and the Grenadines

	Items	Unit	2010	2015	2020
Basic info.	Total population	inhab	108,250	109,150	110,940
	Urban population	inhab	53,520	55,780	58,740
	Rural population	inhab	55,790	53,670	52,020
	Population density	inhab/km ²	278	280	284
Economics	Gross Domestic Product (GDP)	current US\$	681,225,926	755,400,000	809,681,481
	Agriculture	value added to GDP	X	41,410,370	47,114,815
	Industry	value added to GDP	X	86,020,370	89,385,185
	Services	value added to GDP	X	456,818,148	508,440,742
	GDP per capita	current US\$/inhab	6,293	6,921	7,298

Source: FAO AQUASTAT

¹ Source: Embassy of Japan, Tobago, Trinidad (2024), St. Vincent and the Grenadines



Source: (left) OpenStreetMap, (right) EU, Global Human Settlement Layer

Figure 7-1 Population distribution map of the St. Vincent (2020)

(2) Macroeconomics

The key economic indicators are shown in Table 7-2. The GNI per capita in 2022 is USD 9,110, which leaves SVD as a DAC listed country. Since the GDP per capita is USD 9,125 and the GDP per capita growth rate is 5.3% per year, assuming this growth rate continues for five years, the GDP per capita in 2027 will be USD 11,591.

The economy depends on the seasonal factors of activities and remittances related to agriculture, tourism, and construction. Most of the workforce is employed in banana farming and tourism. St. Vincent and the Grenadines are areas where small offshore financial providers have fully cleared international regulations to operate their business. The country is an upper-middle income country and is vulnerable to shocks caused by natural phenomena and external factors. In recent years, however, diversification of agricultural products, increased tourism, and growth in the construction industry have had a positive impact on the economy. An international airport opened in 2017, improving air transportation with foreign countries. In April 2021, however, an eruption of Mt. La Soufrière located in the northern part of the country caused a large number of casualties and material damage, which adversely affected the country's economy, mainly in tourism and agriculture. In addition, the domestic economy was affected by the spread of COVID-19, making economic recovery a challenge.

Table 7-2 Key economic indicators of St. Vincent and the Grenadines

GNI (in USD million)	GNI per capita (USD)	GNI growth rate (%/year)	GNI per capita growth rate (%/year)	Inflation rate (%/year)	Trade balance (in USD million)
927	9,110	No data	No data	5.7	-341.1
GDP (in USD million)	GDP per capita (USD)	GDP growth rate (%/year)	GDP per capita growth rate (%/year)	Unemployment rate (%)	Service revenues and expenditures (in USD million)
949	9,125	4.9	5.3	19.0	0.3

Source: World Bank (2022) World Development Indicators, Moody's (2022) Economic Indicators (except for service revenues and expenditures from International Trade Statistics (2019))

(3) Financial Position

Saint Vincent and the Grenadines has a current account deficit. In FY 2022, current revenues were USD 407 million, but expenditures reached USD 444 million, resulting in a deficit of approximately USD 37 million. In FY 2023, while the current revenues are USD 283 million, the current expenditures are only USD 364 million, but the deficit is projected to continue at USD 81 million. The central government projects a deficit in the current account for the period from FY 2024 to FY 2026. Public debt is chronically high and far from the 60% of GDP benchmark for the Eastern Caribbean countries.

Table 7-3 Current accounts and public debt in St. Vincent and Grenadines

Current revenue (in USD million)		Current expenditure (in USD million)		Outstanding public debt (in USD million)		Outstanding public debt Percentage by GDP	
FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 September forecast	FY'22 Actual	FY'23 Forecast
248	283	308	364	837	938	84.7	88.1

Source: St. Vincent and the Grenadines (2023) Estimates of Revenue and Expenditure for the Year 2024)

(4) Business environment

The Ease of Doing Business Index is 57.1 (2020). It ranks 130th out of 190 countries internationally, in the middle to lower range, and falls below 59.1 in Latin America and the Caribbean region, which is fourth among the six countries covered in this survey. In contrast, the Corruption Perceptions Index is 60 (2023), which ranks 36th out of 180 countries covered worldwide, the highest among the six countries covered in this survey.

(5) National Development Plans

The National Economic and Social Development Plan 2013-2025 has been established, with five strategic goals and four sectoral strategies. Strategic Goal 4 "Improving Physical Infrastructure, Preserving the Environment and Building Resilience to Climate Change" lists "To ensure an adequate, safe, reliable and sustainable supply of water"

among its 10 objectives. In Sectoral Strategy 1 "Economic Sector", it is stated that efforts will be made in relation to agriculture and fisheries, such as the implementation of irrigation programs, the strengthening of the institutional systems that respond to natural disasters, and the appropriate implementation of water management practices, including reforestation, soil conservation, and riverbank stabilization. In Sectoral Strategy 4 "Physical Infrastructure and the Environment Sector", an objective and strategic interventions for the water sector are listed in the table below.

Table 7-4 Objective and strategic interventions for the water sector in the "physical infrastructure and the environment sector"

Objective: To ensure an adequate, safe, reliable and sustainable supply of water at affordable prices
Strategic interventions
<ul style="list-style-type: none"> ✓ Expand the water supply and distribution system. ✓ Improve the protection and management of water resources. ✓ Increase the economic viability of the provision of water services. ✓ Discontinue squatting, farming and other human activities around major water catchments. ✓ Develop and promote conservation measures and best water use practices to ensure optimal utilization of the water resources. ✓ Improve the quality of the potable water supply. ✓ Expand the provision of potable water to the Grenadines. ✓ Upgrade the system for the collection, monitoring and management of hydrological and other data/information on water resources.

Source: St. Vincent and the Grenadines (2013) National Economic and Social Development Plan 2013-2025

(6) Outline of electric power business operation

The electricity business is operated by VINLEC, which was established in 1961 by taking over the business of CDC². At the time of its establishment, the government owned 49% of its shares and CDC owned 51%. Currently, the government of SVD holds 100% of its shares and the company has become the state-owned enterprises.³ As they have reflected almost 100% of the impact of the recent sharp increase in fuel costs in the surcharges, there is no major impact on VINLEC's finances. In addition, the impact of high electricity costs on users is being mitigated by government subsidies.

(7) Power infrastructure development situation

In terms of supply-demand balance in SVD, the peak demand is 24.6 MW, while the installed capacity of thermal power generation is 44.9 MW, and they have secured sufficient redundancy rates even assuming stoppage due to maintenance or other minor incidents.⁴ Even though the newest domestic hydropower plant was built more than 35

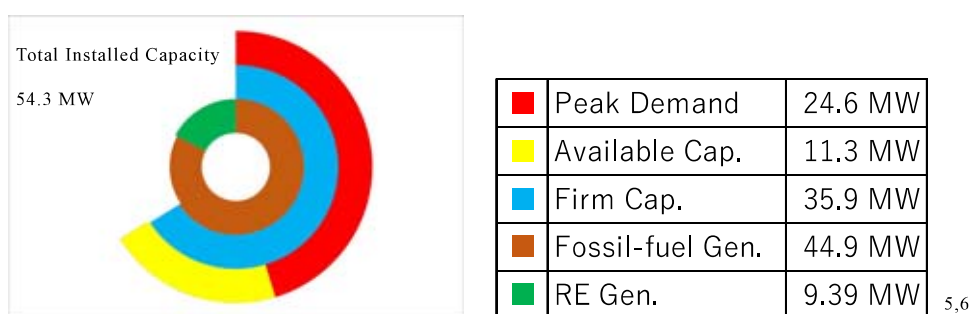
² Commonwealth Development Corporation

³ VINLEC website; <https://www.vinlec.com/>, 2024

⁴ Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022

years ago, a large number of rehabilitation projects have been carried out in the 2010s. By replacing thermal power plants with new ones and reinforcing transmission lines, the risks of unexpected power shortages and blackouts have been suppressed.

In 2021, the country's electricity generation consists of thermal power generation, solar power (capacity 3.7 MW) and hydropower (capacity 5.71 MW). The share of renewable energy exceeds 17%, a large share among the Eastern Caribbean countries. The country has set a target of 60% renewable energy by 2025, but it is unlikely to be achieved before the target year.



Source: JST preparation

Figure 7-2 Outline of electricity situations in St. Vincent and the Grenadines

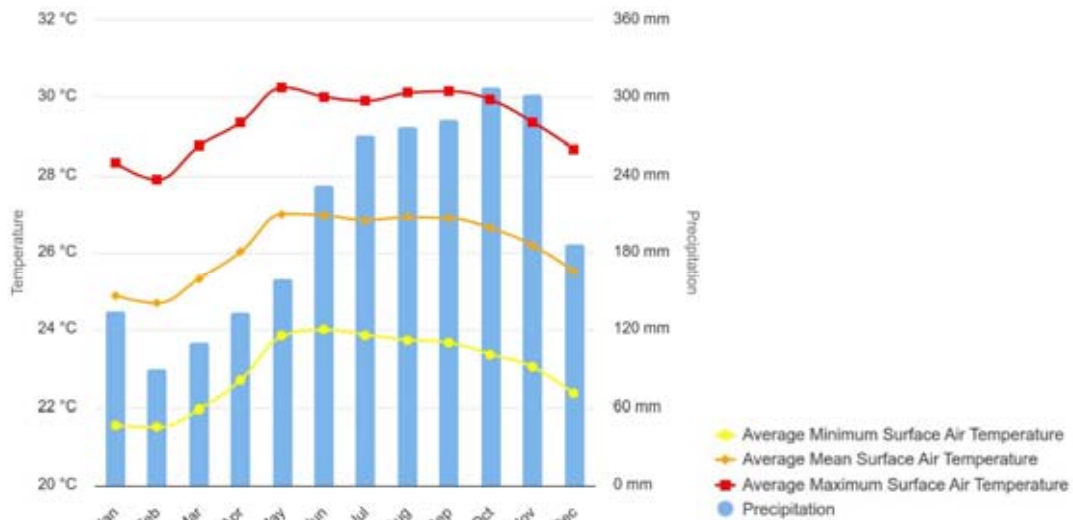
As a future plan to introduce renewable energy, there are many small and medium-sized solar power generation projects. As a large-scale project, there is a plan for geothermal power generation. This geothermal power project was originally planned in 10 MW, but the project was suspended due to the risk of economic aspects. However, in 2022, a Canadian private company with the latest geothermal technology (Eavor-Loop™) re-evaluated the project and proposed to restart the project, reducing it to 5 MW at the time of research.

⁵ Peak Demand: Demand electricity, Available Cap.: reserve capacity, Firm Cap.: feed-in capacity, Fossil-fuel Gen.: thermal power plant capacity, RE Gen.: renewable energy plant capacity

⁶ In the absence of Firm Capacity, 80% of the installed thermal power capacity was assumed to be Firm Capacity.

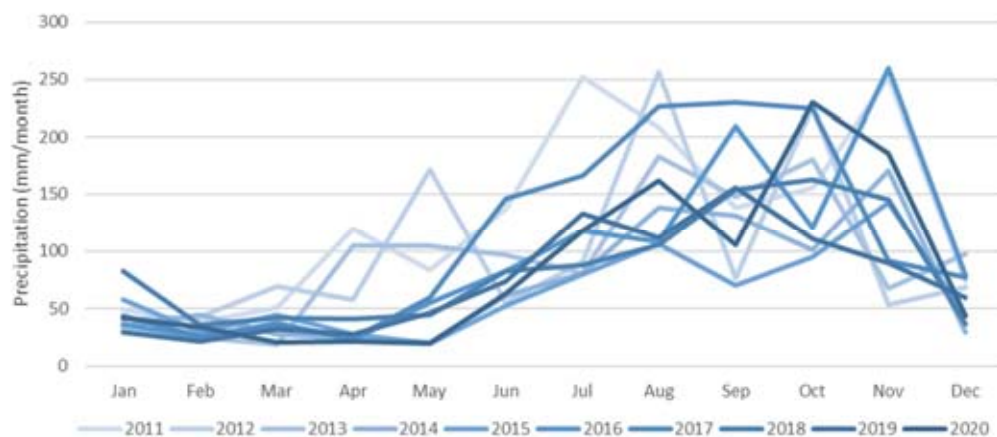
7.1.3 Natural conditions

St. Vincent and the Grenadines has a tropical climate with average temperatures of around 25-27°C, dry seasons from December to May, rainy seasons from June to November, and hurricane seasons from June to October. Figure 7-4 shows the monthly rainfall for 10 years. Even in the dry season, the rainfall is less than 50mm, especially from January to March.



Source: World Bank Climate Change Knowledge Portal
 Note: Average for 1991-2022

Figure 7-3 Average temperature and precipitation for St. Vincent and the Grenadines



Source: JST based on World Bank Climate Change Knowledge Portal
 Note: Monthly data for 2011-2020

Figure 7-4 Monthly precipitation in St. Vincent and the Grenadines

Table 7-5 Monthly precipitation in the St. Vincent and the Grenadines

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	49	39	51	119	83	137	252	208	138	155	251	73	1,556
2012	41	43	69	58	172	55	91	256	76	226	53	68	1,207
2013	34	25	19	104	104	96	81	183	147	181	67	97	1,139
2014	35	44	27	24	21	61	81	138	131	101	171	30	864
2015	57	30	44	27	20	52	79	106	70	94	143	43	767
2016	36	25	37	23	55	82	118	108	210	120	260	79	1,154
2017	44	26	36	24	59	146	166	227	230	224	91	77	1,350
2018	82	35	42	41	44	82	88	106	154	163	145	36	1,018
2019	29	21	32	27	46	73	132	111	155	111	90	60	888
2020	42	34	21	21	20	63	118	162	105	230	186	43	1,045

Source: JST based on World Bank Climate Change Knowledge Portal

7.2 Policy and legal framework related to the water sector

7.2.1 National water Policy

In St. Vincent and the Grenadines, no comprehensive water sector policy has been formulated. However, as described above in Section 7.1.2 Socio-Economic Conditions (5) National Development Plan, the sectoral strategies of the National Economic and Social Development Plan set out objectives and priorities for the water sector.

7.2.2 Related organizations

- (1) Ministry of Health, Health and Environment (Ministry of Health, Wellness and Environment)

The Public Health Administration (Public Health Department) within the Department controls the monitoring and regulation of water quality for human activities, seawater quality for safe recreation, and effluent quality from sewage systems. The functions of the Bureau are in accordance with the Environmental Health Service Law (Environmental Health Services Acts) enacted in 1991 and the Public Health Law (Public Health Act) enacted in 1977.

- (2) Central Water Supply and Sewerage Agency (CWSA: Central Water & Sewerage Authority)

The Central Water Supply and Sewerage Authority (CWSA: Central Water & Sewerage Authority), a statutory body established in 1970, is responsible for the provision of water supply, sewerage, irrigation, and solid waste management services in St. Vincent and the Grenadines. It is a semi-independent organization under the Ministry of Health, Wellness and Environment, and major decisions are made by a Cabinet-appointed Board of Directors of CWSA. CWSA consists of six departments: Engineering, Finance, Customer Care, Human Resources, Information Technology, and Public Relations.

The collection and disposal of solid waste is carried out by the Solid Waste Management Unit (SWMU in the same buildings as CWSA). SWMU was established in 1999 as a part of CWSA, but it became an independent organization due to the Waste Management Act in 2000.⁷

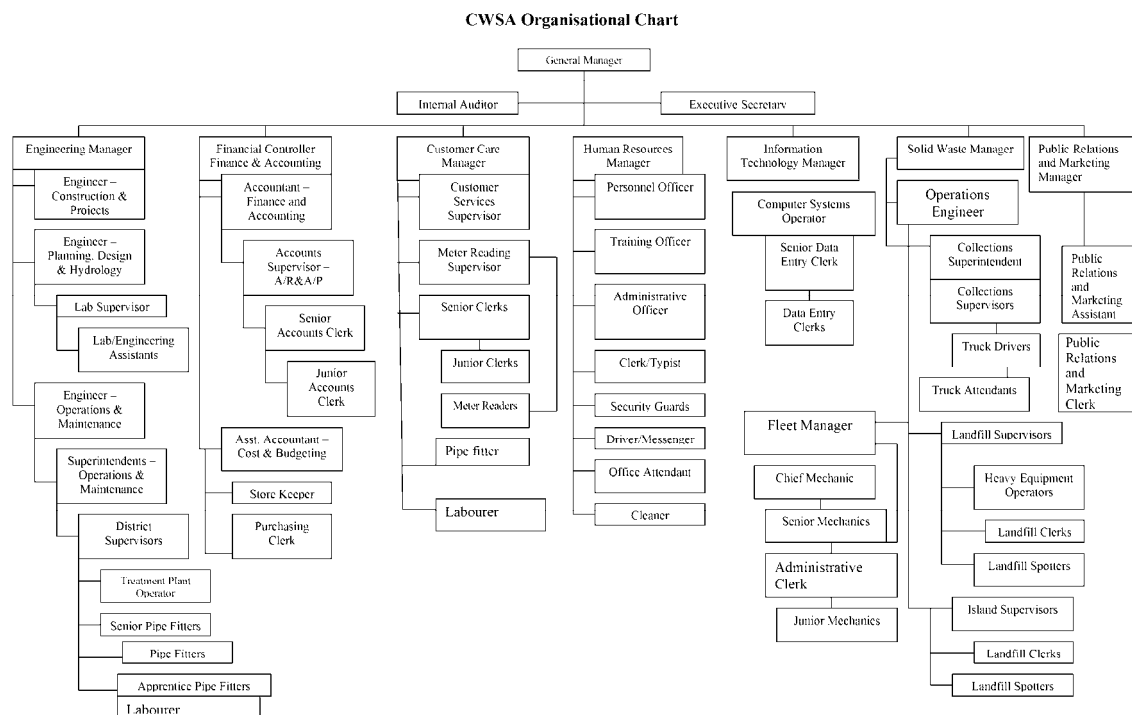
CWSA has 290 employees, with 215 regular jobs and 75 non-regular jobs (including project adoption).⁸

The Engineering Department is the largest, with 129 staff members. The Water Resources Division consists of 6 members, consisting of manager, data management, and field work. In addition, the company does not have any electricians who are familiar with

⁷ CWSA COUNTRY PROFILE, St. Vincent and the Grenadines

⁸ There are a total of 97 SWMU staff members, with 80 regular and 17 non-regular jobs.

SCADA and sewage pumps. Therefore, it has contracted with electricians on a project basis.



Source: Received from CWSA

Figure 7-5 Organizational structure of CWSA⁹

7.2.3 Related laws and regulations

The basic legislation governing the water sector in St. Vincent and the Grenadines consists of the Central Water Supply and Sewerage Corporation Law (Central Water and Sewerage Authority Act) enacted in 1991 and the Central Water Supply and Sewerage Corporation Rule (Central Water and Sewerage Authority Regulations), its implementation rules. The composition of all 36 articles of the law is as follows.

- ✓ Introduction (Articles 1 to 2)
- ✓ Chuo Water Supply and Sewerage Public Corporation (Articles 3 to 5)
- ✓ Management (Articles 6 to 10)
- ✓ Water Supply and Sewerage Services (Articles 11 to 22)
- ✓ Finance (Articles 23 to 26)
- ✓ Rates and charges (Articles 27 to 31)
- ✓ Miscellaneous Provisions (Articles 32 to 36)
- ✓ Exhibit

The composition of all 36 articles of the same rule is as follows.

⁹ SWMU is also given for convenience, but after 2000 it is the position of the independent organization.

- ✓ Introduction (Articles 1 to 4)
- ✓ Approval of Services (Articles 5 to 9)
- ✓ Private Sewage Operations (Articles 10 to 26)
- ✓ Commercial Waste Agreement (Sections 27-30)
- ✓ Prohibited waste (Articles 31 to 33)
- ✓ Sewage rates (Articles 34 to 38)
- ✓ Violations (Articles 39 to 44)
- ✓ Exhibit

7.2.4 Related plan

In the National Climate Change Policy (National Climate Change Policy of St. Vincent and the Grenadines), adopted by the Caribbean Natural Resources Institute (CANARI: Caribbean Natural Resources Institute) in 2019, the goals for adaptation are "safe and reliable water supply to the public and efficient use of water resources for building resilience" and for mitigation "reduction of greenhouse gases through sustainable waste management."

7.3 Status of water resources

7.3.1 Use of water resources

(1) Water source

The water source of the water supply system in St. Vincent is 100% surface water source, and the river water source is used except for one spring water source. Surface water is decreasing due to the effects of climate change, and the development of groundwater sources is being planned as a new water resource, and seawater desalination facilities have not yet been studied. On the other hand, the Grenadines are considering the introduction of a desalination plant.



Source: FAO AQUASTAT (2015)

Figure 7-6 Water source of St. Vincent and the Grenadines (major rivers)

(2) Use of Rainwater

There is no requirement to promote or mandate the use of rainwater due to the abundance of water sources on St. Vincent. On the other hand, the Grenadines are almost dependent on the use of rainwater, and their Building Law mandates the installation of rainwater

storage systems. Residents use the stored rainwater for various kinds of domestic purposes without any treatment.



Date: March 2024

Figure 7-7 Rainwater use in the Grenadines (Bequia)

(3) Recycled water use

Recycled water use is not widespread, because of the lack of STPs. However, according to CWSA, it is very likely to be introduced in the Grenadines, where there are few surface water sources and rainwater is actively used.

7.3.2 Implementation status of integrated water resources management

(1) Implementation organization of water resources management

The Water Resources Department (WRD) was established in CWSA in 2009, and is responsible for water resources management. Although policies and planning for IWRM efforts cannot be confirmed, the Water Resources Department implements monthly mutual information sharing with the Forestry Department, Saint Vincent Meteorological Service, NEMO and others on source water quantity and water quality control. For example, real-time water level observation data managed by NEMO for flood forecasting is shared as flow rate monitoring data, while informal efforts are being made to allow other organizations to log in and monitor the conditions at any time.

(2) Integrated water resources management plan

Although water use is described in the Central Water and Sewerage Authority Act, the application and approval process for water rights is not formalized and does not function as a system. The WRD believes that it is first necessary to develop legal systems for the management of water resources, including water rights. Most rivers and springs are owned by the national government and cannot be acquired by the private sector. From a water resources management perspective, illegal construction and agriculture in

watershed areas are prohibited by law. On the other hand, there are problems with unauthorized grazing in water source areas.

(3) Status of monitoring implementation

Water level gauges are installed at all water sources and are managed by WRD. On the other hand, it is necessary for staff members to visit the site directly to collect data, and the development of monitoring stations capable of automatic measurement becomes a problem.

6.3.3 Challenges in Water Resources Development, Use and Management

(1) Issues in water resources development

In CWSA, a groundwater resource survey was conducted last year, but the scope of the survey is considered insufficient. The shift to desalination is expected to be avoided as much as possible due to the high operating costs.

(2) Impacts on agriculture and tourism

Since agricultural water is not part of the CWSA water supply, such problems have not been identified. Since the high tourist season coincides with the dry season, each hotel tends to have a backup water supply system for about one day in case of a water disruption.

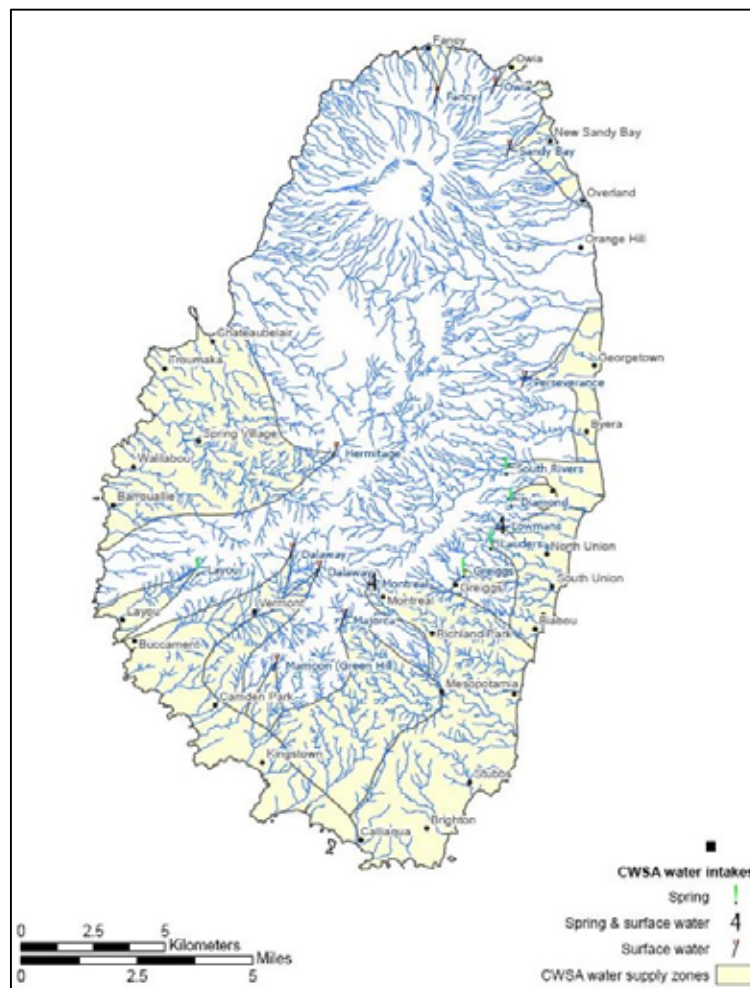
(3) Issues in integrated water resources management

Although there is a framework for cooperation with other informal departments and institutions, there is no clear framework for which organizations play what role. However, there are no plans like in Grenada to create a new unit for IWRM, and this is due to the fact that such small islands do not consider IWRM as a major challenge because they practice mutual data sharing as mentioned above.

7.4 Status of water supply

7.4.1 General condition of water supply

CWSA is responsible for water services in the areas shown in Figure 7-8. The number of customers is 40,470 (of which approximately 39,000 are ordinary households) and covers 97-98% of the island’s population. In 2022, the average daily water distribution was estimated to be approximately 32,350 m³/day, of which 30-40% were estimated to be lost as non-residential water. In principle, water supply is achieved 24 hours a day, 7 days a week. However, there are several areas where water supply is limited to approximately 8 hours per day during the dry season, and the situation has worsened over the years. In the Grenadines, a water supply system has not been implemented, leaving the islands dependent on rainwater harvesting. Figure 7-8 CWSA water supply zones and intake locations



Source: CWSA provided materials¹⁰

Figure 7-8 CWSA water supply zones and intake locations

¹⁰ Information as of January 2024

7.4.2 Water supply systems

(1) Water intake and water treatment plant

In the past, Dalaway WTP (established in 1958), Jennings WTP (established in 2007) and the Water Pipe Network were developed with the assistance of the French AFD, and these two are the main water treatment plants. Dalaway WTP is the largest domestic WTP with a facility capacity of approximately 11,150 m³/day (2.5 million imperial gallons per day) and supplies water to industrial areas with drinking water production plants and about 1/4 to 1/3 of the total population.¹¹

The water supply facilities in CWSA are basically composed of a WTP with a slow sand filtration system, which does not require chemical injection, and gravity distribution, which is characterized by low operating costs. Dalaway WTP is distributed from a sedimentation tank (3), a slow sand filter (4) and chlorine gas treatment, and from a clear water reservoir with a capacity of approximately 2,270 m³ (0.5 million imperial gallons) under natural flow. Even in the event of a power failure, the impact on the water supply system is limited.



Date: February 2024

Figure 7-9 slow sand filtration and clear water reservoir at Dalaway WTP

(2) Pipeline networks

The pipe material used to be DI pipes with a diameter of 100 mm or larger and GI pipes for less than 100 mm, but in recent years it has begun to adopt HDPE pipes instead of GI. On the other hand, most of the existing pipes are still GI pipes. In addition, steel and CI pipes have been used in the past. There are still many CI pipes in Kingstown. The largest diameter of the transmission mains is 400mm. The mains from the Dalaway WTP were damaged by the hurricane in 2019, and the water supply was interrupted for six weeks. Subsequently, transmission mains were installed with rerouting under their own budget.

CWSA's water supply system consists of eight water supply systems. Multiple water supply systems are interconnected to provide redundancy in the event of a disaster,

¹¹ Agence française de Développement

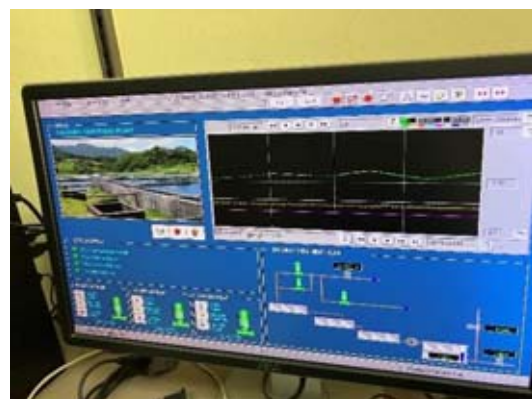
allowing for the mutual water supply in the event of an emergency. As a result, CWSA has invested continuously for several years to overcome the vulnerability of its water systems. Regarding the distribution network, the DMA is not currently constructed, but CWSA has a plan to construct it within the next 10 years.

7.4.3 Operation status of water supply business

(1) Operation and maintenance of facilities

The operation and maintenance of the Dalaway WTP is performed by a total of four employees, consisting of two supervisors and two assistants. SOPs and disaster response manuals focusing on hurricanes are in place for WTP operation of and water quality control. If the raw water turbidity exceeds 40 NTU, three influent valves in the WTP are controlled and water intake is stopped. On the other hand, since it is often a maximum of 1-2 hours that water intake is suspended due to high turbidity caused by heavy rains, hurricanes, etc., during this time, the water is covered by the reservoir storage volume. If the reserved water is low, the upper limit of turbidity up to 100 NTU may be allowed as a special measure. Since the WTP uses a slow filtration method, the sand is scraped approximately once every two to three months, and the scraping frequency is increased during the rainy season. Cleaning and replenishing the filtered sand requires time and manpower, and replacing the sand is cheaper, while there is a problem with the quality of the filtered sand, and there is a need for filtered sand cleaning technology.^{12,13}

O&M for the water distribution management is divided into 8 areas (Area 1, 2A, 2B, 3 to 7), and supervisors are placed in each area. Information on water sources, pipelines are registered to and managed by ArcGIS. CWSA remotely monitors and controls the Dalaway and Jennings WTPs and their distribution reservoirs (Figure 7-10) with raw water turbidity, treated water volume, and water level.



Date: February 2024

¹² The operation-response policy for emergencies is summarized, and the development of a comprehensive BCP has not yet been completed.

¹³ Although the supply of filtered sand has been tried from Guyana in the past, there is a problem with the grain size and uniformity of the sand, and at present, it has concluded a contract with a construction company of sand for construction in the northeastern part of the island. However, sand of ideal quality has not been obtained.

Figure 7-10 SCADA installed at the CWSA office

(2) Water quality management

Water quality testing is conducted in laboratories located at CWSA headquarters (Figure 7-11), and their water quality standards are in compliance with WHO standards. In addition to periodic testing of source water quality, the water quality at taps in each service area is sampled and tested on a weekly basis.



Date: February 2024

Figure 7-11 Water quality testing laboratory of the CWSA office

(3) Status of non-revenue water (NRW)

In CWSA water supply systems, the NRW is estimated to be approximately 30-40%¹⁴, of which the percentage of water leakage is unknown. The main sources of the NRW are as following. The amount of stolen water is considered to be negligible.

- ✓ Increase in water leakage due to high water pressure
- ✓ Public institutions (government, schools, prisons, etc.) and public taps are paid at fixed rates, and water meters are installed, but meter reading is not implemented
- ✓ The old and inaccurate water meter

(4) Water rates and collection status

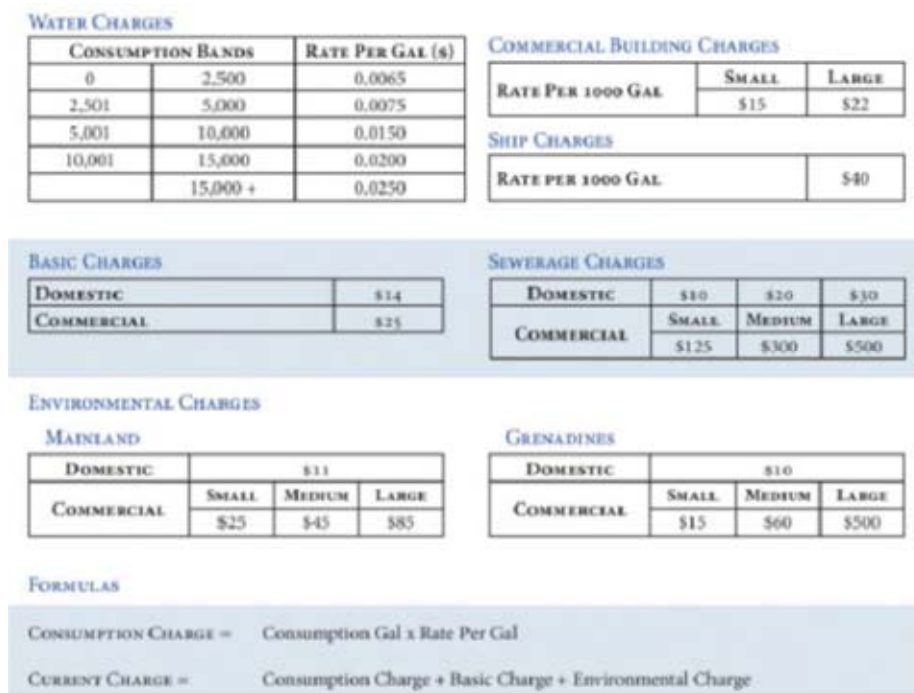
Figure 7-12 shows the current water rate system of CWSA. The water charge per 20 m³ of domestic supply calculated from the tables, EC\$ 55.49, is at an average level among the other countries. There are three types of water supply rates, domestic, commercial, and cruise ship. The sum of the basic charge for a fixed monthly amount and the metered charge according to the amount used is the tariff. Environmental charges are divided into two categories: the main island and the Grenadines. The number of sewerage customers is as low as 315, and most of them are commercial establishments.

CWSA water rates have not been updated for more than 10 years since they were revised in 2011. When water rates are revised, the Cabinet and MoH approve a revision

¹⁴ According to the data in 2008, "Unaccounted for water" is estimated to be 30% based on actual usage (4.3 million gals/ days) and water production (6.2 million gals/ days).

proposal from CWSA, but raising the water rates is a sensitive issue, as it is in other countries. It takes longer to obtain approval for the rate increase because of the need for objective evidence to support the rate increase. Therefore, CWSA is now planning a rate study by a consultant.

Regarding their collection status in 2023, the total actual charge was EC\$ 26.7 million and the billed amount was EC\$ 30.8 million, while the collection rate exceeded 100%.¹⁵



Source: CWSA website

Figure 7-12 Water and sewage rate system of CWSA

(5) Issues related to customer management

CWSA uses ABECAS insight software for inventory management, customer management, and billing system. The ratio of complaints is water leakage (87.5%), water supply time (10.0%), water pressure (2.0%) and taste/color (0.5%). Although customer satisfaction surveys have been conducted for more than 10 years, CWSA recognizes that the level of customer satisfaction is very high because due to the low water rates and the adequate water quality with 24-hour supply from their perspective.

Public relations is conducted through newspapers, radios, and SNS, TV to give advance notice and report on temporary suspension and resumption of water supply when maintaining water pipelines. In addition to marketing and radio broadcasting as water conservation awareness activities, it also provides educational programs for elementary and junior high school students.

¹⁵ If there is a time lag between the charge and the collection of the charge, the case of exceeding 100% occurs.

(6) Issues of operation and maintenance

CWSA has not implemented an asset management system. In its procurement of materials and equipment, there are many imported items that take time to obtain. At present, this is supplemented by stockpiling and redundancy of equipment, but this increases maintenance and management costs.

The shortage of staff also has a big impact on their maintenance work, and CWSA needs training programs for O&M, construction, and water quality analysis to ensure the skills of the staff. Improving the efficiency of their operations is also a challenge, and there is a need for a SCADA system for water intake management¹⁶, NRW reduction techniques, pipe network analysis, and integrated management system for GIS and customer management.

(7) Organizational challenges

Budgets for new employment and staffing at CWSA are not funded by the government. However, the securing of human resources is a major challenge, and there is a particular shortage of engineers with technical skills related to water source management, NRW reduction, disaster management, and climate change.

Salaries are not lower than those of other government agencies in the same country, but personnel do not stay. Even after training and developing staff through education and practical work, as soon as they acquire knowledge and experience, they tend to go abroad where salaries are higher than at home. As a result, the situation requires repeated recruitment and staff development.

There are no universities with engineering faculties in the country. Therefore, to study engineering education, it is necessary to enroll in universities in Trinidad and Tobago, Barbados, Jamaica, etc. Most OECS students who wish to become engineers study at the University of the West Indies in Jamaica. Because they can easily obtain well-paying jobs abroad after graduation, many do not return to their home countries, contributing to the brain drain. In addition, the workforce is aging, making it difficult to ensure sufficient time for the transfer of knowledge and skills. This has made capacity building and development plans an important issue.

In addition, the aging of the workforce, the inability to ensure sufficient time for knowledge and skill succession, and capacity development and promotion plans are also becoming major issues.

¹⁶ The monitoring of water sources and intakes is done directly by the staff in the field.

7.4.4 Technical training system

For internal training, senior engineers conduct monthly training on pipe connections and there are also many opportunities for external training through organizations such as CAWASA, CWWA, CIMH, JICA.

There are rules regarding the objectives of the training policy, attendance requirements, and cost sharing. Employees who have completed training are required to submit a report to the Engineering Manager and, if necessary, workshops are held as a platform for sharing technical knowledge. Training materials are shared within the Engineering Department, and if digital, are stored on the department's server. Each department has its own data server, and the fact that it is not accessible from other departments is a challenge.

7.4.5 Trends of in the private sector

All of the desalination plants listed in DesalData are owned by local municipalities and private companies, and the CWSA is not involved. The CWSA believes that there is no advantage in contracting out any part of the project to the private sector, as the most experienced staff in the domestic water supply sector are located within the CWSA.

7.4.6 Situation of NRW reduction

(1) NRW reduction plan

No NRW reduction plan has been formulated, but a proposal to implement an NRW reduction program has been submitted to the GCF. However, as this program only partially implements NRW reduction measures, such as the implementation of software, the updating of flow meters, and the construction of several DMAs, CWSA believes that additional financial support is needed to implement NRW reduction measures on a larger scale.

Currently, leak repairs are carried out in response to leak reports from residents, but in the future, the creation of a NRW reduction unit focused on leak detection is being considered internally (the supporting organization is yet to be determined).

(2) Implementation of NRW reduction

If there is a complaint about a water leak, the sequence of contacts is as follows: Customer Service Department, Superintendent, O&M Department, District Supervisor, after which a plumber is dispatched to make the repair. In 2023, there were 7,967 leak repairs. The history of leak repairs is manually recorded and compiled into a report that is submitted to the supervisor on a monthly basis.

The CWSA has one leak detection equipment, but only one employee is capable of using it. There is no link between the leak history and the GIS. In addition, a pipeline replacement plan has not been formulated due to the frequent changes in project priorities.

Leak repair work is the responsibility of the O&M Department, but as the current situation remains reactive, the department plans to conduct leak detection training for its staff and establish a dedicated team focused on NRW reduction in the future.

(3) Pilot project of smart meter introduction

The existing water meter has been in use for more than 20 years with maintenance, and the replacement work is performed at the rate of approximately 1,000 defective meters per year. Therefore, the meter failure rate is assumed to be less than 1%. The maximum water pressure in the water distribution pipe network will be 300psi (2.1MPa) and high water pressure due to the terrain with severe relief. In recent years, it has become more difficult to procure old-fashioned meters that meet the requirements of the imperial gallon display. The problem of inventory management of water meters is not the budget, but the restriction of such product specifications and the procurement time. Under these circumstances, the company is shifting to smart meters in anticipation of difficulties in future repairs and securing spare parts.

Although CWSA had planned to deploy three smart meters as a pilot project, it has twice applied to the National Telecommunications Regulatory Commission (NTRC) for permission to install the automated meter reading system, but the permission has not yet been granted and the pilot project has not proceeded (it is planned to start as soon as the permission is granted by the NTRC).

7.4.7 Facility development plan

(1) Water demand forecasting

The last project-based survey in 2008 estimated a daily average of approximately 19,700 m³/day. The amount of water demand as of 2024 and in the future is unknown, and it is necessary to revise the estimates.

(2) Ongoing projects

The major projects currently underway in CWSA are described below.

- ✓ A survey of groundwater sources throughout St. Vincent is being conducted with the loan assistance of the IAEA^{17,18}. The project started in January 2024 and is scheduled to be implemented over the next three years. In order to maintain a low-cost operating system, CWSA intends to develop groundwater sources first, prior to costly desalination.

¹⁷ IAEA; International Atomic Energy Agency (International Atomic Energy Agency)

¹⁸ Saint Vincent and the Grenadines' Country Programme Framework (CPF) for the period of 2022-2027

- ✓ New WTPs and distribution reservoirs are being built in the François area with CWSA's own funds. This will complement the Dalaway WTP, which also meets water needs, including commercial water use during the dry season.
- ✓ As a water sector sub-project of the WB-supported Volcanic Eruption Emergency Project, the North Windward Water Supply Project is being implemented. To improve resilience during volcanic eruptions, relatively small-scale facilities such as a water treatment plant with a production capacity of 70 m³/hour and distribution reservoirs are currently being constructed.¹⁹

(3) Planned project

The 2014-2018 version of the Strategic Plan, which outlines CWSA's improvement program, is current and is being updated. The business areas currently being planned in CWSA are as follows.

- ✓ To obtain financial support from the GCF Resilience Fund, the CWSA prepared a Concept Note and submitted it in March 2020. However, the initiative was put on hold due to the impact of COVID-19 and the volcanic eruption. The initiative was restarted in the second half of 2023, and a funding proposal is currently being prepared with the assistance of a consultant hired by the Ministry of Economic Planning, and is expected to be submitted in the coming months. While the project implementation period is currently undetermined, it is expected to last approximately five years. The proposal includes the construction of solar-powered desalination plants on three islands in the Grenadines. If approved, CWSA will begin providing water services to this region as well. However, the treatment of the concentrated brine produced during desalination prior to discharge into the sea remains a challenge.

¹⁹ CWSA NWINDWARD WATER SUPPLY PROJECT DRAFT TOR; World Bank

7.5 Status of wastewater treatment

7.5.1 Development status of sewerage system

(1) Overview of the sewerage system

Currently, the country does not have its own sewage treatment plant, and sewage pipes are only installed in some areas of Kingstown, but the number of connected houses is only 315, and most of them are commercial establishments. The collected sewage is pumped up at the pumping station and discharged directly into the sea about 1.4km offshore without any treatment. According to CWSA, it was concluded that STP was not necessary for the area in question, because the environmental impact was shown to be lower through diffuse dilution in the ocean, which was conducted in recent years to assess the status of contamination in the sea area where it was discharged. As a matter of policy, no STPs have recently been planned in other areas of the country.²⁰

In the area where the sewerage system is not developed, it is obligatory to install a septic tank in the building, and it is the jurisdiction of the Ministry of Health (Public Health Department).

(2) Operation status of the sewerage system

Complaints are sometimes received regarding blockages of sewer pipes. In such a case, the manholes are flushed and the blockage is removed using water from a fire hydrant. For septic tanks, there are some cases where the septage has not been removed for more than 30 years.

(3) Waste and septage sludge treatment

Two garbage disposal sites and a septage disposal site are prepared close to each other in Diamond Sanitary Landfill, which was established in 2011. There is also the Belle Isle Landfill, which was established in 2005 with a design capacity of 15 years. Garbage collection is provided by three private companies contracted by the CWSA, and 100 truckloads of garbage are collected each day. There is currently no separate collection of combustible and noncombustible waste. The cost of garbage disposal is collected by adding EC\$ 15 per month per household to the water bill.

The delivery of the septage is approximately 20-25 vacuum trucks per month. The septage disposal site with 2 ponds of concrete structure is located near the coast, and is finally discharged to the sea area by soil infiltration.

(4) Development plan

Currently, CWSA does not have a master plan for its sewer system, and there is no prospect of planning.

²⁰ In 2023, this discharge route was stretched (L=1,440m, HDPE pipe ϕ 400mm) with a new harbor construction.

7.5.2 Pollution status of public water areas

As noted above, domestic sewage is treated in septic tanks in areas where sewer systems have not yet been developed, but graywater is discharged untreated into nearby waterways and rivers without treatment. In Calliaqua, the area has small hotels and restaurants, but as shown in Figure 7-13, there have been problems with water pollution from untreated sewage.



Date: March 2024

Figure 7-13 Waterway in undeveloped sewerage areas (Calliaqua area)

7.6 Financial position

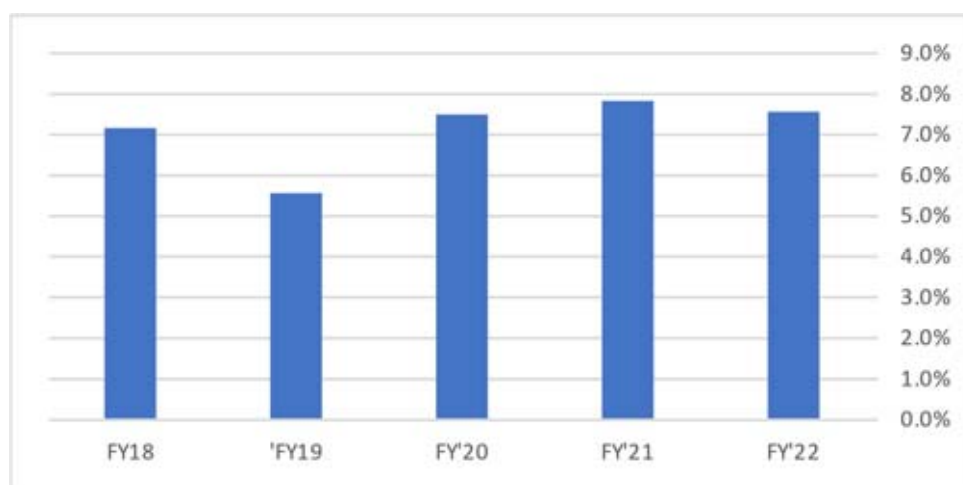
CWSA's fiscal year runs from January to December. Its externally audited financial statements are disclosed in the annual report, but the latest annual report available on the website is for FY 2021, and the financial statements for FY 2019 are not published in the annual report. Therefore, the disclosure of the financial statements in the annual report depends on the fiscal year.

7.6.1 Key financial indicators

CWSA's financial condition has been analyzed using the published financial statements and the FY2022 Annual Report obtained from CWSA as follows.

(1) Stability

CWSA's debt ratio has remained below 10%, and it is assumed that CWSA is expected to maintain a healthy balance sheet with adequate capital. The debt ratio can rise sharply due to excessive borrowing, so it is desirable to maintain financial discipline in the future as well.

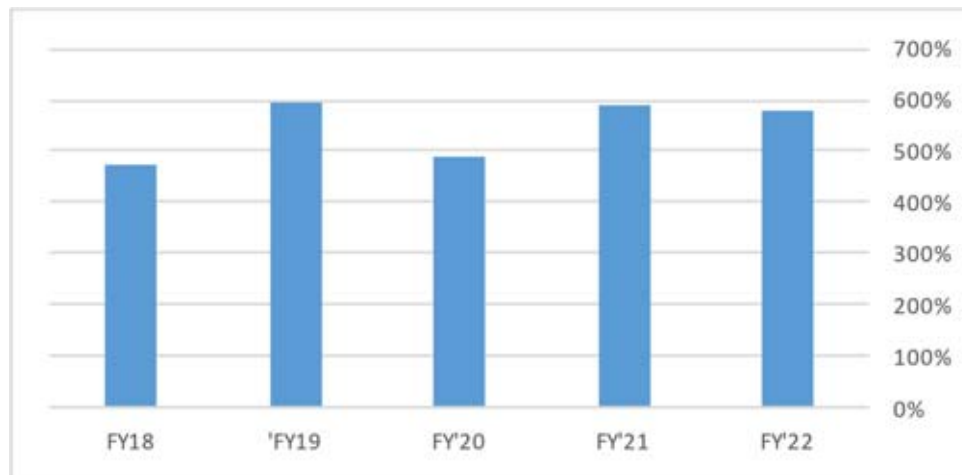


Source: Created by the survey team using CWSA financial statements

Figure 7-14 CWSA debt ratio

(2) Liquidity

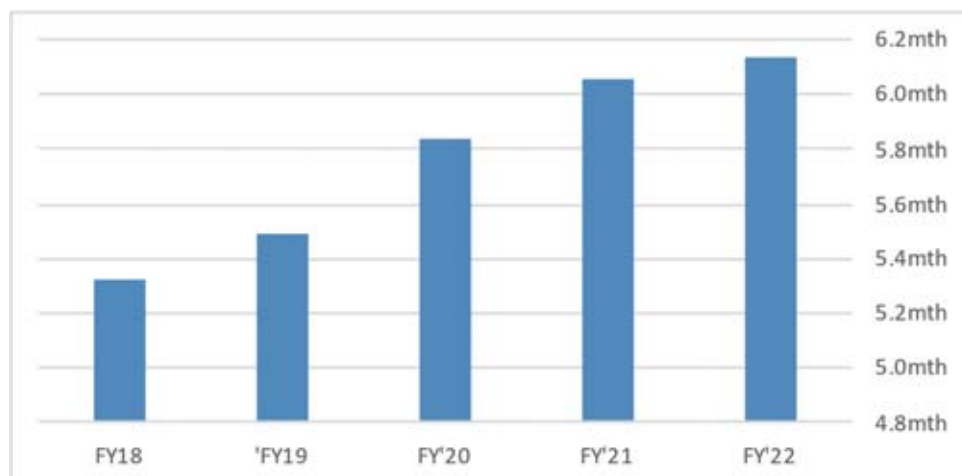
The current ratio is good, and current assets are calculated to be five to six times current liabilities. Even if sudden, unexpected and large payments were required, this would not be a significant concern.



Source: Created by the survey team using CWSA financial statements

Figure 7-15 CWSA current ratio

The accounts receivable collection period, which can be one of the measures of the financing ability by representing the collection status of water rates, has been calculated. It has worsened from year to year, and it is not the level that can be considered short, exceeding half a year at the latest. It is necessary to check the structural factor that causes the long period of water rate recovery.

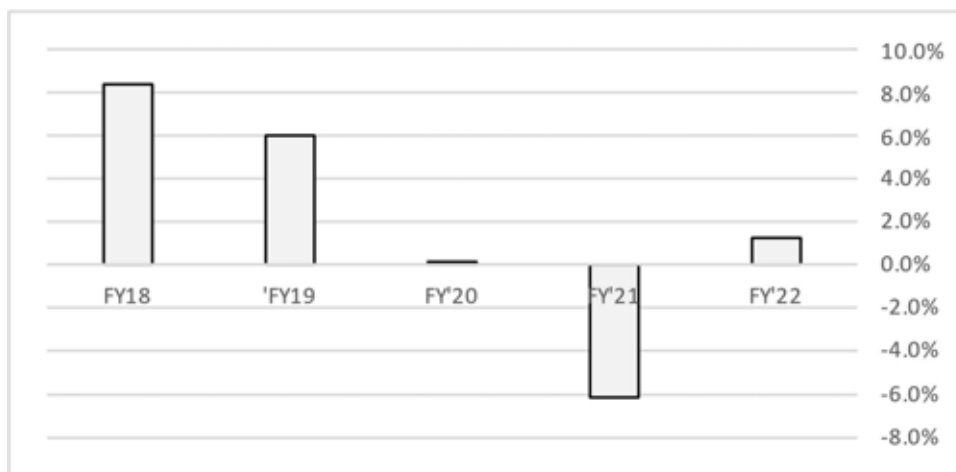


Source: Created by the survey team using CWSA financial statements

Figure 7-16 CWSA accounts receivable collection period

(3) Profitability

The historical change in net profit margin on sales has been analyzed. In FY22, it recovered to a one-year surplus, but it is difficult to determine that it has completely bottomed out. A comprehensive review is desired to ensure that there is no problem with the non-revenue water rate or waste in costs.

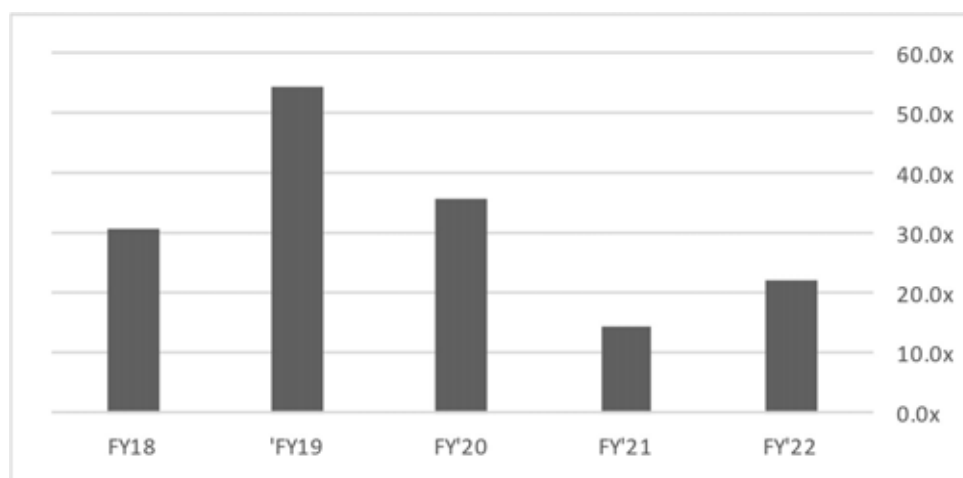


Source: Created by the survey team using CWSA financial statements

Figure 7-17 CWSA net income margin

(4) Interest payment capacity

The ups and downs of the ICR generally show opposite movements to the debt ratio. As the level is more than 10 times, it is considered that there is no significant problem. The deterioration of the ICR is a sign of concern about company's ability to pay interest on debt when the profits decline due to the occurrence of risk events such as disasters.



Source: Created by the survey team using CWSA financial statements

Figure 7-18 CWSA ICR

7.6.2 Financial and investment plan

CWSA does not prepare pro forma financial statements or investment plans. Improving the system for formulating and implementing medium- to long-term financial and investment plans would be essential to ensure a stable water supply for the population and to continue water services that are resilient to climate change and natural disasters.

Chapter 8 Grenada

8.1 Basic information

8.1.1 Outline of the country

Grenada is a small island with a total area of about 340km², consisting of eight main islands of Grenada Islands, Grenadines, and other small islands, and is located in the southernmost part of the country, about 12 degrees north latitude and 61 degrees west longitude and 40 minutes north latitude of the Windward Islands.

The capital is St. Georges in the southwestern part of the island of Grenada, and the population composition is African (82.4%), mixed race (13.3%), etc.¹

8.1.2 Socio-economic conditions

(1) Population dynamics

The population dynamics from 2010 to 2020 are shown in the table below, with a population growth rate of 0.4%. In Grenada, mountainous regions extend from the northern to the central part of the island, with the population concentrated primarily in the foothills and especially in the southern areas.

Table 8-1 Grenada's population and economic status

	Items	Unit	2010	2015	2020
Basic info.	Total population	inhab	106,230	109,600	112,520
	Urban population	inhab	37,540	38,450	39,940
	Rural population	inhab	67,130	68,370	69,370
	Population density	inhab/km ²	312	322	331
Economics	Gross Domestic Product (GDP)	current US\$	771,014,815	997,007,407	1,043,412,699
	Agriculture	value added to GDP	X	34,796,296	74,061,153
	Industry	value added to GDP	X	83,518,518	90,068,421
	Services	value added to GDP	X	557,014,815	698,436,943
	GDP per capita	current US\$/inhab	7,258	9,097	9,273

Source: FAO AQUASTAT

¹ Source: Overview of Grenada (2022) by the Embassy of Japan in Trinidad and Tobago



Source: (Left) OpenStreetMap, (Right) EU, Global Human Settlement Layer

Figure 8-1 Population distribution map of Grenada (2020)

(2) Macroeconomics

The key economic indicators are shown in Table 8-2. The GNI per capita in 2022 is USD 9,070, which keeps GND as a DAC listed country. Since the GDP per capita is USD 9,689 and the GDP per capita growth rate is 5.7% per year, assuming this growth rate continues for five years, the GDP per capita in 2027 will be USD 12,784.

Grenada has relied on tourism to earn foreign exchange, but more recently, as in other Eastern Caribbean countries, revenues from the Economic Citizenship Programme have played a major role. Agriculture is also the main industry, supported by the production of Nutmeg, Grenada's main agricultural product, which ranks eighth in the world (2018 FAO). The gross national product has also grown due to the excellent level of education throughout the country, and the robust state of the construction and manufacturing industries. However, in the years following the 2009 financial crisis, the economy stagnated with the slump in tourism, and the country's wealth declined. In 2013, the country also experienced a debt default. Since then, policies aimed at strengthening tax revenues and stabilizing the economy have been effective. In Grenada, the domestic economy has also been affected by the spread of COVID-19, making the economic recovery a challenge.

Table 8-2 Key economic indicators of Grenada

GNI (in USD million)	GNI per capita (USD)	GNI growth rate (%/year)	GNI per capita growth rate (%/year)	Inflation rate (%/year)	Trade balance (in USD million)
1,111	9,070	No data	No data	2.6	-466.9
GDP (in USD million)	GDP per capita (USD)	GDP growth rate (%/year)	GDP per capita growth rate (%/year)	Unemployment rate (%)	Service revenues and expenditures (in USD million)
1,215	9,689	6.4	5.7	No data	100.0

Source: World Bank (2022) World Development Indicators, Moody's (2022) Economic Indicators (except for service revenues and expenditures from International Trade Statistics (2019))

(3) Financial Position

Grenada's current account balance remains in surplus. In FY 2022, there were revenues of USD 320 million and expenditures of USD 266 million, resulting in a surplus of USD 54 million. In FY 2023, there were also revenues of USD 468 million, while expenditures were only USD 259 million. Accordingly, the surplus is expected to be USD 209 million. Public debt reached 100% of GDP at the time of the 2013 default, but has continued to decline since then, falling to around 60% of GDP in recent years.

Table 8-3 Current accounts and public debt in Grenada

Current revenue (in USD million)		Current expenditure (in USD million)		Outstanding public debt (in USD million)		Outstanding public debt Percentage by GDP	
FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 Forecast	FY'22 Actual	FY'23 September forecast	FY'22 Actual	FY'23 September forecast
320	468	266	259	767	793	63.7	59.2

Source: Grenada (2023) Estimates of Revenue and Expenditure for the Year 2024, (2023/2022) Public Debt Bulletin 2023 Quarter 3 / 2022 Quarter 4

(4) Business environment

The Ease of Doing Business Index is 53.4 (2020). This ranks 146th out of 190 countries in the world, and also falls below 59.1 in Latin America and the Caribbean, the lowest among the six countries covered in this survey. On the other hand, the Corruption Perceptions Index is 53 (2023), which ranks 49th out of 180 countries in the world, the lowest among the countries covered by the Index and this survey.

(5) National Development Plans

Grenada's flagship national development plan is the National Sustainable Development Plan 2020-2035, which sets out three national goals. In the Medium-Term Action Plan (MTAP) 2022-2024 for the implementation of the National Plan and goals, #3 "Environmental Sustainability and Security" calls for achievements in the areas of climate resilience, hazard risk reduction, and energy security and efficiency. It also

highlights climate-smart water conservation practices as part of measures to mainstream climate change adaptation and mitigation practices.

(6) Outline of electric power business operation

GRENLEC (Grenada Electricity Services Ltd.) is responsible for the country's electricity business. GRENLEC shares are commercially available, but more than 70% are owned by the government. The remaining shares are held by the National Insurance Scheme and common shareholders.² In 2022, the fuel cost increase significantly increased the fuel surcharge (EC\$ 0.50→EC\$ 0.87), but at the same time GRENLEC reduced the unit price of electricity by 25% in order to reduce the burden on the public. This became a financial burden of GRENLEC and had temporarily led to deficit operations, so this reduction was abolished at the end of the year. The electricity tariff is 0.91 XCD per kWh (approx. 52.8 JPY; for industrial use, in May 2024), and is relatively cheap in the Eastern Caribbean countries³.

(7) Power infrastructure development status

With regard to the supply-demand balance in GND, the peak demand is 32.2 MW while the installed thermal power generation capacity is 52.1 MW.⁴ It can be said that the redundancy rate is ensured even in case of maintenance outages. The construction of generators and the reinforcement of the transmission network have been carried out systematically. The total blackout time had been reduced to less than 8 hours in 2022. The country's energy infrastructure is reliable.

In 2021, the country's electricity generation consisted of thermal and solar power (GRENLEC: 1.12 MW of installed capacity + private sector: 2.83 MW). The share of renewable energy remains low at 7%, and the target of 100% renewable energy by 2030 is unlikely to be achieved. The country has implemented the Self-Generator Programme⁵ and aims to expand the capacity of supply by 1.2 MW. However, in 2022, the growth was only 280 kW.

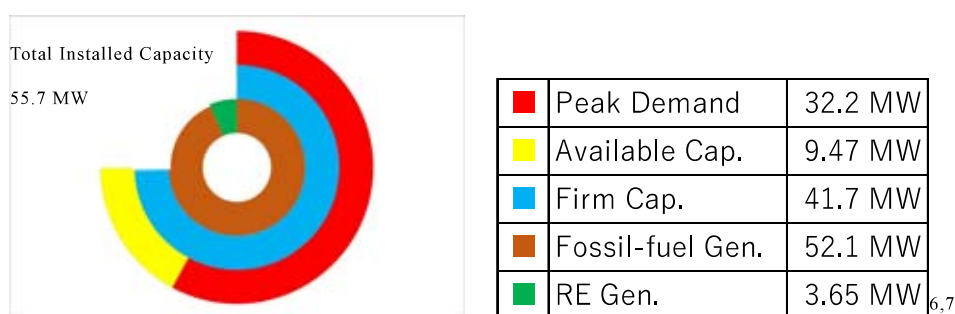
² Annual Report 2022; Grenlec, 2023

³ <https://grenlec.com/customers/ratesandfees> (2024.5). An average electricity tariff of targeted countries (including fuel surcharge) is 1.051XCD. (Excluding ANU where the fuel surcharge is not publicized.)

⁴ Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022

Annual Report 2022; Grenlec, 2023

⁵ Self-Generator Programme (Grenada, Carriacou and Petit Martinique); Public Utilities Regulatory Commission, 2021: Experimental Framework to Recommend Power Generation and Sales by Users for Increasing Domestic Renewable Energy Generation Capacity



Source: JST preparation

Figure 8-2 Power situation summary in Grenada

Future medium-to-large-scale renewable energy plans include wind power (1 MW capacity) and geothermal power generation (15 MW capacity). CDB, the New Zealand Ministry of Foreign Affairs and Trade, and JICA provided technical support for the geothermal survey. Although the selection of drilling sites has progressed to 2018 and the environmental and social impact assessment survey was conducted in 2023, the fund has not been procured.

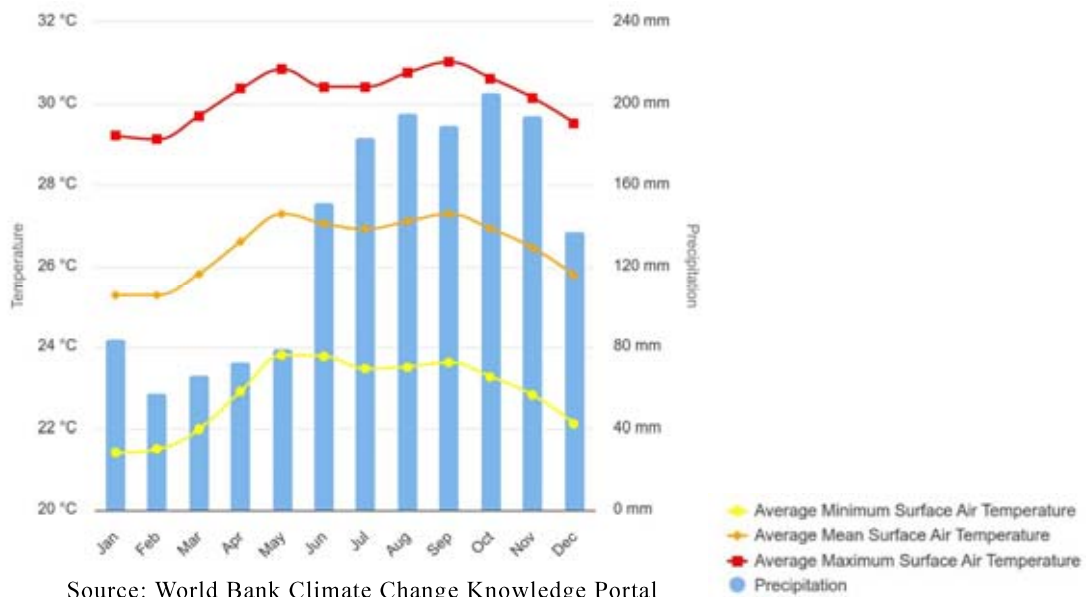
The country takes seriously the temporary deficit in 2022 due to the increase in fuel prices and recognizes the need to increase the share of renewable energy, which is not affected by fuel prices, to 25% in the next three years, not only for the environmental aspect but also to avoid financial risk.

8.1.3 Natural condition

Grenada has a tropical climate with average temperatures of around 25-27°C, dry seasons from December to May, and rainy seasons from June to November, of which June to October are hurricane seasons. Figure 8-4 shows the monthly rainfall for 10 years. In the dry season, the rainfall is less than 50mm from January to March.

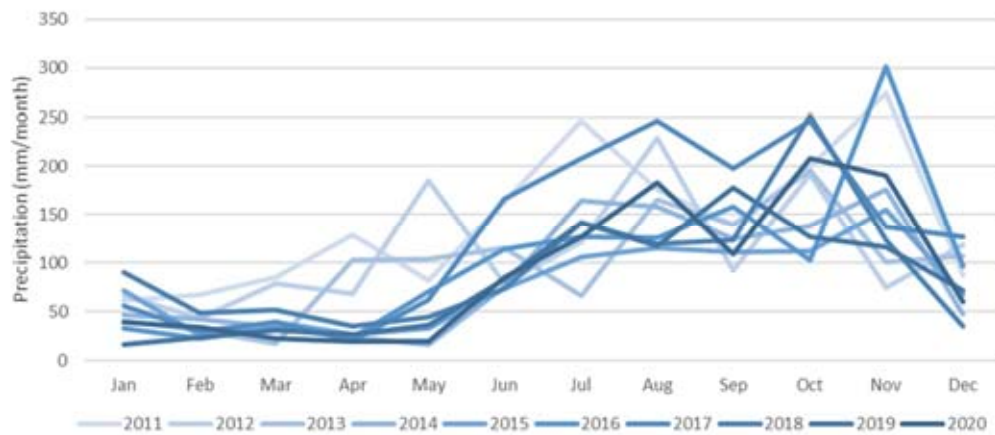
⁶ Peak Demand: Demand electricity, Available Cap.: reserve capacity, Firm Cap.: feed-in capacity, Fossil-fuel Gen.: thermal power plant capacity, RE Gen.: renewable energy plant capacity

⁷ In the absence of Firm Capacity, 80% of the installed thermal power capacity was assumed to be Firm Capacity.



Source: World Bank Climate Change Knowledge Portal
 Note: Average data for 1991-2022

Figure 8-3 Grenada's average temperature and precipitation



Source: JST based on World Bank Climate Change Knowledge Portal
 Note: Monthly data for 2011-2020

Figure 8-4 Monthly precipitation in Grenada

Table 8-4 Monthly precipitation in Grenada

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	61	67	85	128	82	163	246	175	139	199	274	87	1,706
2012	66	43	79	68	185	79	121	228	92	191	74	118	1,344
2013	40	30	17	102	104	115	66	165	139	196	100	107	1,182
2014	47	42	34	23	17	75	164	157	125	138	175	47	1,045
2015	72	26	39	27	33	73	106	115	111	112	154	67	935
2016	33	22	33	24	70	114	127	126	158	102	301	97	1,206
2017	55	30	39	20	62	166	208	246	197	246	137	127	1,534
2018	90	48	51	34	45	73	141	119	123	251	123	35	1,135
2019	17	23	30	27	36	83	141	117	177	127	116	72	966
2020	40	34	23	19	20	85	126	183	109	207	190	60	1,095

Source: JST based on World Bank Climate Change Knowledge Portal

Annotation: mm/month

8.2 Policy and legal framework related to the water sector

8.2.1 National water policy

The National Water Policy was developed in 2020 as a comprehensive policy for the water sector in Grenada, consisting of a goal, four outcomes necessary to achieve the goal, and a total of 13 policy objectives linked to each outcome, as shown in the table below.

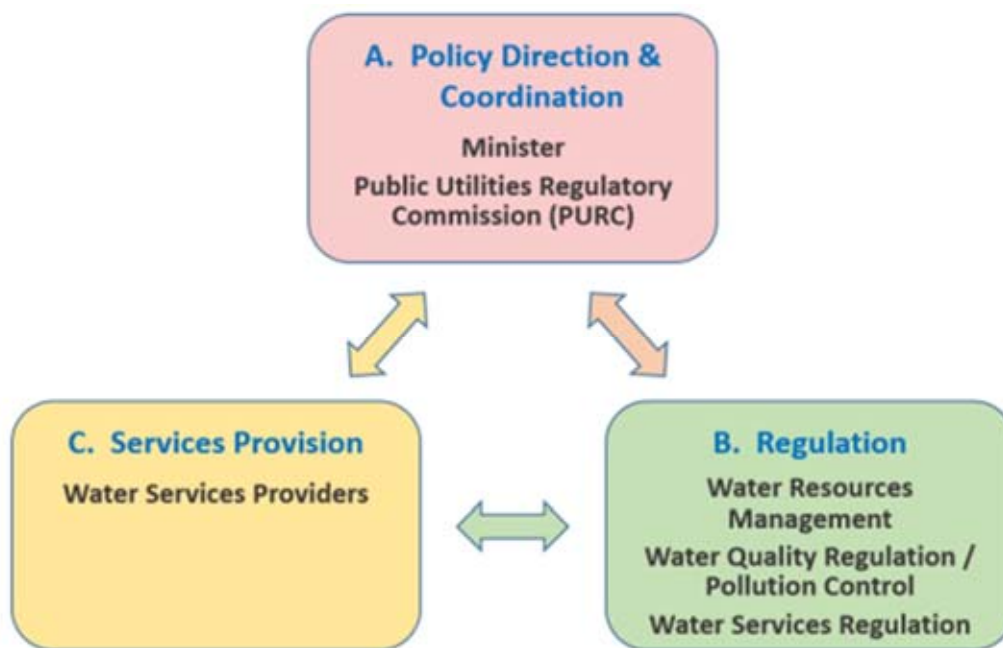
Table 8-5 Goal, outcomes, and policy objectives of Grenada’s national water policy

Goal: Provide sustainable management of the country’s water resources, through stakeholder participation and contribution to economic, social and environmental development in an efficient and equitable manner
Outcome 1: Enhanced enabling environment and improved, ‘climate smart’ water-related behavior
Policy objectives: 1.Improve the policy, legal, regulatory and institutional frameworks for the water sector. 2.Build national human capacity for the design and implementation of water-related climate adaptation projects. 3.Increase public awareness of integrated water resources management.
Outcome 2: Increased water access, availability and quality
Policy objectives: 1.Ensure that present and future generations have access to water of sufficient quality and quantity for their various uses and an acceptable standard of sanitation. 2.Promote the sustainable use of alternative water sources, such as RWH and water recycling and reuse, to ensure water availability under a changing climate. 3.Secure water for ecosystem services, recreation and aesthetics in order to ensure that vital ecosystems are maintained, restored and enhanced. 4.Promote sound stormwater management, as a measure which can contribute to the enhancement of limited available resources. 5.Promote the reduction of pollution of fresh and adjacent coastal waters through implementation of the obligations of the Cartagena Convention’s LBS Protocol.
Outcome 3: Increased water use efficiency and conservation
Policy objectives: 1.Improve water infrastructure to build climate resilience. 2.Ensure water is used as efficiently as possible, including promotion of wise use and conservation, while recognizing the important role of women in household water management. 3.Promote ‘climate smart’ agriculture.
Outcome 4: Strengthened preparedness for climate variability and extremes
Policy objectives: 1.Improve hydrometeorological monitoring, emergency planning and decision making. 2.Minimize water-related climate change risks by adopting ecosystem-based adaptation solutions.

Source: Grenada (2020) National Water Policy

8.2.2 Related organizations

The institutional framework for implementing the National Water Policy in Grenada is as follows.



Source: Government of Grenada (2020) National Water Policy

Figure 8-5 Institutional framework in the Grenada water sector

(1) Direction and adjustment of policy

The main role of the minister of the relevant ministry is to provide high-level policies that are applied at the national and local levels. The Public Utilities Regulatory Commission (PURC), which was established in 2016 as the statutory body for the water sector, develops policies and makes decisions on the policies in coordination with related organizations, cooperates with other sectors, provides advisory support on policies, and supervises organizations responsible for water resources management.

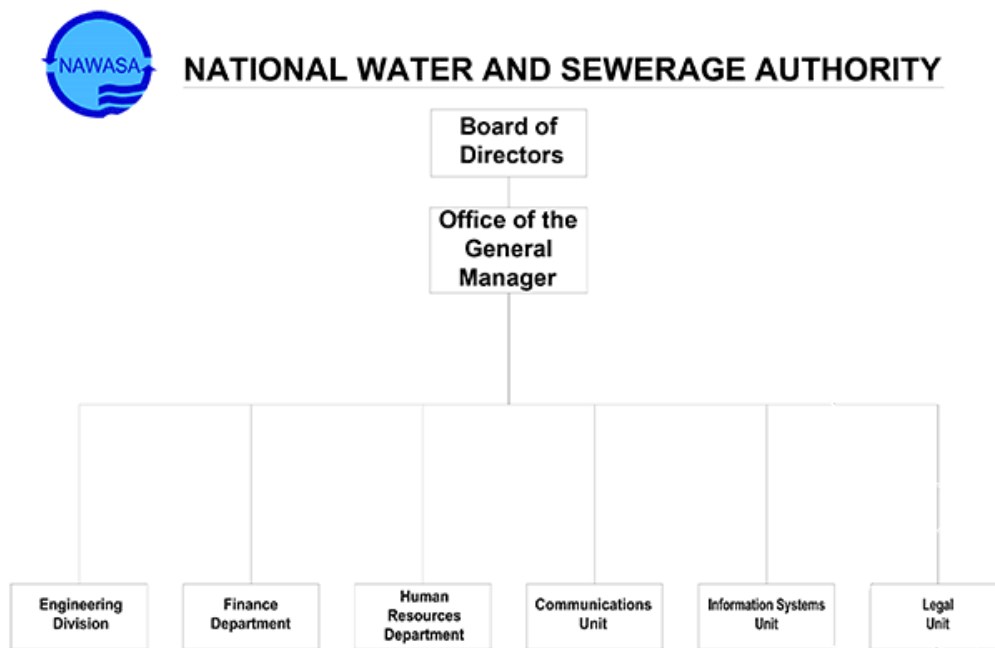
(2) Regulations

The National Water Policy proposes the establishment of a water resources management organization responsible for the comprehensive water source management of water resources, including surface water, groundwater, rainwater, and seawater, but the current status of the proposal is unclear. Regarding water quality regulations/pollution control, the National Water and Sewerage Authority (NAWASA) is responsible for conducting water quality inspections and reporting the inspection results to the Ministry of Health. Water service regulations are considered a PURC function.

(3) Service provision

Water services in Grenada are provided by NAWASA. NAWASA, established under the National Water Authority Act of 1990, is under the auspices of the Ministry of Infrastructure and Physical Development, Public Utilities, Civil Aviation & Transportation and is responsible for both domestic water supply and water resources management.

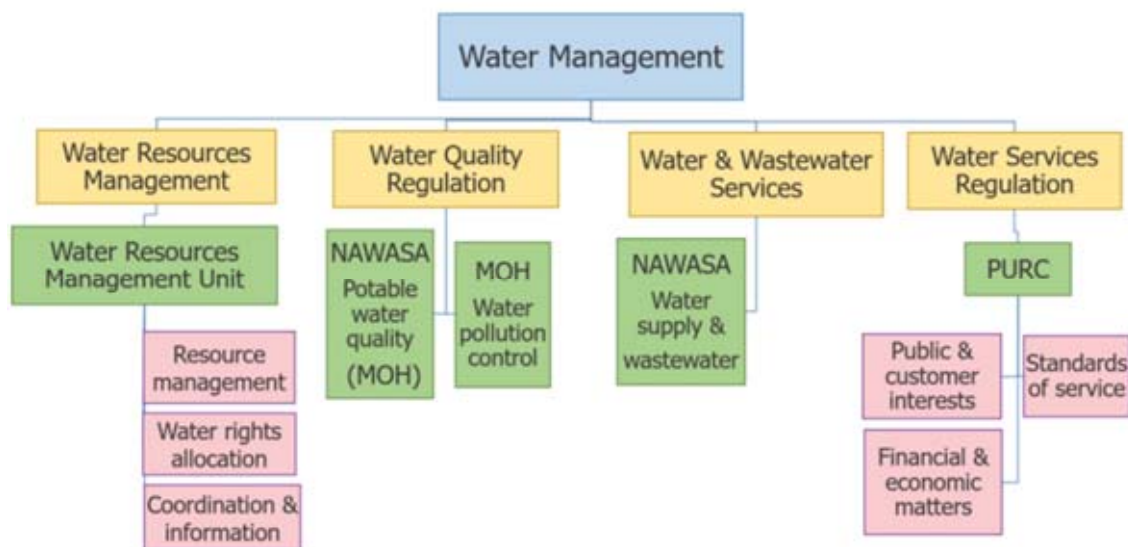
NAWASA consists of 267 employees (256 permanent and 11 casual) and six departments. In addition, the IT and Communications Departments are under the General Manager. The Customer Service Department is under the Finance Department.



Source: <https://nawasa.gd/about-us/organisational-structure>

Figure 8-6 Organizational structure of NAWASA

The following figure shows the functions of relevant organizations in water management as presented in the National Water Policy.



Source: Government of Grenada (2020) National Water Policy

Figure 8-7 Functions of relevant organizations in Grenada's water management

8.2.3 Related laws and regulations

The National Water and Sewerage Authority Act and the Water Quality Act have been established as basic laws on the water sector in Grenada. The National Water and Sewerage Authority Act, enacted in 1990, consists of all 57 articles as follows.

- ✓ Preliminary (Articles 1 to 2)
- ✓ National Policy and Establishment of the National Water and Sewerage Authority (Articles 3 to 7)
- ✓ The Board and Staff of the Authority (Articles 8 to 10)
- ✓ Power of Entry on and Acquisition of Land, etc. (Articles 11 to 23)
- ✓ Financial Provisions (Articles 24 to 26)
- ✓ Rates, Charges and Fees (Articles 27 to 35)
- ✓ Catchment Areas (Articles 36 to 40)
- ✓ Miscellaneous (Articles 41 to 57)
- ✓ Schedule

The National Water Policy mentions a movement towards the enactment of the Water Resources, Supply and Sewerage Bill. The enactment of the Bill, which includes the separation of water resources management from water services, will legislate the institutional framework described in 8.2.2 (2).

The PURC is established by the Public Utilities Regulatory Commission Act, and the National Water and Sewerage Authority Sewerage Regulations and the National Water and Sewerage Rates and Charges Regulations have been enacted as implementing regulations for water supply and sewerage services.

8.2.4 Related plan

The MTAP, described in Section 8.1.2 (5) National development plan, as an important related plan for the water sector, refers to the climate-smart water conservation practice as part of the measures for mainstreaming of climate change adaptation and mitigation. The budget amount, however, is not shown in the MTAP, so that the details are not clear.

8.3 Status of water resources

8.3.1 Water resources use

(1) Water source

The source of tap water is 95% of surface water, and the remaining 5% is groundwater.



Source: FAO AQUASTAT (2015)

Figure 8-8 Water source location map of Grenada (major dams and rivers)

(2) Rainwater use

Since there are no rivers on the islands of Carriacou (with a population of about 7,000) and Petit Martinique (with a population of about 700), and groundwater sources are also very limited, rainwater harvesting and the desalination plants that have been in operation since 2014 rely on tap water sources. On the both islands, all homes are equipped with underground or aboveground rainwater storage tanks, with a capacity of approximately 45-55 m³, equivalent to one month's water consumption. This is because it is necessary to be self-sufficient during the severe drought period of four to five weeks.

Treatment methods for rainwater use have been addressed by each household by adding chlorine to the tanks, but recently the Ministry of Health has conducted a dry season chlorination campaign to provide chlorination agents according to the water tank capacity

of each household. When using rainwater as drinking water, some residents boil it before use, but in general, most residents use it only after disinfecting the tank.

On the other hand, due to the abundance of water on the main island of Grenada, the benefits of rainwater storage are not understood, and the installation rate of rainwater storage tanks remains at around 5%. However, due to the impact of climate change on the water supply system, the G-CREWS Project is currently working on the development of legislation regarding the use of rainwater, and the installation of rainwater storage systems will be mandatory for new buildings. NAWASA's goal is to promote the use of rainwater harvesting in Grenada. In particular, the policy focuses on popularizing the system for farmers and hotels.

(3) Recycled water use

Water reuse is not practiced in Grenada, and wastewater reuse of is considered culturally unacceptable.

8.3.2 Implementation status of integrated water resources management

(1) Implementation organization of water resources management

Water resources management is handled by the Water Resources Unit of NAWASA's Planning & Development Department. In addition, the Ministry of Economic Development, Planning, Tourism, ICT, Creative Economy, Agriculture and Lands, Forestry, Fisheries & Cooperatives is responsible for the protection of watershed forests under watershed management, and some functions related to NAWASA and water resources management overlap.

On the other hand, with the idea that the functions of water supply and water resources management should be separated, the establishment of a water resources management unit under the Public Utility Regulatory Commission (PURC) is supported.

Because the surface water source basins are vulnerable to drought, meetings are held annually before the dry season to discuss countermeasures. This meeting involves relevant departments within NAWASA and other organizational stakeholders.

(2) Integrated water resources management plan

Regulations and IWRM programs are in place for integrated water resources management. On the other hand, since the destruction of the forests by Hurricanes Ian and Hurricane Emily in 2005, no efforts have been made to restore the watershed forests. Therefore, it is necessary to develop a watershed management plan that includes reforestation and aquifer monitoring.

In NAWASA's water supply systems, the business continuity plan (BCP), including the budget security during emergencies, and the disaster management plan are being formulated, and the emergency operations manual is being developed. Concrete

emergency response measures are being promoted in cooperation and consultation with NEMO.

(3) Response to water shortages

To prioritize water distribution to areas where water supply conditions are more severe, the water distribution volume is adjusted by valve operation. If the water shortage becomes more severe, restrictions will be placed on the use of tap water for car washing and sprinkling.

(4) Status of water source monitoring

Since there are no automatic water measuring gauges for river flow rate in remote areas, staff currently go out to measure the flow rate every month. In the future, they plan to increase the frequency to daily. Since there is water resources management at present, they hope to establish a water resources management unit as described above.

8.3.3 Challenges in water resource development, use and management

(1) Issues in water resource development

In the development of water resources, environmental impact assessment and public consultation are carried out and are carefully promoted, so there is no particular problem.

(2) Impacts on agriculture and tourism

While farmers prefer to use river water for irrigation, they do not avoid using chlorinated tap water, and sometimes use NAWASA tap water during the dry season. Although the yield of tomatoes, etc., which can be harvested in a short time, can be secured even in the dry season, the root rot occurs in the rainy season on the contrary. However, there are obviously more disadvantages in terms of the whole agriculture, and in the dry season, the reservoir will dry up, and the shortage of water will cause the production level to drop.

Many hotels also have their own desalination facilities because the dry season, when water is scarce, is also the tourist season. Therefore, the impact is great in that the burden of operating costs increases. If they do not have seawater desalination facilities, they have to rely on water tankers.

(3) Issues in integrated water resources management

The problems related to water resources management are the lack of staff in the water resources unit and the lack of fixed water measuring equipment for river flow rate in remote areas. Preparations are underway to increase staffing, but appropriate equipment that is resilient to natural disasters has not yet been identified.

8.4 Status of water supply

8.4.1 General condition of water supply

Water service in Grenada is provided by NAWASA, a public enterprise. According to the 2021 Population Census, the population of Grenada is approximately 110,000, with a water supply coverage of 96% and 42,719 connections (of which, about 90% are for domestic use). While the water demand is about 40,900 m³/day (9 million imperial gallons/day), the water production is about 45,450 m³/day in the rainy season and decreases to about 33,000 m³/day in the dry season. As for the water supply situation, water is supplied 7 days a week for about 20 hours a day, and in some areas during the dry season, water is supplied for about 12 hours a day due to drought. Therefore, some large hotels have their own water treatment system.

8.4.2 Water supply systems

Figure 8-9 shows the location of NAWASA's water sources, water supply facilities, and water service areas. NAWASA's water supply systems consist of 33 systems with a total of 26 surface water systems and 6 groundwater systems. In the surface water system, water treatment plants (WTPs) are of the slow or rapid filtration system (including pressure filtration), and as the number of facilities increases, WTPs with the slow filtration system are more popular. Table 8-6 lists the NAWASA WTPs. As mentioned above, Grenada has already achieved a 96% water supply coverage, so the master plan for water supply facilities has not been developed.



Figure 8-9 Locations of water sources, water supply facilities, and distribution areas of NAWASA

Table 8-6 NAWASA WTP list

<u>TREATMENT PLANTS</u>	Avg Daily Flow	Pop served	Class	Raw water source
1. Annandale	2,000,000	57143	III	Surface
2. Mardigras	200,000	5714	III	Surface
3. Bon Accord	40,000	1143	I	Surface
4. Radix	30,000	857	I	Surface
5. Vendomme	250,000	7143	II	Surface
6. Mirabeau	800,000	22857	II	Surface
7. Mt. Horne	200,000	5714	II	Surface
8. Munich	23,333	667	I	Surface
9. Spring Gardens	233,333	6667	I	Surface
10. Plaisance	10,000	286	I	Surface
11. Brandon Hall	250,000	7143	II	Surface
12. Apres Tout	6,667	190	I	Surface
13. Union	6,667	190	I	Surface
14. Les Avocat	266,667	7619	II	Surface
15. Mama Cannes	266,667	7619	II	Surface
16. Pomme Rose	150,000	4286	I	Surface
17. Petit Etang	166,667	4762	II	Surface
18. Concord	300,000	8571	I	Surface
19. Dougaldston	166,667	4762	II	Surface
20. Grand Roy	266,667	7619	II	Surface
21. Peggys Whim	400,000	11429	II	Surface
22. Tufton Hall	233,333	6667	II	Surface
23. Guapo	10,000	286	I	Surface
24. Morne Longue	3,333	95	Distribution system	Surface
25. Blaize	3,333	95	Distribution system	Surface
26. Clozier/Mt. Felix	13,333	381	Distribution system	Surface
Total		179905		
<u>Groundwater wells</u>				
Ballies Bacolet #2	150,000	4286	Distribution system	groundwater
Ballies Bacolet #3	300,000	8571	Distribution system	groundwater
Chemin Valley# 2	150,000	4286	Distribution system	groundwater
Chemin Valley# 2	150,000	4286	Distribution system	groundwater
Wood Lands #2	220,000	6286	Distribution system	groundwater
Wood Lands #3	140,000	4000	Distribution system	groundwater
Carriacou	45,000	1286	Distribution system	groundwater

Source: Quoted from NAWASA website

The Annandale WTP with the rapid filtration system is the largest WTP in the country and was constructed in 1974. The treatment capacity is about 9,100 m³/day (2 million imperial gallons/day) on a daily average and consists of one circular clarifier and three circular rapid sand filters. As for chemicals, since Polyaluminum chloride (PAC) does not coagulate well due to alkalinity problems during the rainy season, the flocculant uses aluminum sulfate and lime is used as a pH adjuster. The disinfectant is chlorine gas.



Date: February 2024

Figure 8-10 Annandale WTP (left: clarifier, right: rapid sand filter)

The Vendomme WTP is the second oldest WTP in the country, with both slow and pressure filters (rapid filtration) located on site, each consisting of an independent water treatment and distribution system. As the raw water contains high levels of iron and manganese, oxidation treatment by aeration is carried out at the water intake.



Date: February 2024

Figure 8-11 Vendomme WTP (left: slow sand filter, right: pressure filter)

The distribution network consists of 12-inch mains, 1.5- to 4-inch pipes for industrial areas, and 1/2-inch pipes for domestic use. In recent years, however, the diameter of the pipes has become incompatible with the increase in water supply. The District Metered Areas (DMAs) are being constructed under the G-CREWS project, an ongoing project supported by the GCF Fund. In addition, standpipes have been installed in 425 locations (as of 2023), and the central government is responsible for the water consumption charges, allowing residents to use them free of charge. Galvanized iron (GI) pipes are used for service lines on the main island of Grenada, and high-density polyethylene (HDPE) pipes, which are highly corrosive, are used in remote island areas.

While the main island of Grenada does not have a seawater desalination plant, the outlying islands of Carriacou and Petit Martinique each have a small-scale seawater desalination plant, with a capacity of about 370 m³/day (82,080 imperial gallons per day)

and about 180 m³/day (40,320 imperial gallons per day), respectively. Currently, there is an unmet demand for water on the island of Carriacou and the feasibility of the second seawater desalination plant is being studied with the assistance of the CCCCC.

8.4.3 Water Supply Operation

(1) Operation and maintenance of facilities

Several operation and maintenance (O&M) manuals have been prepared for water supply facilities in the past.

The O&M of the Annandale WTP is performed by a 5-person team in three shifts, and pH, turbidity, and residual chlorine are measured once an hour. The WTP faces the problem of not being able to treat high turbidity caused by heavy rainfall, although it can provide sufficient water supply during the rainy season.

Although SCADA is not currently implemented, the G-CREWS projects will implement a comprehensive SCADA system that includes WTPs, distribution reservoirs, and pumping stations. In addition, due to the division of departments, NAWASA is working to implement an integrated asset management system that will allow for centralized management of asset and financial information. It is also in the process of selecting suppliers for the G-CREWS project.

(2) Water quality management

The Ministry of Health, Wellness & Religious Affairs (MoH) is supposed to monitor NAWASA's water quality in accordance with the Public Health Act, but the Ministry does not have a laboratory and is unable to monitor. In practice, based on NAWASA's own water quality testing program, water quality tests are conducted in the laboratory located at NAWASA headquarters and reports are submitted to the MoH. Grenada's own water quality standards are developed with reference to WHO and water quality standards in European countries.⁸



Date: February 2024

Figure 8-12 Water Quality Testing Laboratory of NAWASA

⁸ Water Quality Act 2005

(3) Status of non-revenue water (NRW)

NAWASA considers the reduction of non-revenue water (NRW) as a major problem, and the apparent loss (commercial loss) is 18% to 20% while the physical loss (leakage) is not known. It is said that theft of water, which is one of the apparent losses, is small. In the NRW reduction pilot project under the ongoing G-CREWS project, the NRW rate in the pilot area is calculated to be approximately 40%, and further analysis is desired.

(4) Water rates and collection status

Figure 8-13 shows the current NAWASA water tariff table. Based on the table, the billing rate per 20 m³ for domestic use is calculated to be EC\$ 64.45, which is the average level for the countries surveyed. (see Section 2.3.2 for comparisons of water rates across countries). Water rates are classified into two categories, i.e., domestic and non-domestic, and are determined by the fixed monthly basic charge and the metered charge based on water consumption. The sewerage charge is determined by the ratio of the fixed basic charge and the metered charge to the water charge, and is 1/3 of the water charge for domestic use and 2/3 for non-domestic use.

NAWASA has a relatively successful revision record among the countries surveyed. Water tariffs were reviewed in 1993, 2010 and 2020. In addition, water tariffs are being evaluated as part of the ongoing G-CREWS project. Based on the results, water tariffs are expected to be revised again in 2025. The changes are expected to introduce new concepts; for example, households that install rainwater harvesting systems as a climate change adaptation measure will receive a water charge deduction as support for NAWASA's water supply.

	Tariff Structure	Variable Rate (per 1,000 gallons)		Fixed Monthly Water Charge	
		Previous Rates	New Rates	Previous Rates	New Rates
Domestic	Less than 2,800 Gallons	\$8.10	\$9.48	\$10.80	\$12.64
	2,801 - 5,500 Gallons	\$13.50	\$15.80		
	Greater than 5,500 Gallons	\$20.25	\$23.70		
Non-Domestic	Less than 2,800 Gallons	\$21.35	\$29.35	\$15.00	\$20.62
	2,801 - 20,000 Gallons			\$33.75	\$46.39
	20,001 - 100,000 Gallons			\$140.00	\$192.42
	Greater than 100,000 Gallons			\$550.00	\$762.79
Sewer	Domestic	1/3		1/3	
	Non - Domestic	2/3		2/3	

Source: NAWASA’s website

Figure 8-13 Water and sewerage rate table of NAWASA

Regarding the water rate revision process, since there is no NAWASA regulatory authority in Grenada, water rate revisions are approved directly by the Cabinet. When a rate increase is proposed, an external consultant prepares a water rate assessment report and submits it to the Cabinet after approval by the NAWASA Board of Directors.

Rate collection is good at almost 100% in FY2023, and a customer management and billing system from NorthStar Utilities Solution of Canada has already been installed.

(5) Issues related to customer management

NAWASA currently has 42,719 customers, including 38,481 domestic, 3,338 commercial, 26 industrial, and 823 government and school customers. Some of the customers are hotels that do not have their own water treatment facilities and require

priority water supply during the dry season, which coincides with the tourist season. Such hotels are one of NAWASA's main customers.

Eighty (80) percent of customer complaints are related to the time of water supply, especially during dry seasons when water rationing is imposed by valve operation. Complaints about water quality also increase due to brown water coming out of taps immediately after the water supply is resumed.

Challenges related to customer management included 1) time constraints in responding to customer complaints, 2) insufficient staff to improve efficiency in responding to customer complaints (pipe bursts, meter checks, etc.), 3) difficulty in obtaining heavy equipment and materials needed for work, 4) aging staff, 5) inadequate customer support, and 6) inadequate customer service training.

(6) Issues related to organization

NAWASA's personnel costs are funded from its internal budget and are not subsidized by the government. NAWASA's manpower is in flux, and in particular, there is a shortage of engineers in the Production & Quality Department and personnel in the Financial Department, so securing appropriate personnel on the island is a major issue for NAWASA. Currently, after leaving the predecessor, Financial Manager has not found anyone who meets the requirements of the NAWASA Board after leaving the predecessor, and has hired an Acting Financial Manager from abroad. There is also a shortage of engineers, and NAWASA currently employs three foreign engineers.

8.4.4 Technical training system

NAWASA has developed an Annual Training & Development Plan and Training Policy that requires participation in training, and has also secured XCD 500,000 annually for training budget. Internal training is on sewage collection and treatment, and as external training includes participation in GCF-supported occupational health and safety training. On the other hand, there is a lack of expertise in design/procurement, and it is considered problematic that designs/specifications cannot be determined in G-CREWS projects.

In terms of training needs, water distribution management is identified as the greatest need, followed by facility O&M, water quality management, construction management, performance management, health and safety management, etc.

8.4.5 Trends of in the private sector

NAWASA does not outsource its operations to private companies and does not have the any public-private partnership project.

8.4.6 Situation of NRW reduction

(1) Implementation of NRW reduction

The number of water leak repairs in 2023 was 9,233 and the repair records are being registered in the GIS system. Under the G-CREWS project, (1) a pilot project on NRW reduction is underway, (2) an NRW reduction plan is being developed, and (3) an NRW management unit is being established.

(2) Pilot project of smart meter introduction

The existing mechanical water meters have experienced meter errors and failures due to sand intrusion and clogging in the pipes (the number of meter failures is unknown). Currently, water meters are being procured from the U.S. and Europe, but NAWASA is considering upgrading to electromagnetic meters in the future. NAWASA is also interested in implementing smart meters, and is currently piloting 100 smart meters on the island of Petite Martinique and 46 on the island of Carriacou.

8.4.7 Facility development plan

(1) Water demand forecasting

Water demand forecasts have been conducted on a project basis, the most recent being conducted in 2008.

(2) Ongoing project

The largest water-related project in Grenada, “Climate Resilient Water Sector in Grenada (G-CREWS)” is underway. The project was approved in March 2018 as a result of a funding proposal to the GCF Funds. The co-financing by GCF, GIZ and the Government of Grenada will provide the largest grant ever in NAWASA, amounting to EUR 45 million. The project will be implemented over a six-year period from 2019 to 2025. The main objective of the project is to improve water storage and transmission/distribution, including the construction of water transmission pipelines, reservoirs and DMAs, and to reduce NRW.

(3) Planned project

NAWASA is not in a hurry to develop a master plan as it has already reached 96% water supply coverage, but a new Strategic Plan 2024-2029 is currently being prepared.

The Water Supply Expansion and Sewerage Improvement Project, supported by the Government of the United Kingdom through the United Kingdom Caribbean Infrastructure Fund (UKCIF) and CDB, was launched on February 21, 2024. The project aims to upgrade WTPs, expand the distribution networks in the capital city of St. Georges, and improve the sewerage system with a grant of USD 21 million. Another objective is to address the problem of water supply hours, especially during the dry season, in the

southern region of the country. Construction is currently scheduled to be completed by December 2025.

8.5 Status of wastewater treatment

8.5.1 Development status of sewerage system

(1) Overview of the sewerage system

There are two small sewerage systems in the country, one of which includes St. Georges since the 1940s, and one that was developed in the 1990s for the district near the airport in the southern part. Although these are separate sewerage systems, neither of them has a STP, and the sewage is discharged to the seabed after only removing the debris through a screen.

The two sewerage systems cover only 5% of the national population, with the remaining 80% using septic tanks and 15% using pit latrines. Septic tanks are typically emptied of sludge by vacuum trucks every 5-7 years, at a cost of EC\$ 800 per time. Although there are two landfill sites in Grenada (separate collection has not been implemented), septage sludge is collected and dumped into the manhole without treatment.



Date: March 2024

Figure 8-14 NAWASA's sewage pumping station

(2) Development plan

Grenada's master plan for sewerage development in Grenada has not been updated since it was developed in 1990. In light of the above, NAWASA emphasizes the need to update the master plan, and hopes to construct a sewage treatment plant.

8.5.2 Pollution status of public water bodies

The sewage from the capital of St. Georges is discharged untreated into the ocean. The point of discharge into the ocean is only 500 me from the foreign line, and NAWASA is not directly affected because it is diluted in the ocean.

In areas where sewerage systems are not yet developed, gray water is discharged into nearby rivers. In Mount Gay area shown in the following photograph, the sewerage system will be expanded and improved in the future. At present, there are no complaints or health problems from the residents, and there is no contamination of the rivers that serve as sources of drinking water. Therefore, although a new STP is planned for the St. Georges area, the priority of the projects within NAWASA is low and no concrete plans have been made.



Date: March 2024 (Near the National Cricket Stadium in the St. George's area)

Figure 8-15 River conditions at the discharge point (left) of untreated sewage water and in areas with undeveloped sewage systems (right)

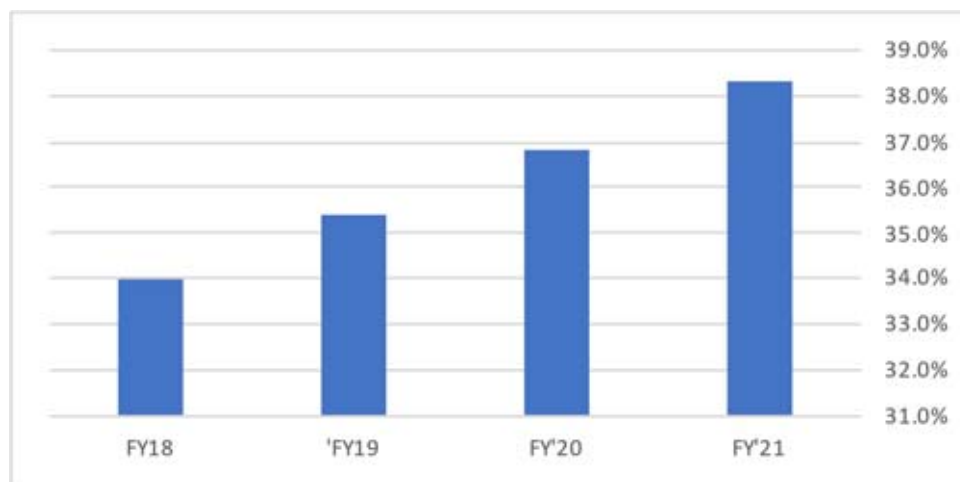
8.6 Financial position

8.6.1 Key financial indicators

The following analyses have been conducted using the NAWASA financial statements obtained in the survey.

(1) Stability

NAWASA's debt ratio has been increased within the range between 30% and 40%. If this trend becomes fixed for a long period of time, there may be increased concerns about financial stability.

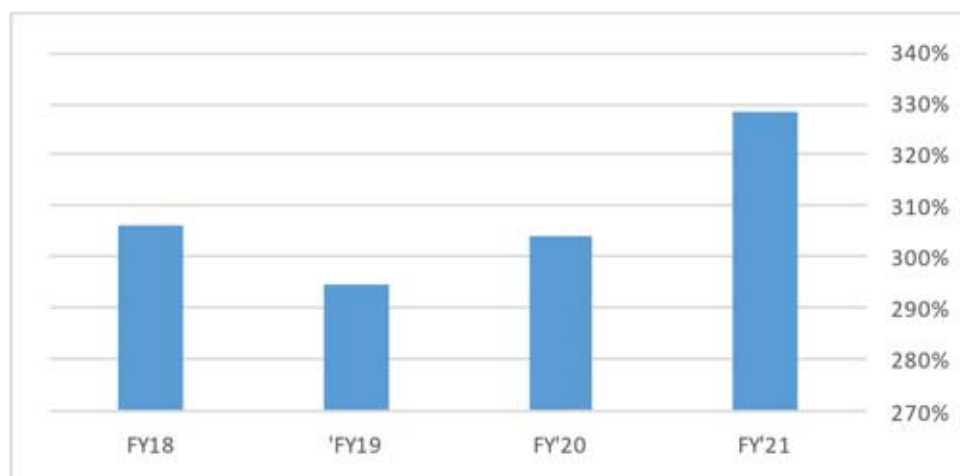


Source: Created by the survey team using NAWASA financial statements

Figure 8-16 NAWASA Debt Ratio

(2) Liquidity

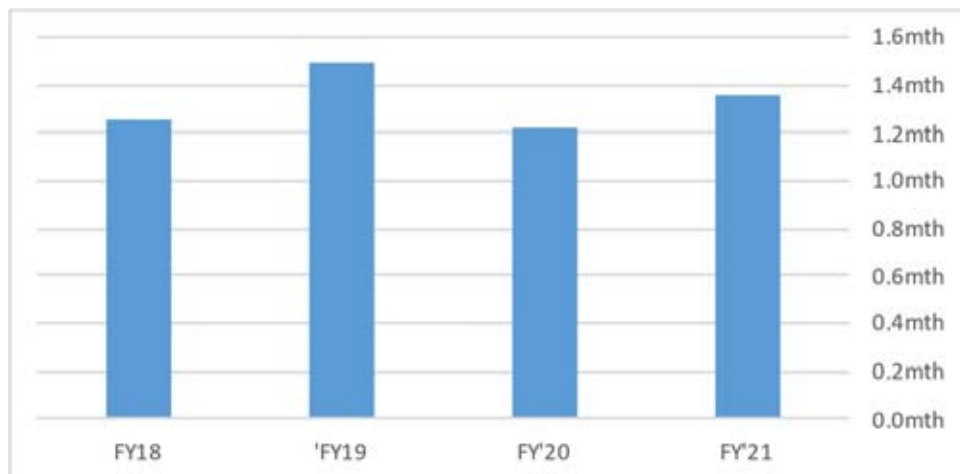
The current ratio is improving.



Source: Created by the survey team using NAWASA financial statements

Figure 8-17 NAWASA Current Ratio

The accounts receivable collection period, which can be one of the measures of the financing capacity by representing the collection status of the water tariffs, has been calculated. It remains in the range of one to two months, which is a satisfactory level compared to other Eastern Caribbean countries.⁹

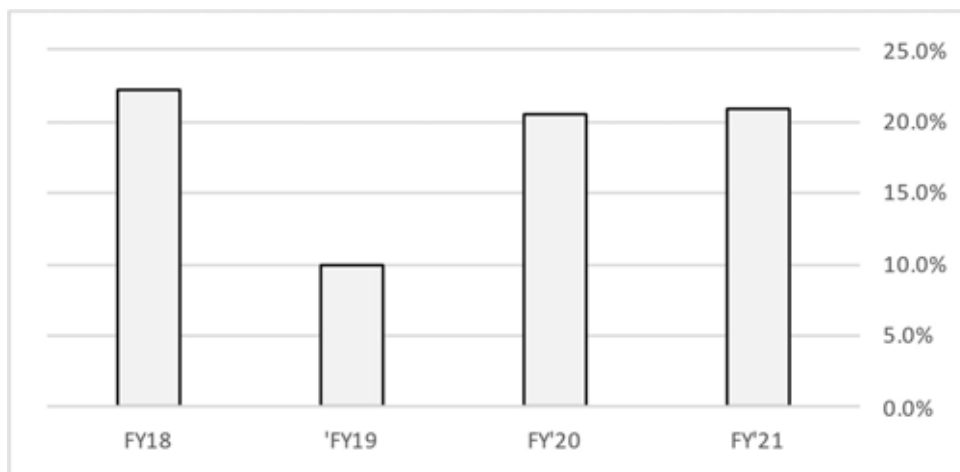


Source: Created by the survey team using NAWASA financial statements

Figure 8-18 NAWASA Accounts Receivable Collection Period

(3) Profitability

The historical change in net profit margin on sales has been analyzed. It is generally stable around 20%, except in FY 2019.



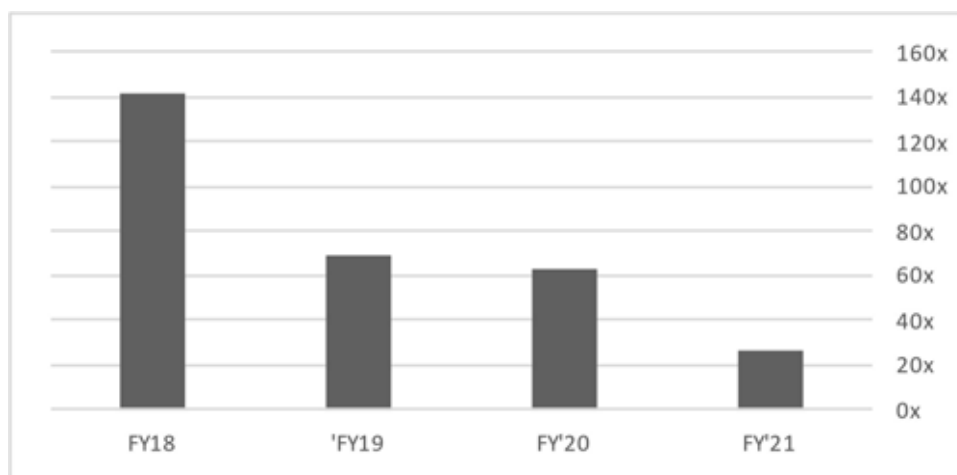
Source: Created by the survey team using NAWASA financial statements

Figure 8-19 NAWASA Net Income Margin

⁹ St. Lucia, Dominica, and St. Vincent and the Grenadines among the countries covered by the survey.

(4) Interest payment capacity

The ICR has been declining as if keeping pace with the increasing debt ratios. Although it is not a major concern, as the ratio still remains above 20 times, a review of borrowing and/or an increase in water tariff revenues should be considered, if this downward trend appears to continue.



Source: Created by the survey team using NAWASA financial statements

8-20 NAWASA ICR01

8.6.2 Financial and investment plan

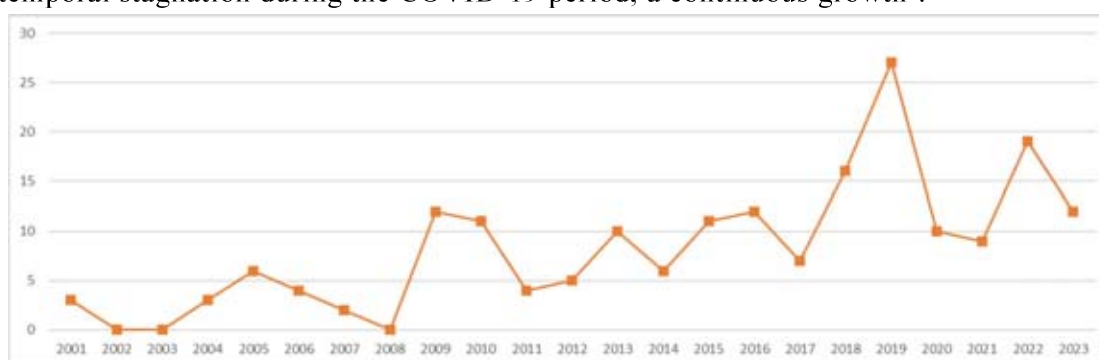
Although there is no subsidy from the Government of Grenada, the Government is taking over the process, because NAWASA cannot borrow on its own. The loan will be repaid from NAWASA's retained earnings.

NAWASA does not prepare pro forma financial statements or investment plans. Developing and strengthening the system's capacity to formulate and implement medium- to long-term financial and investment plans would be essential to ensure a stable water supply and continued resilient water services.

Chapter 9 Trends of the International Organizations

9.1 General situation

In the context of the recent situation including the worldwide influx of development fund into areas of response to climate change associated with concerns with global warming, the number of water projects for Caribbean countries has been significantly increased. In the Inter-American Development Bank (IDB), for example, the historical change in the number of water projects annually approved generally shows, except a temporal stagnation during the COVID-19 period, a continuous growth¹.



Source: Created by the survey team using IDB website.

Figure 9-1 Historical change in the number of IDB water projects in the Caribbean region

As below, other donors or international bodies have conducted plenty of water projects in the Caribbean region, the coordination with which enables efficient, effective assistance and can lead to the synergy with related activities. Especially, in small island countries in the Eastern Caribbean region, quite a few opportunities are expected in order to realize collective impacts by effective interventions leveraging experience and network of water sector associations or regional organizations.

9.2 Donor institutions

9.2.1 Caribbean Development Bank (CDB)

(1) Structure and strategy of water-related businesses

The Caribbean Development Bank (CDB) is a regional financial institution, which was established by an Agreement signed in October 1969, in Kingston, Jamaica, and entered into force in January 1970, headquartered in Barbados with 19 borrowing member

¹ Picked up as water project, by downloading project data from IDB website, any water and sanitation projects labelled WATER as the Sub-Sector. Out of the picked-up projects, and counted the number of approvals per year based on the Approval Date for the projects with IDB borrowing member countries in the Caribbean region: Bahamas, Barbados, Dominican Republic, Haiti, Jamaica, and Trinidad and Tobago, as the Project Country.

countries: Anguilla, Antigua and Barbuda, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Guyana, Haiti, Jamaica, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, The Bahamas, Trinidad and Tobago, Turks and Caicos Islands.

CDB handles water-related businesses in the Economic Infrastructure Division. The division consists of 13 staff members and is engaged in businesses related to water, sanitation, transportation, and energy. In particular, water resources management is supported by the Environmental Sustainability Unit, a separate organization within the Bank. The strategy for the water sector is not currently in place, but the strategy for the water and wastewater business is being developed.

CDB is the main donor institution in the Caribbean region including the countries covered by the survey but it is a small donor institution with an asset size of USD 2.1 billion (FY2022), which limits CDB to provide financial assistance in relatively modest amounts: mainly less than USD 50 million. For projects requiring large scale mobilization of funds, a scheme will be adopted in which CDB itself works as the implementing agency with financial assistance in collaboration with European and American donor institutions². These schemes include funds and programmes for climate change, disaster prevention and infrastructure development. Typical examples in the past are as follows.

- ✓ Caribbean Action for Resilience Enhancement (CARE) Programme:
In the areas of climatic change and disaster prevention, the European Union (EU) granted EUR 14 million over the five-year period from 2022.
- ✓ Community Disaster Risk Reduction Fund (CDRRF):
Eight projects for disaster prevention and climate-change adaptation were funded by the Canadian Government, EU, and CDB.
- ✓ United Kingdom Caribbean Infrastructure Partnership Fund
The UK funded eight DAC listed Caribbean countries³ and Montserrat with GBP 300 million of infrastructure development grants.

(2) Water-Related Projects and Future Trends

The table on the next page shows the major projects under implementation related to water. CDB, a GCF's accredited entity, currently has several projects for which they are preparing concept notes for the use of GCF funds and will further increase the number of applications for GCF funds in the future. The Bank understands that while the need for support for water resources management in OECS regions associated with climate change is expected to increase further, in supporting for the region, measures should be taken in

² Other major donors include the Inter-American Development Bank (IDB), the European Investment Bank (EIB), and the Agence Française de Développement (AFD).

³ Antigua and Barbuda, Belize, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, Saint Vincent and the Grenadines. St. Kitts Nevis, which is covered in the survey, is not included.

accordance with the circumstances of each country, taking into account the water resource issues that differ from country to country in the region.

Table 9-1 Major ongoing projects of water sector in CDB

#	Title	IA ⁴	Amount of support (in USD million)	Beneficiary institution (country/region)	Date of approval	Outline of outcomes
1	Water Sector Strategic Project	CDB	39.5	Dominica Water and Sewerage Company Ltd. (Dominica)	Dec 2021 (Scheduled for completion in December 2025)	<ul style="list-style-type: none"> ✓ Development of climate resilient water sector strategic plan. ✓ Development of options, engineering design and implementation plan of action.
2	Sixth Water (Vieux Fort Water Supply Redevelopment) Project	CDB	31.1	Water and Sewerage Company Inc. (Saint Lucia)	Dec 2020	<ul style="list-style-type: none"> ✓ Rehabilitation works and the newly construction of water treatment plants. ✓ Construction of a new chemical storage building. ✓ Installation of a new pipeline and a transmission main.
3	Third Water - Ambergris Caye	CDB	10.9	Belize Water Services (Belize)	Jul 2018	<ul style="list-style-type: none"> ✓ Awareness activities of safe, reliable and climatic-resilient supply of potable water to residents and businesses on southern Ambergris Caye. ✓ Staff training on gender-inclusive human resources management and communication.
4	Eighth Water Dennery North Water Supply Redevelopment Project	CDB	17.5	Water and Sewerage Company Inc. (Saint Lucia)	May 2016	<ul style="list-style-type: none"> ✓ Construction of a new water intake on a river. ✓ Construction of a raw water transmission line and a new water treatment plant, as well as installation of a water storage tank. ✓ Construction of a new transmission pipeline
5	Water Supply Improvement Project	CDB	41.8	Water Supply and Sewerage	Dec 2015	<ul style="list-style-type: none"> ✓ Construction of water treatment plants. ✓ Installation of transmission mains.

⁴ IA: Implementing Agency

#	Title	IA ⁴	Amount of support (in USD million)	Beneficiary institution (country/region)	Date of approval	Outline of outcomes
				Corporation (The Bahamas)		
6	Water Supply Network Upgrade Project	CDB	44.3	Barbados Water Authority (Barbados)	Dec 2015	<ul style="list-style-type: none"> ✓ Enhance the safety and functionality of the water supply system such as water tanks and reservoirs. ✓ Reduce operational costs by non-revenue water reduction, mains replacement, and photovoltaic installation. ✓ Tariff proposal project and staff training. ✓ Climate change vulnerability assessment.
7	Seventh Water (John Compton Dam Rehabilitation) Project	CDB	20.5	Water and Sewerage Company Inc. (Saint Lucia)	Jul 2015	<ul style="list-style-type: none"> ✓ Repairs to spillway and access road, development of supplementary water intakes and installation of dam monitoring instrumentation. ✓ Enhance management and operational capacity of staff in the areas of gender inclusion, climate resilience planning, and financial management.
8	Third Water Supply Project - Water Area 1 - Network Upgrade	CDB	11.1	Dominica Water and Sewerage Company Ltd. (Dominica)	Oct 2012	<ul style="list-style-type: none"> ✓ Construction of a new intake at a river. ✓ Upgrade of the network transmission and distribution system. ✓ Construction of two distribution storage tanks. ✓ Upgrade of an existing intake and a filtration plant. ✓ Establishment of a leak detection and repair program.

Source: CDB and related institution's website

9.2.2 Inter-American Development Bank (IDB)

(1) Structure and Strategy of the Water Resources Business

The Inter-American Development Bank (IDB) is an organization that provides financial and technical support to its Borrowing Member Countries in Latin America and the Caribbean region, but none of the OECS countries for which this survey was conducted are the members, and the Bank has no offices in the countries. There is an office in Barbados, a neighbouring member country, and information was collected from officials in the field of water and sanitation in the survey. Since IDB alone cannot provide various types of assistance to countries/regions that are not its members, it is necessary to collaborate with other donor institutions or frameworks to provide assistance to such countries/regions. Water-related projects benefiting the Caribbean region including OECS countries, which will be described later, are linked to funding by the Global Environment Facility (GEF) and the United Nations Environment Programme (UNEP), and support for implementation by the Gesellschaft für Internationale Zusammenarbeit (GIZ) as well.

The "Water and Sanitation Sector Framework Document" was formulated in December 2021 as a water sector strategy of IDB. According to the document, IDB Group⁵'s initiatives include the following five items: i) Promote universal access to quality water and sanitation services with equity, inclusion, and affordability; ii) Design policies and programs incorporating disaster and climate change risk management and promoting water security; iii) Improve the financing and governance frameworks; iv) Improve management to ensure efficient, sustainable service delivery and promote private sector participation; and v) Drive innovation in the sector.

⁵ It consists of three organizations: i) IDB; ii) Inter-American Investment Corporation (known as IDB Invest), which aims to contribute to development of the economy in the America region through loans or investments for private enterprises to supplement IDB activities; and iii) Multinational Investment Fund (known as IDB Lab), which was established to provide technical co-operation and develop small and medium-sized enterprises in order to promote private investment.

(2) Water-Related Projects and Future Trends

The table on the next page shows the main water-related projects that benefit the Caribbean region. In the table, items 1 through 3 are projects related to developing CWUIC, a disaster insurance scheme described above in "2.7.4 Initiatives for Climate Change and Natural Disaster Risk." Although categorised as disaster risk reduction, these projects are critical to the IDB's recent support for the water sector in the Caribbean region, including OECS countries.

In addition, in the item 5 project, the Caribbean Regional Fund for Wastewater Management (CReW+) was used to strengthen the system of integrated water supply and wastewater management in the broader Caribbean region, including the OECS countries. In this case, an application for funding was submitted to GEF in collaboration with UNEP, which contributed to the benefit of OECS member states which were non-IDB members countries. It is also characteristic that GIZ in response to IDB solicitation was in charge of the implementation activities for the IDB member countries rather than IDB⁶. IDB staff interviewed by the survey team indicated that the number and value of the projects are expected to increase in the future in order to strengthen water resources management in the Eastern Caribbean region.

⁶ Since the activities of the project are enormous and diverse, IDB focused on total management, progress-oversight, and quality-assurance and inspections, and procured an external implementing agency.

Table 9-2 Main water-related projects benefiting the Caribbean region in IDB

#	Title (number)	IA ⁷	Amount of support (in USD million)	Beneficiary organization and country	Term	Outline of outcomes
1	Parametric insurance premium support to water utilities in the Caribbean under CWUIC SP (RG-G1045)	IDB	1.9 (British government)	Belize, Dominican Republic, Guyana, Haiti, Jamaica, Suriname	24 months from Dec 2022	✓ Funding support for premiums on parametric disaster insurance
2	Structuring of the Caribbean Water Utility Insurance Company (CWUIC SP) as a Segregated Portfolio within CCRIF SPC (RG-T4109)	IDB	3.7 (British government)	Belize, Dominican Republic, Guyana, Haiti, Jamaica, Suriname	24 months from Aug 2022	<ul style="list-style-type: none"> ✓ Arrangement for parametric disaster insurance ✓ Designing an insurance product by modelling the coincidence risk of natural disasters ✓ Technical support for improvement of water infrastructure resistance ✓ Composition of CWUIC SP
3	Structuring of the Caribbean Water Utility Insurance Company (CWUIC SP) (RG-T4105)	IDB	0.3	Bahamas, Barbados, Belize, Dominican Republic, Guyana, Haiti, Jamaica, Suriname, Trinidad and Tobago	36 months from Aug 2022	<ul style="list-style-type: none"> ✓ Private sector participation in CWUIC SP ✓ Training and capacity improvement of water business ✓ Establishment of a trust fund ✓ Data collection ✓ Preparation of training textbooks and materials
4	Data Sharing Platform for Water Utilities in	IDB	0.2	Bahamas, Barbados, Belize, Guyana, Jamaica,	24 months from Jul 2022	<ul style="list-style-type: none"> ✓ Pilot deployment of a data sharing platform ✓ Feasibility study for pooling procurement

⁷ IA: Implementing Agency

#	Title (number)	IA ⁷	Amount of support (in USD million)	Beneficiary organization and country	Term	Outline of outcomes
	the Caribbean (RG-T4032)			Suriname, Trinidad and Tobago		
5	GEF CReW+: An integrated Approach to Water and Wastewater Management using Innovative Solutions and Promoting Financing Mechanisms in the Wider Caribbean Region (RG-T3412)	IDB UNE P	8.5(GEF) 6.4(UNEP)	Barbados, Belize, Columbia, Costa Rica, Dominican Republic, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Suriname, Trinidad and Tobago	36 months from May 2019	<ul style="list-style-type: none"> ✓ Revision of systems, policies, legislation and regulations for integrated water supply and sewerage management ✓ Consideration of sustainable and flexible financing for integrated water supply and sewerage management in urban, suburban and rural areas ✓ Measures for innovative integrated rural/suburban water supply and sewerage management on a small scale ✓ Knowledge management of integrated water supply and sewerage management
6	Support for Implementation of the Regional Strategic Action Plan (RSAP) for Governance and Building Climate Resilience in the Water Sector in the Caribbean (RG-T3467)	IDB	0.3	Caribbean countries using English as an official language, Suriname	24 months from Jul 2019	<ul style="list-style-type: none"> ✓ Preparations for the implementation of the Regional Strategic Action Plan ✓ Training and capacity building for implementation of the Regional Strategic Action Plan ✓ Support for CWWA high-level meetings
7	An integrated Approach to Water and	IDB	0.2	Barbados, Belize, Colombia, Costa Rica,	12 months from May 2018	<ul style="list-style-type: none"> ✓ Revision of systems, policies, legislation and regulations for integrated water supply and sewerage management

#	Title (number)	IA ⁷	Amount of support (in USD million)	Beneficiary organization and country	Term	Outline of outcomes
	Wastewater Management using Innovative Solutions and Promoting Financing Mechanisms in the Wider Caribbean Region (RG-T3209)			Dominican Republic, Guatemala, Guyana, Honduras, Jamaica, Mexico, Panama, Suriname, Trinidad and Tobago		<ul style="list-style-type: none"> ✓ Consideration of sustainable and flexible financing for integrated water supply and sewerage management in urban, suburban and rural areas ✓ Measures for innovative integrated rural/suburban water supply and sewerage management on a small scale ✓ Knowledge management of integrated water supply and sewerage management
8	Governance in the Water & Sanitation Sector for the English-Speaking Caribbean and Suriname (RG-T2775)	IDB	0.3	Caribbean countries using English as an official language, Suriname	24 months from Oct 2016	<ul style="list-style-type: none"> ✓ Knowledge development (a position paper on governance) ✓ Awareness, communication, and information exchange for the beneficiaries (governance training for major local experts)

Source: IDB website

9.3 Water sector associations

9.3.1 Caribbean Water and Wastewater Association (CWWA)

(1) Organizational overview

The Caribbean Water and Wastewater Association (CWWA) was established as a regional NGO by CWWA Act 1991 of Trinidad and Tobago in 1991, and consists of public and private experts and practitioners of water supply, sewerage and waste sectors. It is operated with the membership charges borne by individuals (including students) and members consisting of enterprises and organizations, and funding by other international organizations. CWWA has an office in Trinidad and Tobago with 2 officials and no branches.

(2) Main activities and collaboration with other international organizations

CWWA's major activities include holding annual conferences, conducting training programs and publishing newsletters for members.

The CWWA Annual Conference and Exhibition, which rotates among the Caribbean countries, is regarded as an important event in the water sector in the Caribbean region and functions as an occasion for networking among members, research presentations on the water sector, and commendation for excellent efforts. At the October 2023 conference held in Georgetown, the capital of Guyana, ministers responsible for water and sewage administration in each country announced the Declaration of Georgetown 2023 at the High-Level Forum.

Table 9-3 Declaration of Georgetown 2023 (Excerpt)

<ul style="list-style-type: none"> ✓ Recalling the Regional Strategic Action Plan for Governance and Building Climate Resilience in the Water Sector in the Caribbean (RSAP) and the ongoing implementation works under the stewardship of the Caribbean Water and Wastewater Association and in collaboration with the Multilateral Partners⁸; ✓ Accepting that Small Island Developing States (SIDS) and Caribbean territories remain a special case for water resources management and national development, considering their unique and particular vulnerability to the adverse impacts of climate change; ✓ Reaffirming that disaster risk financing and management is available through CWUIC-SP; ✓ Caribbean water utilities commit to prioritizing <u>the reduction of non-revenue water (NRW) and increase the level of wastewater treatment.</u> ✓ There is potential for Caribbean water utilities to access climate financing for mitigating greenhouse gas emissions through NRW reduction and wastewater treatment projects. ✓ IDB and CDB stand ready to support water utilities to prepare plans to accelerate the reduction of NRW to an optimal level of losses and to increase the wastewater treatment coverage in 7 years.

⁸ See 6 in Table 9-2.

- ✓ Caribbean Ministers with responsibility for water and wastewater commit to reviewing the water sector governance, legal and institutional framework to mainstream integrated water resources management.
- ✓ CWWA commit to capacity building for the Caribbean water and sanitation sector through the CWWA Research and Education Foundation (CWWA ReEF).
- ✓ CWWA, IDB and CDB prepare a concept note for a NRW training programme for practitioners in the Caribbean by the next High-Level Forum.
- ✓ IDB and CDB will begin a GCF funding application process as GCF Certification Organization (Accredited Entities) for the water-sector resilience improvement programme.

Source: Created by the survey team using CWWA website. The underlined text is added by the survey team.

CWWA also provides its members with various seminars and workshops on general and technical aspects of the water sector. In the Eastern Caribbean region, where the Caribbean Water and Sewerage Association (CAWASA) is the main training program provider, CWWA coordinates with CAWASA, for example, by sharing information on CWWA training programs that are not covered by CAWASA training. In addition, CWWA is electronically issuing newsletters to members to share the latest trends in the water sector both within and outside the region.

In addition to these major activities, as a core institution in the ecosystem of the water sector in the Caribbean region, CWWA operates a personnel database exclusively for the members. In the event of a natural disaster, CWWA cooperates with CDEMA and other organizations to mobilize water sector organizations, engineers, and experts within the area.

Much of the activity is undertaken with funding and technical support from other international organizations. The main donors are UNEP, CDB, IDB, and there is no track record of support by governmental and international organizations in the Asian region.

9.3.2 Caribbean Water and Sewerage Association (CAWASA)

(1) Outline

The Caribbean Water and Sewerage Association (CAWASA) is an NGO incorporated in St. Lucia, non-profit but not state-owned⁹, with full membership of water utilities in the Caribbean Island States¹⁰, including the OECS countries. CWWA has characteristics similar to CWWA: other members consist of public and private experts and practitioners in the water, sewerage and waste sectors; and it is funded by members of individuals (including students), companies and organizations as well as other international

⁹ It has a character similar to that of a public interest incorporated association in Japan.

¹⁰ Antigua and Barbuda, Barbados, British Virgin Islands, Cayman Islands, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks and Caicos Islands.

organizations. It was, however, established in 2010¹¹, later than CWWA. In addition, CAWASA has a distinct attribute as a regional association of water utilities in the Caribbean islands and a strong impact on water utilities in the OECS countries covered by the survey, particularly in terms of human resources development through the provision of training programmes. CAWASA has an office in Saint Lucia with 2 officials and no branches.

(2) Main activities

CAWASA focuses on the planning and implementation of training programs related to water services mainly for water utilities, where certificates are issued to the trainees who pass the exams. Training programs are shown in Table 9-4. The certificates are internationally recognized and, if presented, would be effective and make it easier to apply for waterworks jobs; such presentation is optional. The training program of the highest demand is Water Distribution. On the other hand, lectures on NRW reduction are not included.

While the training programs are open not only to members but also to public non-members, members can take them at lower prices. In terms of training implementation, CAWASA staff members do not work as instructors themselves but instead procure outside experts as lecturers, who are professional engineers not only from the OECS countries but from the United States and Canada. Textbooks used in the training are teaching materials published by the American Water Works Association (AWWA) and Water Professionals International (WPI). The lecturers work online and in person (in-person lectures are carried out by lecturers dispatched in response to the request of water utilities).

In the event of a natural disaster, CAWASA mobilizes member staff and coordination to leverage financial support from other international organizations in order to rescue the affected areas. Mr. Ignatius Jean, Executive Director of CAWASA, who was interviewed as part of the survey, has served in key roles in the water sector for many years, including as a minister in the Central Government of St. Lucia, and is a person with extensive connections related to the water sector in the Caribbean region.

¹¹ It is the year of establishment as CAWASA. The origination can be traced back to the Caribbean Basin Management Project organized in Barbados in 1996.

Table 9-4 CAWASA training programs

No.	Training programs	Class
1	Water Distribution	Class I - IV
2	Water Treatment	Class I - IV
3	Wastewater Treatment	Class I - IV
4	Wastewater Collection	Class I - IV
5	Water Laboratory	Class I - IV
6	Wastewater Laboratory	Class I - IV
7	Very Small Water System	Class I
8	Small Wastewater System	Class I
9	Physical/Chemical Industrial Waste	
10	Plant Maintenance	
11	Biosolid Land Application	Class I & II

Source: Created by the survey team

9.3.3 Global Water Partnership-Caribbean (GWP-C)

The Global Water Partnership (GWP) is an international network established in 1996 that promotes the integrated water resources management (IWRM) in the world, headquartered in Stockholm, Sweden with more than 3,000 members across 183 countries. It supports national or regional initiatives on policies and detailed responses on the fields of water-disaster, transboundary rivers, and SDGs as well as IWRM.

GWP-C, not visited during the survey, is a sub-organization in the Caribbean region of GWP with its secretariat in Grenada and provides support for sustainable water resources management in the Caribbean region, led by the Steering Committee consisting of 9 industry-government-academia experts from the member institutions. In 2022, a draft Action Framework for IWRM for the CARICOM Region was developed under the GEF funded Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (IWEco) project. The draft IWRM Action Plan was originally developed for the 10 IWEco participating countries: Antigua and Barbuda, Barbados, Cuba, Dominican Republic, Grenada, Jamaica, St. Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, and Trinidad and Tobago. Later 2024, this draft IWRM Action Framework is anticipated to be revised and finalised to include 9 additional CARICOM States and Associate Member States: Bahamas, Belize, Dominica, Guyana, Haiti, Montserrat, Suriname, Anguilla and Virgin Islands¹².

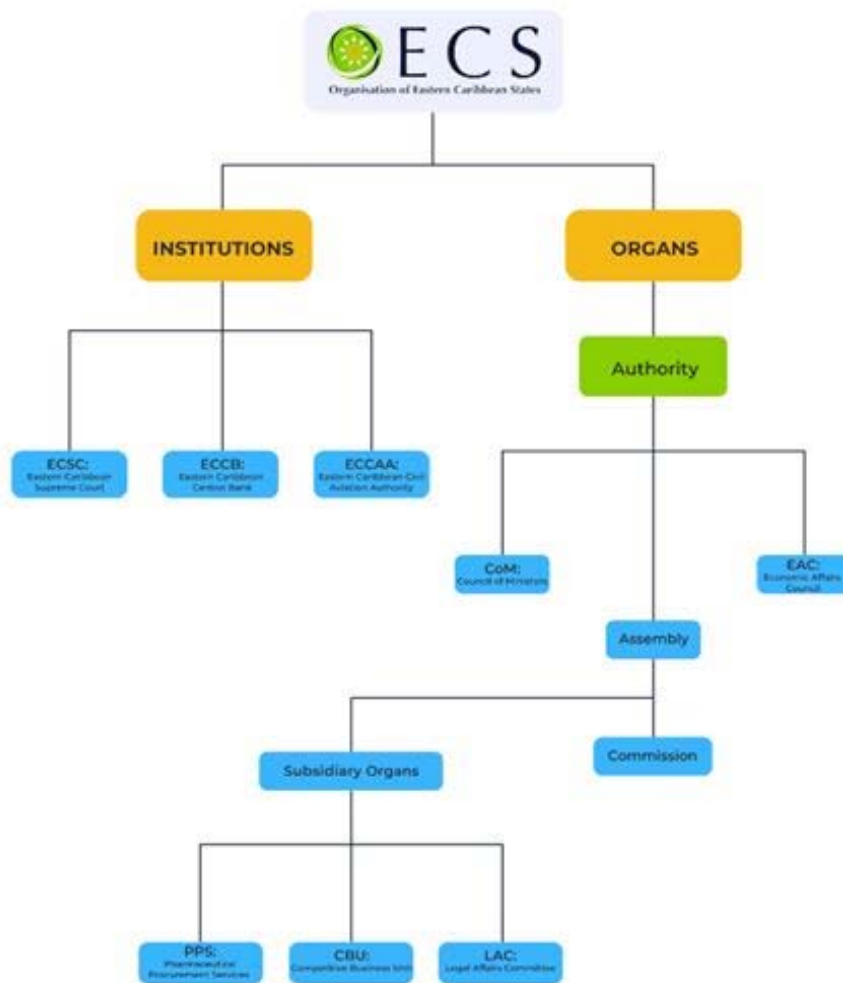
¹² The main source of this section is GWP-C website.

9.4 Regional organisations

9.4.1 Organisation of Eastern Caribbean States (OECS)

(1) Structure and Strategy of the Water Resources Sector

The Organisation of Eastern Caribbean States (OECS) is a regional organisation of seven countries and regions, including the six countries surveyed and Montserrat, as protocol members, and the British Virgin Islands, Anguilla, Martinique, and Guadeloupe as associate members. The organization chart is as shown below.



* Organs and institutions as per the Revised Treaty of Basseterre

Source: OECS website

Figure 9-2 Organizational Chart of OECS

In “Revised St George’s Declaration of Principles for Environmental Sustainability” (SGD2040), where OECS declared its commitment to environmental control, “Land and Water Resources” is one of the six strategic priorities and is the responsibility of the

Environmental Sustainability Division, one of the sectors comprising the Commission. The division was launched in 2017 and currently has eight officials working on four programmes, of which the main programme is the Biodiversity Ecosystems and Ecosystem Services Programme, in which water-resource projects are being promoted through initiatives to support the achievement of SDGs.

(2) Water-Related Projects and Future Trends

Main water-related projects are shown in the table below. OECS recognizes that the need for improved water resources management in the coming years is extremely high in the Eastern Caribbean countries, based on the outcome of the Consultancy to Develop an Action Framework for Integrated Water Resources Management (IWRM) for the CARICOM Region, which the Global Water Partnership-Caribbean developed in March 2022. The consultation points out that the OECS countries, with the exception of Saint Lucia, have not adequately adopted or introduced water-related policies, legislation, and development plans.

Table 9-5 Major Projects in Water-Related Sector in OECS

Title	IA ¹³	Amount of support	Beneficiary organization and country	Term	Outline of Outcomes
Biodiversity Support Programme in ACP Coastal Environments (BioSPACE)	EU	EUR 10.7 million (EU)	OECS member states and regions	5 years from Dec 2019	<ul style="list-style-type: none"> ✓ Capacities of ACP regions and countries to effectively manage coastal and marine biodiversity and enhance resilience to climate change are strengthened. ✓ Regional, national and local efforts to assess, protect, manage and sustainably use marine and terrestrial biodiversity are supported. ✓ Partnerships for environmental sustainability are developed and strengthened.
Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States (GEF-IWEco) Project	UNEP UNDP	USD 9.5 million (GEF)	Antigua and Barbuda, Cuba, Barbados, the Dominican Republic, Grenada, Jamaica, St. Christopher and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago	7 years from Sept 2016	<ul style="list-style-type: none"> ✓ Develop and implement integrated targeted innovative, climate-change resilient approaches. ✓ Strengthen sustainable land management, integrated water resources management, and ecosystems monitoring and indicators framework. ✓ Strengthen the policy, legislative and institutional reforms and capacity building. ✓ Enhance knowledge exchange.

Source: OECS website

¹³ IA: Implementing Agency

9.4.2 Caribbean Community (CARICOM)

(1) Structure and Strategy of the Water Resources Sector

The Caribbean Community (CARICOM), joined by countries and territories in the Caribbean region, is a governing body with five Councils¹⁴ and four Committees¹⁵ as well as the Secretariat¹⁶ assisting two Principal Organs, comprising the Conference of Heads of Government and the Community Council of Ministers¹⁷. In terms of the water sector, the Directorate of Economic Integration, Innovation and Development under the Secretariat is in charge as an important theme of sustainable development, and water-related projects are mainly undertaken by CARICOM's sub-institutions responsible for water resources sector, including the Caribbean Disaster Emergency Management Agency (CDEMA) and the Caribbean Community Climate Change Centre (CCCCC). In addition, the CARICOM Development Fund (CDF), which works to eliminate intra-regional disparities, is also one of the major intra-regional support frameworks.¹⁸

2) Water-Related Projects and Future Trends

Refer to the ones of two sub-institutions described in 9.5 below. CDF's achievements are mainly in the areas of SME development, sustainable energy, and infrastructure. Water-related projects utilizing CDF have not been observed. On the other hand, CDF was newly certified as an accredited entity for GCF in October 2023, and it seems that project-funding applications to GCF will be raised in various areas including the water sector.

¹⁴ Five Councils: Finance and Planning, Foreign and Community Relations, Human and Social Development, National Security and Law Enforcement, Trade and Economic Development

¹⁵ Four committees: Budget, Central Bank Governors, Legal Affairs, Ambassadors

¹⁶ The Secretariat has their headquarters in Georgetown with an Office in Barbados and a small satellite unit in Jamaica, comprising 4 Directorates: i) Foreign and Community Relations; ii) Human and Social Development; iii) Economic Integration, Innovation and Development; and iv) Single Market and External Trade.

¹⁷ Source: CARICOM website

¹⁸ Since the latter half of the 1980s, CARICOM has sought to strengthen economic integration in the region and to strengthen and expand the common market where services, capital and people are able to be exchanged freely, aiming to become the CARICOM Single Market and Economy (CSME). In August 2009, the fund began its activities in Barbados as a central support organization to promote CSME and respond to the intra-regional disparities among countries and regions that are concerned.

9.5 Related sector institutions

9.5.1 Caribbean Disaster Emergency Management Agency (CDEMA)

(1) Structure and Strategy of the Water Resources Sector

The Caribbean Disaster Emergency Management Agency (CDEMA) was established as the Caribbean Disaster Emergency Response Agency in 1991. It is an organization to coordinate national and regional disaster response within the CARICOM region and was reorganized in 2009 into the present CDEMA advocating the principle of Comprehensive Disaster Management.

CDEMA operational policies are developed by the Council consisting of the Heads of Government of the Participating States or their nominees. The Technical Advisory Committee, which is composed of specialists of disaster prevention organizations in the Participating States, is the technical and programmatic advisory arm of the CDEMA, and forms four Sub-Committees: i) Information Communications Systems; ii) Plan Development and Review; iii) Climate Change, Disaster Risk Reduction and Environment; and iv) Work Programme Development and Review. In addition, the Coordinating Unit managed by an Executive Director who is appointed by the Council is responsible for the practical functions in four areas: education, research and information; finance and administration; preparedness and response; and mitigation and research. The CDEMA interviewer at the survey on the water sector was an Executive Director.

(2) Water-Related Projects

The table on the next page shows the main water-related projects.

Table 9-6 Main water-related projects in CDEMA

#	Name	IA ¹⁹	Amount of support (in USD million)	Beneficiary Country	Term	Outline of Outcomes
1	EWS Project	CDEMA, UNDP, International Red Cross (Red Crescent)	Financed by EU ²⁰	Antigua Barbuda, Dominica, Dominican Republic, Haiti, St. Lucia, St. Vincent and the Grenadines, Cuba	18 months	✓ Enhance preparedness for disasters and disaster risk reduction through integrated early warning systems.
2	Strengthen integrated and cohesive preparedness capacity at a regional, national and community level in the Caribbean	CDEMA, UNDP, International Red Cross (Red Crescent) OCHA ²¹	Financed by EU ²²	Antigua Barbuda, Dominica, Dominican Republic, St. Lucia, Saint Vincent and the Grenadines, Cuba	-	<ul style="list-style-type: none"> ✓ Support actions in detail for effective early warning systems. ✓ Improve information management and operational capacity for the Regional Response Mechanism.

Source: CDEMA website

¹⁹ IA: Implementing Agency²⁰ By European Civil Protection and Humanitarian Aid Operations (ECHO), a body of the European Union that provides foreign and civilian assistance²¹ Abbreviation of Office for the Coordination of Humanitarian Affairs²² Same as 23

9.5.2 Caribbean Community Climate Change Centre (CCCCC)

(1) Structure and Strategy of the Water Resources Sector

The Caribbean Community Climate Change Centre (CCCCC) was established in Belmopan, the capital of Belize, in August 2005 as a coordinating body for climate-change responses in the Caribbean region. In addition to accumulating information and data on climate change in the region, it provides recommendations and guidance on climate change policies to CARICOM member countries and the rest of the British Caribbean.

CARICOM is deeply involved in the governance system of CCCCC. CCCCC is overseen by a Board of Governors selected by CARICOM Council of Ministers, in accordance with the Policy Guidelines developed by the Council for Trade and Economic Development (COTED) of CARICOM²³. The chart below shows the governance structure.



Source: CCCCC website

Figure 9-3 Governance organization chart of CCCCC

²³ Source: CCCCC website

The Caribbean Community Climate Change Centre Strategic & Implementation Plan 2021-2025 (hereinafter referred to as the "CCCCC Plan") developed in September 2021 indicates water-related potential impacts of climate change in the Caribbean region, as follows.

Table 9-7 Potential Impacts of Climate Change in the Caribbean (Water Related)

Resource/Sector	Description	Potential impacts
Water resources	Availability of freshwater is a significant factor in economic and social development. Many islands rely on rainwater as the primary source of water supply.	<ul style="list-style-type: none"> ✓ Most islands projected to see reductions in rainfall ✓ Saline intrusion into groundwater reserves ✓ Decreased fresh water availability ✓ Increased incidents of drought ✓ Declining agricultural productivity ✓ Impacts on other sectors such as Health, Tourism, Industry
Forest ecosystems	Forests provide protection for watersheds and soils; prevent erosion and landslides; are part of the water supply system.	<ul style="list-style-type: none"> ✓ Reduction of water resources
Human health	The tropical climate of the region is favourable for the water-borne diseases.	<ul style="list-style-type: none"> ✓ Increased diseases and incidents of fish poisoning ✓ Increased injuries and deaths associated with tropical storms

Source: Created by the survey team using CCCCC plan

The CCCCC plan has five points to be strengthened corresponding to its strategic objectives: i) management of the effects of climate change; ii) strategic partnership; iii) uptake of data; iv) public's ability; and v) strong and sustainable CCCCC. However, no clear targets have been set for the water sector.

(2) Water-related projects and collaboration with other international organizations

The table on the next page shows the main water-related projects.

Table 9-0-8 Major Water-Related Projects in CCCCC

#	Title	IA ²⁴	Amount of support	Beneficiary Organization and Country	Term	Outline of Outcomes
1	Enhancing Climate Resilience in CARIFORUM Countries	CCCCC	EUR 12 million (EU: European Development Fund)	Relevant organisations in 15 member countries of Caribbean Forum and Cuba (major climate change authorities, central/regional universities, private sectors including vocational organizations such as construction and engineering, water and electricity utilities, and climate change NGO and community organizations) ²⁵	36 months from 2019/04	<ul style="list-style-type: none"> ✓ Improve forecasting, prediction and information generation for effective development planning. ✓ Improve climate resilient water sector infrastructure and management. ✓ Enhance public awareness and education on climate change. ✓ Improve climate risk management planning at all institutional levels.
2	Government of Italy/ CARICOM	CCCCC	USD 7.6 million (Government of Italy)	DOWASCO (Dominica), NAWASA (Grenada), etc.	-	<p>Two of the 11 projects funded by the Italian Government cover the water sector:</p> <ul style="list-style-type: none"> ✓ A Solar PV system at the DOWASCO Sewage Treatment Plant ✓ A Carriacou PV powered SWRO desalination system in Grenada

Source: CCCCC website

²⁴ IA: Implementing Agency²⁵ The Caribbean Forum is a subgroup including the Organization of African, Caribbean and Pacific States, and serves as the main counterpart of EU's support for the Caribbean region. Fifteen Member States are Antigua and Barbuda, the Bahamas, Barbados, Belize, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, St. Kitts Navis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago.

The following table shows the main organizations that are designated as collaborative partners in CCCCC programs.

Table 9-9 Major partner organizations in CCCCC

Regional Partners ²⁶	International Partners
✓ CDB	✓ EU
✓ CDEMA	✓ GCF
✓ CIMH	✓ GEF
✓ CWWA	✓ IAEA
✓ OECS	✓ IDB
✓ University of the Bahamas	✓ Italian Ministry for Environment, Land and Sea
✓ University of Guyana	✓ German Development Bank
✓ University of West Indies	✓ Potsdam Institute
	✓ UK Meteorological Hadley Centre
	✓ UNDP
	✓ USAID

Source: Created by the survey team using CCCCC Plan

In addition, CCCCC has been supported by the governments of countries outside the Caribbean region. The Governments of Italy and Greece have long provided assistance in project financing and operational practices, and the Government of Australia has provided support to strengthen institutional aspects as CCCCC becomes an accredited entity of GCF. Government agencies of the United States, the United Kingdom and Germany have also provided project financing.

²⁶ With the exception of other sector institutions such as agricultural and fishery, and health

9.6 United Nations Development Programme (UNDP)

UNDP, not visited during the survey, signed in March 2023 an agreement with the Government of Canada, acting as a donor, to launch the Strengthening Resilient Water Resource Management in the Eastern Caribbean, a water sector project in three countries in the Eastern Caribbean: Grenada, Saint Lucia, and Saint Vincent and the Grenadines. In November 2023, an inception workshop of the project, abbreviated as W4R, was held in Grenada, where key stakeholders, government officials, experts, and community leaders collaboratively shape the project's implementation strategy and 2024 work plan. Afterwards, the project has completed the initial stages of its preparatory phase, with the hosting of their second inception workshop in St. Vincent and the Grenadines in March 2024.

Through the support of the government of Canada with a financial contribution of CAD 4,847,825, the project aims to support vulnerable communities that are particularly vulnerable to the impacts of climate change, including droughts, floods, and hurricanes, to increase access to secure, nature-friendly water supplies and enhance ecosystem conservation for improved water resources management, both in communities and at the governance level, with an emphasis on supporting women-lead households and rural women farmers.²⁷

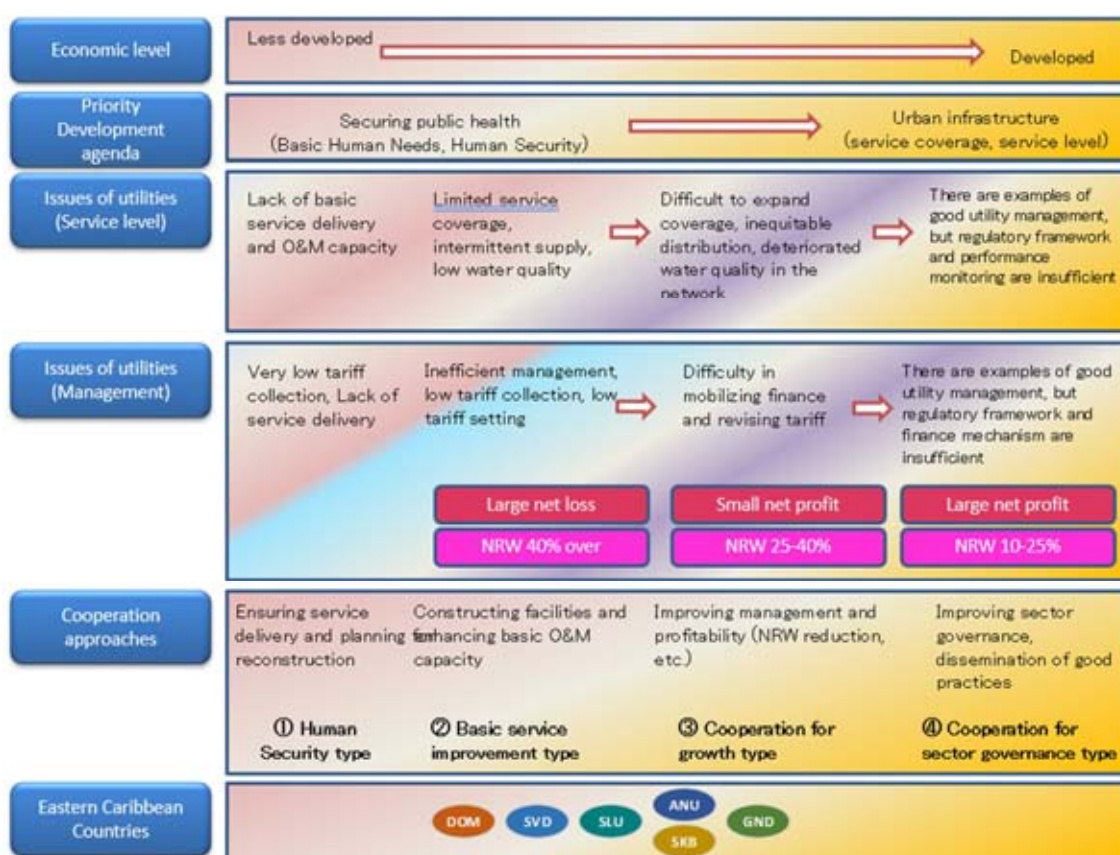
²⁷ The main source of this section is UNDP website.

Chapter 10 Proposals for cooperation contributing to water security

10.1 Current Status of the Water Sector in the Target Regions

10.1.1 Overview of each country's situation

Based on the interview results of the first and second field surveys, the current status of the water sector in each country, which has been described in the previous chapters, is summarized in Table 10-2 and Table 10-3. Figure 10-1 shows the development stages of water utilities according to the JICA Global Agenda No. 19 "Securing Sustainable Water Sources and Water Supply" cluster strategy "Support for Water Utility System Growth".



Source: JICA, edited by JST

Figure 10-1 Criteria for Assessing the Development Stages of Water Utilities (Operational Maintenance and Management, Management Issues)

Table 10-1 shows the economic levels and the status of issues (operational maintenance and management) of water utilities in the six Eastern Caribbean countries. The assessment focuses on per capita GNI (USD), water supply coverage rate, NRW status, net profit margin, and water rate revisions.

Table 10-1 Status of water utilities in each country

	SLU	ANU	DOM	SKB	SVD	GND	Notes
Per Capita GNI (USD) and Classification	12,400 Upper-middle income	19,050 High income	8,430 Upper-middle income	20,020 High income	9,110 Upper-middle income	9,070 Upper-middle income	World Bank (2022)
Water Supply Coverage Rate	98%	90% Rainwater 10%	98%	99%	98%	96%	
NRW Rate	55%	50%	58%	50%	30-40%	40%	
Net Profit Margin	1.4%	N/A Net loss	N/A	1.2%	20.9%	Good at 5% or higher	

According to the World Bank classification (2022), DOM, SVD, SLU, and GND are upper-middle-income countries, while ANU and SKB are high-income countries. Water facilities are generally well developed with coverage rates close to 100%. However, the NRW rate is over 40% in all countries, and some areas suffer from water leakage due to aging distribution pipes, which need to be replaced. In terms of net profit, data is missing for ANU and SKB, but SVD and SLU have less than 5% (usually good if 5% or higher), while GND is good at 20.9%. Water rates have not been revised for about 10 years in all countries except GND, resulting in no increase in revenue. The collection rate of water charges is approximately 100%, suggesting that revision of water rates is desirable to increase revenues.

Considering the above situation, water utilities in each country are considered to be classified as “2) Basic Service Improvement Type” to “3) Cooperation for Growth Type”. The position of the Eastern Caribbean countries is shown in the lower part of Figure 10-1.

The common challenge in each country is to reduce the high NRW ratio and set rates at a level that allows cost recovery. 2) In countries classified as basic service improvement type, a shift from net loss to net profit is needed. In countries classified as 3) cooperation for growth type, it is necessary to improve management efficiency (such as human resource development, system implementation), while ensuring financial health to secure net profits that can be invested in facilities and financing.

Therefore, support will take the approach of technical cooperation or financial cooperation.

Table 10-2 Summary of basic information and water sector conditions in each country (1/2)

Large item	Small item	Saint Lucia	Antigua Barbuda	Dominica	St. Christfirst Navis	Saint Vincent and Grenadines	Grenada	Source (The content of hearing is not shown.)
Social and econom	Nationwide population (2019)	178,583 人	92,117 人	71,428 人	47,712 人	104,924 人	122,724 人	World Bank Open Data
	GDP(2019)	2,103 Mill.US\$	1,725 Mill.US\$	612 Mill.US\$	1,107 Mill.US\$	911 Mill.US\$	1,213 Mill.US\$	World Bank Open Data
	GDP(2019 per capita)	11,773 US\$	18,730 US\$	8,562 US\$	23,205 US\$	8,680 US\$	9,888 US\$	World Bank Open Data
	Tourism population (2019)	1,220,000 人	1,035,000 人	322,000 人	1,107,000 人	392,000 人	526,000 人	World Bank Open Data
Natural condition	National land area	610 krf	440 krf	750 krf	272 krf	390 krf	340 krf	Overview of the embassy of japan
	Annual rainfall (2011-2020 average)	1,087 mm	915 mm	1,108 mm	895 mm	1,099 mm	1,215 mm	World Bank
	CRI against extreme weather hazards	60.3	64.5	33.0	116.0	59.2	39.7	German Watch * Higher risk for lower
Organizational str	Water supply corporation	WASCO (public enterprise)	APUA (Public Enterprises)	DOWASCO (public enterprise)	SKWSD (Governmental Agency)	CWSA (public enterprise)	NAWASA (public enterprise)	
	Number of water utility staff	440 人	850 人	145 人	129 人	290 人	256 人	APUA: Head Office Functions + Water Supply Business Unit
	Number of technical staff	244 人	231 人	102 人	84 人	129 人	171 人	
Water source utili	Surface water (rivers and dams)	100 %	5 %	100 %	30 %	100 %	95 %	
	Groundwater	0 %	5 %	0 %	70 %	0 %	5 %	
	Seawater desalination	0 %	90 %	0 %	0 %	0 %	0 %	ANU: Utilization status in dry season (70% in rainy season)
Water supply busi	Diffusion rate of water supply	98 %	90 %	98 %	99 %	98 %	96 %	ANU: Remaining 10% use rainwater
	Number of connected customers	73,914 nos	27,759 nos	24,000 nos	18,000 nos	40,470 nos	42,719 nos	
	Master plan	Not developed	Not developed	Not developed	Not developed	Not developed	Not developed	
	Maintenance plan (government budge)	-	Seawater 13,500 m3/day addition	-	Deep well 4500 m3/day Freshwater 20000 m3/day	-	-	
	Maintenance program (CDB support)	-	Scheduled to request assistance for pipe renewal	-	-	-	-	
	Maintenance program (UAE support)	-	-	-	Freshwater 136 m3/day*2	-	-	
	Maintenance program (IAEA support)	-	-	-	-	Water Purification Plant and Dist	-	
	Maintenance program (WB support)	-	-	-	-	Small-scale water purification pla	-	
	Development Program (GCF Funds)	To strengthen disaster resilience Reconstruction of water supply system, etc.*Applications are under way.	Expansion of seawater facilities*	To the renewal of pipelines to reduce non-revenue water Extension of distribution reservoir * Application is under	Development of fresh water sou	Seawater facilities*3 *Under application DMA construction * Scheduled application	To strengthen disaster resilience Water system restructuring, etc. *Ongoing	
	Maintenance program (UKCIF/CDB)	-	-	DMA construction* in progress Maintenance of water purification plants*6 locations	-	-	Renewal of water treatment plants and expansion of distribution network	
Use of rainwater	Government Policy Regarding the Use	Recommend use of rainwater	Obligation to install rainwater tanks	In principle, water receiving tanks should be installed instead of sanitary tanks.	Recommend use of rainwater Navis Island is obligatory to install tanks	Mandatory installation of rainwater tanks in Grenadines	Policy to establish the obligation to install tanks in new buildings	
	Utilization of Rainwater	Urban areas: not permeating Rural areas: Used by 60-80% of households	Rainwater tank installation rate: Approx. 100% Treated by activated carbon filtration, etc.	Use only in mountainous areas (government implicit)	St. Kitts: Used in some areas Navis Island: obligatory tank installation	St. Vincent Island: No mandate Grenadin Islands: obligatory installation	Grenada Island: 5% installation rate Kareaka Island and others: 100% installation rate	
	Use of rainwater	Cleaning/Water for sprinkling/Water for daily use	Domestic water including drinking water	-	Water for sprinkling and domestic use	Domestic water including drinking water	Grenada: agricultural water and hotels Kariae Island and others: Water for daily use including drinking water	
	Treatment methods when using domes	Filtration, disinfection or boiling	Filter and disinfect activated carbon	-	Filtration and sanitization	No processing	Disinfection or boiling	
Sewerage business	Number of houses connected to sewages	4,453 nos	0 nos	3,300 nos	0 nos	315 nos	2,000 nos	
	Sewage removal system	Separate sewerage	-	Separate sewerage	-	Separate sewerage	Separate sewerage	
	Sewerage connection ratio	7 %	0 %	NA	0 %	NA	NA	
	Wastewater treatment rate (sewage tr)	3 % (STP 1 nos)	0 %	99 % (Roseau)	0 %	0 % (No STP)	0 % (No STP)	
	Pollution status of public waterways	Untreated sewage discharged to harbor	Untreated sewage discharged to harbor	Some water pollution in city w: river areas	Some water pollution in coastal r quality impact: Soil infiltration to water pollution in the southern r	Discharged only after removal of some sewage sinks		
	Master plan	Not developed	No renewal over 30 years ago	Not developed	Not developed	Not developed	No renewal since 1990	
	Maintenance plan (government budge)	New STP 5,600 in cubic meters per day* Designing stage Planned funding through the government's Blue Bond	-	The preferential area for sewerage development has been established in WSSDP, but no concrete improvement program has been implemented.	-	-	-	
Maintenance program (CDB)	-	Maintenance for reuse of sewage	-	Establishment of Sewage Manags	-	-		
Maintenance program (UKCIF/CDB)	-	-	Sewage treatment plant 320 m3/d	-	-	Drawing of sewage pipe (not including STP)		
Usage of Recycled Sewage Water	Sold to golf course operators for sprinkling water	Unused because there is no sewage treatment plant, but feeling is high because of water shortage	Sewage treatment plants are still unused Residents have a sense of avoidance for reclaimed water	Unused because there is no sewage treatment plant	Unused because there is no sewage treatment plant	Unused because there is no sewage treatment plant Be not customarily familiar		
Water supply stat	Achievement status of 24-hour water supply	Rainy season: 75% of the total Dry season: 24-hour water supply is 60% of the total	Rainy season: 20-hour water supply Dry season: 18-20 hours water supply ※ Vary by region	Rainy season: 7 days a week 24-hour water supply Dry season: 7 days a week 24-hour water supply	Rainy season: 7 days a week 24-hour water supply Dry season: Limited nighttime water supply (80% of the total)	Rainy season: 7 days a week 24-hour water supply Dry season: 8-hour water supply in multiple areas	Rainy season: 7 days a week 20-hour water supply Dry season: 12-hour water supply in some areas	
	Water demand	60,000 m3/d	36,000 m3/d	34,000 m3/d	29,500 m3/d	NA	40,900 m3/d	
	Water supply capacity	73,300 m3/d	32,000 m3/d	32,500 m3/d	31,800 m3/d	32,390 m3/day (actual value for 2022)	33,000 m3/day (actual value for 2022)	The actual value is the average daily water supply
	Water supply: dry season	40,000 m3/d	31,000 m3/d	32,500 m3/d	31,800 m3/d	NA	33,000 m3/d	
	Water supply/water demand: dry se	67%	86%	96%	108%	#VALUE!	81%	
	Water supply: rainy season	60,000 m3/d	31,000 m3/d	32,500 m3/d	NA	NA	45,450 m3/d	

Table 10-3 Summary of basic information and water sector conditions in each country (2/2)

Large item	Small item	Saint Lucia	Antigua Barbuda	Dominica	St. Christfirst Navis	Saint Vincent and Grenadines	Grenada	Source (The content of hearing is not shown.)
Water supply quality	Periodic inspection in the laboratory	Periodic inspection in the laboratory	Periodic inspection in the laboratory	Periodic inspection in the laboratory	Internal inspection conducted in unauthorized labs	Periodic inspection in the laboratory	Periodic inspection in the laboratory	
			10% complaints about taste and color	Few complaints about taste and color	0.5% of complaints regarding taste and color	0.5% of complaints regarding taste and color	Complaint information not collected	
Feed water pressure		15% complaint about water pressure	30% complaint about water pressure	The second most frequent complaint about water pressure	15% complaint about water pressure	2% complaint about water pressure	NA	
Non-revenue water	Water meter installation rate	100 %	100 %	93 %	89 %	100 %	100 %	
	Water meter failure rate	8 %	25 %	NA	20 %	1 %	NA	
	Meter reading frequency	1 time/month	1 time/month	1 time/month	1 time/month	1 time/month	1 time/month	
	Yield rate of water	55 %	50 %	58 %	50 %	30~40 %	40 %	
	Water leakage rate	47 %	NA	30 %	NA	NA	NA	
	Situation of non-revenue water control	Water Distribution Analyses with CDB Support Planning to build a team to cut water-free	Every time based on a water leakage report	There is no water-free reduction unit, and it remains in response after the fact	There is no non-rechargeable water reduction unit.	Planning to build a team to cut water-free	A pilot-scale project is underway in G-CREWS to reduce water use.	
	Status of water leakage detectors	Water leak detector*4-5 units Correlated detector*1 (in fault)	Two water leak detectors*	1 older model of leak detector*	Fujitekomi Leak Detector*1 unit Correlation detector*1	One water leakage detector*	1 older model of leak detector* Correlation detector*1 One conduit detector*provided with G-CREWS	
	DMA construction status	DMA1 compartment constructed Plans are under way to construct	Planning to build DMA	Scheduled construction of DMA *Bidding stage	Undeveloped	Planning to build DMA	Planning to build DMA	
	GIS utilization	In use	ed information that is in use but reduced with CDB support but not utility use (controlled by another or			In use	In use	
	Water leakage history management	Not associated with GIS	Being linked to GIS	Management on a paper basis	Managed by Word	Not associated with GIS	Associated with GIS	
Project for Prevention of Water Recovery	Though it was decided with the pipe renewal plan by CDB support, the budget could not be secured, and it was not carried out.	Preparation of a no-pay water measure plan in APUA A pipe renewal plan including priority list has also been prepared.	Applied for GCF to reduce unacceptable water and increase in reservoir volume	Status of Miya Company's suggestions for a non-catching water reduction programme	We are planning to build a DMA and are looking for donors with a view to applying for GCF.	G-CREWS is planning to reduce non-revenue water, constructing a DMA and a non-revenue water control unit.		
Introduction of smart meters	Planning for verification testing Applied for equipment renewal cost to GCF	50% ⇒ 25% in verification test Applied for equipment renewal cost to CDB	The results of verification tests (50 sites) are being compiled, but all updates are planned.	Planning for verification testing (25 locations)	Switching to Smart Meter	Demonstration tests are being conducted at 146 locations.		
Management status	Accounting system	Corporate Accounting (Private)	Corporate Accounting (Private)	Corporate Accounting (Private)	Corporate accounting is not applied	Corporate accounting (public)	Business accounting	
	Water rate (EC\$ per 20-cubic meter)	71.99	104.95	56.02	33.67	55.49	64.45	
	Rate of withholding tax	110%	NA	NA	72%	115%	100%	For 100% or more Potential inconsistency between billing and toll collection years
	Net sales	50,724,449 XCD (FY2020)	NA	21,175,964 XCD (FY2022)	NA	30,343,718 XCD (FY2022)	42,641,013 XCD (FY2021)	
	Net income	731,837 XCD (FY2020)	NA	-3,522,486 XCD (FY2022)	NA	375,019 XCD (FY2022)	8,920,366 XCD (FY2021)	
	EBITDA	6,586,673 XCD (FY2020)	NA	4,700,353 XCD (FY2022)	NA	4,589,791 XCD (FY2022)	9,789,358 XCD (FY2021)	
	EBITDA margins	13 %	NA	22 %	NA	15 %	23 %	
	Operating profit to total assets	-2.0 % (FY2020)	NA	-0.6 % (FY2022)	NA	0.6 % (FY2022)	6.2 % (FY2021)	
	Ordinary Income to Net Sales	2.5 % (FY2020)	NA	-16.6 % (FY2022)	NA	1.2 % (FY2022)	20.9 % (FY2021)	
	Equity ratio	61.4 % (FY2020)	NA	32.9 % (FY2022)	NA	92.4 % (FY2022)	61.7 % (FY2021)	
Fixed assets capitalization	64.8 % (FY2020)	NA	107.4 % (FY2022)	NA	78.5 % (FY2022)	65.3 % (FY2021)		
Electricity rate	0.37 US\$/kWh	0.35 US\$/kWh	0.46 US\$/kWh	0.28 US\$/kWh	0.34 US\$/kWh	0.33 US\$/kWh	Materials from electric power companies, CCREEE Energy report, etc.	
Integrated water management	Main engine	WRMA	APUA (Dept of Environment)	Not set	Not set	CWSA	NAWASA (P&Development)	
	Planning status	IWRM Roadmap 2008 / SASAP	Environment Protection Act	NIWRM 2011(Draft)	None	None	NAWASA Act	
	Water Rights Body	WRMA	APUA	Ministry of Public Works	NA	CWSA	Undeveloped	
	Water rights legislation	Water and Sewerage Act	The Public Utilities Act	Yes	Watercourses and Waterworks Act	None	Undeveloped	
Maintenance and monitoring	Number of staff/number of customers	6.0 staff/1,000nos	8.3 staff/1,000nos	6.0 staff/1,000nos	7.2 staff/1,000nos	7.2 staff/1,000nos	6.0 staff/1,000nos	APUA: Estimated by the number of water supply unit staff
	SCADA utilization	SCADAX (1996)	To be introduced	In use	Unused (budget pending)	SCADAX (2007)	eduled to be introduced in G-CREWS	
	Asset tracking system	Introduction schedule/current Excel control by internal budget	In use	Introduction in progress at CAMS	Unused	Application in GCF	eduled to be introduced in G-CREWS	
	Customer management system	ABECAS insight	Great Plains	BillMaster	Utility Management System	ABECAS insight	NorthStar Utilities Solution	
	Implementation status of customer satisfaction surveys	Not implemented	Not implemented	Not implemented	Not implemented	Not implemented	Be implemented	
Human Resource	Internal training implementation status	Implemented (difficult to secure budget)	Not implemented	Not implemented	Not implemented	Yes (Unknown details)	Single implementation: Sewage field	
	External Training Conditions	CAWASA:WPI ABC testing Employers Federation: Management training JICA Japan training CARIBSAN Projects	CAWASA:WPI ABC testing	CAWASA:WPI ABC testing CWWA:Water Loss Specialist Group wawiner Training hosted by JICA and other donors	CAWASA:WPI ABC testing	CAWASA:WPI ABC testing Training hosted by JICA and other donors	CAWASA:WPI ABC testing GCF: Occupational safety and technical training	

10.1.2 Analysis of problems and causes in each country

Table 10-4 and Table 10-5 attempt to systematize and analyze the problems facing the water sector in each country from the perspectives of human resources, infrastructure (facility development), and finance. The issues identified at Level 4 are presented as problems to be solved. Proposed cooperation plans and Japanese technologies that could help address these issues are summarized. The following outlines each section, leading to the recommendations for future cooperation proposals detailed later.

(1) Shortage of human resources

A common problem in all countries is the shortage of human resources. One identified cause is the lack of domestic universities with engineering faculties. For example, students from OECS countries must attend the University of the West Indies to obtain engineering degrees, with its engineering faculty located in Trinidad and Tobago. Studying abroad offers opportunities for attractive job prospects in other countries or fields, resulting in a shortage of returning graduates to work in the water sector. In addition, employees who gain experience and qualifications within water utilities often leave for other opportunities. Addressing the recruitment of new personnel requires significant societal changes, making early solutions difficult and requiring long-term efforts. The perception of staff shortages may also be due to inefficiencies in work processes. Therefore, in the short term, the focus should be on optimizing the use of limited current human resources. Solutions include expanding training programs and establishing management systems and structures that do not rely on individual skills.

(2) Insufficient water supply

Insufficient water supply can be temporary due to natural disasters or droughts or chronic when supply capacity fails to meet demand. Various measures are being implemented with funds like the GCF to strengthen resilience to the impacts of climate change. However, a common challenge across countries is the high rate of leakage (Leakage rates were confirmed only in St. Lucia and Dominica out of six target countries; 47% compared to 55% of NRW (St. Lucia), and 30% compared to 58% of NRW (Dominica), respectively, showing the physical loss is relatively high. The same situation is presumed in other target countries.). Even with plans to reduce NRW, some countries lack the implementation units needed for effective action. There is a strong need for support in the implementation of NRW reduction plans.

(3) Financial pressure on operations

The high rate of NRW related to the above leakage issue is a significant factor putting pressure on operating finances. Water utilities in all countries share the expectation of resolving this issue, with many showing a strong interest in deploying smart meters to

improve the situation. In addition, many utilities are struggling with customer service, which requires a significant amount of daily labor. They often lack GIS registration for complaint locations or do not conduct customer satisfaction surveys. Strengthening customer management systems to improve financial situation of water utility is a common challenge.

(4) Water quality and environment

Perceptions of the need for sewerage development vary from person to person. In general, because there are no direct impacts such as pollution of water sources, and because future population growth is expected to be slow or declining, it is not perceived as a pressing issue. However, in St. Lucia and Antigua, untreated sewage is discharged into the harbors of tourist areas, causing odor complaints and highlighting the need for sewage treatment facility development.

Table 10-4 Cause analysis tree diagram for each Country (1/2)

Level 1	Level 2	Level 3	Level 4: Problems to be solved	SLU	ANU	DOM	SKB	SVD	GND	Count	
Shortage of human resources	Difficulty in securing new staff	Insufficient personnel who satisfy the requirements for work qualifications due to a spill of human resources overseas	Be less attractive in terms of pay	-	✓	-	✓	✓	-	3	
			New jobs are difficult due to shortage of government budget	✓	-	✓	✓	-	-	3	
	Lack of personnel capacity	Lack of training opportunities for human resource development	Water utilities do not have personnel rights	-	-	-	✓	-	-	1	
			Shortage of budget for training implementation	✓	-	✓	✓	✓	-	4	
			Lack of training details (field, trainer, text)	✓	✓	✓	✓	✓	✓	6	
	Inefficient operation		Insufficient space to share knowledge gained through external training	-	✓	-	-	-	-	1	
			Non-integration of various control systems. (GIS linkage not implemented)	✓	-	✓	✓	-	GCF	3	
Insufficient water supply	Water shortage during the dry season	Increased drought frequency due to decreased surface water sources	Have little back-up water sources	✓	✓	-	✓	✓	✓	5	
			Lack of water storage capacity	Steep topography poor water storage function of the island itself	✓	-	-	-	✓	-	2
				Reduction of reserved water by sedimentation at the bottom of dam	✓	-	-	-	-	GCF	1
	Insufficient water supply during disasters	Water cut-off due to damage to water intake facilities and pipeline facilities	Preparation of back-up water supply from other systems	✓	✓	✓	✓	✓	✓	6	
			Vulnerability of each facility to disaster risks	(GCF)	✓	(GCF)	(GCF)	(GCF)	(GCF)	1	
			Lack of reservoir capacity	(GCF)	✓	(GCF)	✓	(GCF)	✓	3	
			Stopping water supply beforehand to divide the inflow of raw water with high turbidity	Lack of reservoir capacity	(GCF)	✓	(GCF)	✓	(GCF)	✓	3
	Insufficient water supply	Lack of facility capacity	Shortage of facility maintenance budget	Preparation of disaster BCP planning and disaster response manuals	-	-	-	(GCF)	✓	GCF	1
				Expenses for imported materials and equipment increase	✓	✓	✓	✓	✓	✓	6
		Inadequate water source management and inefficient use	Decrease in water supply capacity due to aging facilities	Undeveloped asset management plan	The Integrated Water Resource Management Plan has not been established.	(GCF)	-	-	✓	✓	-
Shortage of personnel for integrated water resource management agencies					✓	✓	✓	✓	-	✓	5
Water Source Management Department not yet developed					-	-	-	✓	-	-	1
Lack of survey of new groundwater sources					✓	-	✓	GCF	GCF	✓	3
Lack of a water source monitoring system					-	-	✓	✓	✓	✓	4
High water consumption by inhabitants	Low awareness of water conservation among inhabitants	Water rights are not established and mandated.	Law related to water rights not developed	-	-	-	✓	-	✓	2	
			Existence of farmers who take water illegally by ignoring water rights	✓	-	-	-	-	-	1	
			Cases in which farmers graze occupied near wells	-	(GCF)	-	-	-	-	0	
	High dependence on tap water in domestic water	High dependence on tap water in domestic water	There is no policy on land use.	There is a sense of avoidance in the use of tap water containing chlorine.	-	(GCF)	-	-	-	-	0
				Lack of resident awareness	-	-	-	✓	-	-	1
				Rainwater is not used thoroughly.	✓	-	✓	✓	✓	✓	5
Insufficient water distribution management	Water volume control not implemented	SCADA not utilized	Non-widespread use of sewage recycling	✓	(GCF)	✓	✓	✓	✓	5	
			Monitoring and control of all facilities by SCADA was not implemented.	-	✓	-	some count	-	GCF	1	
			No DMA has been constructed	✓	✓	✓	✓	✓	GCF	3	
			Improper asset-management (AMS not introduced)	-	-	GCF	✓	✓	GCF	2	
High water yield rate (physical loss)	Deterioration of pipeline facilities	Improper asset-management (AMS not introduced)	Monitoring and control of all facilities by SCADA was not implemented.	some count	-	some count	✓	(GCF)	(GCF)	1	
			Inadequate pipeline renewal plan	-	-	✓	✓	✓	✓	4	
			High cost, low quality, and time required for procurement because of imported materials	✓	✓	✓	✓	✓	✓	6	
	Generation of stolen water	Lack of resident awareness	Lack of training system	Lack of resident awareness	-	✓	✓	✓	-	-	3
				Lack of training system	-	-	-	-	-	-	5
	Lack of leakage repair technology and knowledge	Lack of leakage repair equipment	Shortage of water leakage detection equipment	Lack of heavy excavation equipment and reliance on rental	✓	✓	-	✓	✓	✓	5
				Pressure reduction valve not installed in the water pipe network with difference in elevation	✓	✓	✓	✓	✓	✓	6
				Increase in pipe water pressure due to capacity expansion (increase in water supply volume)	✓	✓	✓	✓	✓	✓	5
	Inadequate pipe pressure	Improper leak repair history management	Linkage with GIS not implemented	Linkage with GIS not implemented	✓	some count	✓	✓	✓	-	4
				Non-revenue water reduction team not built up	✓	✓	✓	✓	✓	GCF	5
Squeeze on business firms	High yield water rate (commercial loss)	There are many faults in the water meter.	Existing meter is low in quality	✓	✓	-	-	-	-	2	
			Aging of existing meters	✓	✓	✓	✓	✓	✓	6	
			Blockage due to scale formation	-	✓	✓	-	-	-	2	
			Low water meter inventory due to insufficient budget	✓	-	-	✓	-	-	2	

Table 10-5 Analysis tree diagram for problems in each country (2/2)

		✓:Applicable, (Donor Name): Planned, Donor Name: Present								
Level 1	Level 2	Level 3	Level 4: Problems to be solved	SLU	ANU	DOM	SKB	SVD	GND	Count
		Misreading during meter reading operations	Lack of training for meter reading work	✓	✓	-	✓	-	-	3
			Government has not paid fees for using public faucets, etc.	✓	✓	✓	✓	✓	-	5
			There is a plan to reduce non-toll water, but the countermeasures will not be advanced due to funding difficult	✓	-	-	-	✓	-	2
	High water yield rate (physical loss)	As in the previous separate section								
	Water tariff hike not realized	Water utilities have no decision and no approval from the government	Low government awareness of improved water supply management	✓	-	✓	✓	-	✓	4
		Low willingness of inhabitants to pay water charges	There are many complaints because water service is low level.	✓	✓	-	✓	✓	✓	5
			Frequent disconnection of water causes air to enter the piping, causing the meter to malfunction.	✓	✓	-	-	-	-	2
		Low water conservation awareness due to low rates	Insufficient public awareness	-	-	-	✓	-	-	1
	Have a high production cost	Dependence on desalination facilities	Have to depend on the fresh water because of its lack of surface water sources	-	✓	-	-	-	-	1
			Electricity unit price and chemicals are high because they are islands.	(GCF)	✓	(GCF)	✓	✓	GCF	3
	Lower water supply services	Staff have poor customer response experience	Lack of training on customer response	✓	✓	✓	✓	✓	✓	6
			Undertaken customer satisfaction survey	✓	✓	✓	✓	✓	-	5
		Insufficient customer management system	Shortage of staff	✓	✓	-	✓	✓	✓	5
		Points of complaint are not identified.	Linking with GIS has not been performed.	✓	✓	✓	✓	✓	✓	6
		Low water supply quality (detection of coliform bacteria from groundwater)	Inappropriate water source setting	-	-	-	✓	-	-	1
Water quality environment	Complaints about deterioration of water quality in public waters	Sewage treatment plant not yet developed (untreated discharge)	The master plan for sewage system is not developed or renewed.	✓	✓	✓	✓	✓	✓	6
			Poor awareness of sewage maintenance priority	✓	✓	✓	✓	✓	-	5
			Shortage of facility maintenance budget	✓	✓	✓	✓	✓	✓	6
		Untreated discharge of miscellaneous wastewater (septic tank maintenance area)	Loading of septage into sewage pipe drain + Untreated discharge	✓	-	✓	-	✓	✓	4
			Untreated sewage discharge outlet to the ocean is closer to the coast	time count	-	-	-	-	-	0

10.1.3 Good practices in the water sector in each country

Table 10-6 organizes the good practices in the water sector of each country, derived from the results of the current survey, by area. Creating opportunities to objectively organize and share such practices can lead to the horizontal dissemination of knowledge and experience of good practices within the region (in particular, the items underlined in the table are expected to have a positive impact through horizontal dissemination).

Table 10-6 Good practices in the water sector in each country

	Saint Lucia	Antigua Barbuda	Dominica	St. Christfirst Navis	Saint Vincent and Grenadines	Grenada
Water sector structure	Water-resource monitoring and control (WRMA)			Ministry of Health has its own water quality testing laboratory to monitor tap water quality		
Outline of water supply business					Implementation of cross-communication of water supply systems within the island as a response to water shortages	Establishment of national water supply standar
Tap water source	<u>Facility to drain sediment in the dam</u>	Measures to monitor electrical conductivity and stop water intake to minimize salinization of well water sources		Construction of seawater freshwater facilities		
Integrated water resources management (IWRM)	Water intake policies and regulations (WRMA) <u>Development of IWRM road map</u>					Laws and regulations and IWRM planning
Water facilities	Switch to HDPE to strengthen resilience	Water pipe control by ArcGIS DMA construction	Switch to HDPE to strengthen resilience	<u>Discontinue use of public faucets due to water conservation and underpaid fees</u> Switch to HDPE to strengthen resilience	Switch to HDPE to strengthen resilience Manage water sources, facilities, and pipelines in ArcGIS	The government pays for the utility faucet's water charge
Facility operation • Maintenance and management	A water quality laboratory accepts an outside inspection request. <u>Examine all WHO criteria for raw water and purified water quality once every four months</u>		Inspect all WHO criteria annually for raw and purified water quality Water is sampled once a week from the water tap in each area and inspected (e.g., coliform, residual chlorine, turbidity) A water quality laboratory accepts an outside inspection request. Introduction of SCADA	Introduction of SCADA Examine all items of WHO standards	Introduction of SCADA (Raw water turbidity monitoring) High awareness of energy conservation due to slow filtration method for water purification and natural downward flow method for water distribution SOP and manuals have been prepared	
Non-revenue water management	Incentives for water theft detectors (not currently implemented) Database of water leakage repair history	Prepare plan to reduce non-revenue water <u>Leakage repair history is being linked to GIS</u>			<u>Implementation of water distribution analysis</u>	
Water rate		Government approval for raising commercial water rates (scheduled for March 2025)				Revised water charges in 1993, 2010 and 2020 (prepared by an external consultant, submitted to the Cabinet after evaluation/approval by NAWASA's board of directors) <u>Examination of rate system reflecting climate change adaptation measures (e.g. rainwater use)</u>
Customer Management				There are poor homes, public toilets and public baths.		
Use of rainwater	<u>WAMA prepared manuals for the treatment and use of rainwater and released them to the public</u>	Obligation to install rainwater storage tanks in accordance with the Building Law				
Natural disasters • Climate change	<u>Preparation of draft disaster management plan (unapproved)</u>		<u>Formulated Business Continuity Planning (BCP) and Accident Management</u>		<u>Prepare manuals for dealing with hurricanes for CWSA</u>	<u>Formulated Business Continuity Planning (BCP) and Accident Management</u> Emergency operation manual is under development.
Sewerage facilities	Reuse of treated sewage as water for sprinkling + sales Use of sewage treatment plant as a school field trip Free distribution of sewage sludge (solar drying) (for agricultural use)		Installation of community-scale septic tanks With O&M manual Installation of oil traps for household use Sewage water discharged from the coast at 457m locations <u>Seawater quality measurement once every three months</u>		<u>Untreated sewage is discharged from the coast at 1,440m position</u> Clean the clogged sewer using water for fire hydrants.	
Human Resource	Training in CAWASA and use of the test certification system <u>Use of St. Lucia Employers Federation training Materials for training in Japan are compiled into a data base and shared with staff (WRMA).</u>	The Training Department provides training. Training in CAWASA and use of the test certification system <u>Employees are provided with e-learning by introducing a Ela320 learning control system. (There are teaching materials, exercises, and tests.)</u>	Utilization of U.S. ABCtesting (O&M Qualification Programme) Overseas training held in other countries Keep teaching materials for training in Japan on the server and share them to staff (Engineering Department only) There is an opportunity to share the results of training (inside and outside the department)	Training in CAWASA and use of the test certi	Training policy (purpose, training requirements, cost burden, etc.) Store training materials in the server and share them to staff (Engineering Department only)	Established annual training development plan Formulate training policies <u>Water conservation publicity in progress</u>

10.1.4 Ongoing and planned projects in each country

To avoid overlap with the future cooperation plans proposed in this survey, the ongoing and planned projects described in Chapters 2 to 8 are organized below. Table 10-7 summarizes the overview and implementation status of projects submitted to the Green Climate Fund (GCF). Table 10-8 summarizes other projects funded from national budgets or supported by donor agencies, and Table 10-9 organizes the timelines of each project identified in this survey.

(1) Projects submitted to the GCF

All the countries surveyed have projects submitted to the GCF. These applications cover a wide range of areas, from capacity building, legal and institutional framework development, water resources management enhancement, water system strengthening, NRW reduction, seawater desalination, rainwater harvesting, water reuse, to the use of renewable energy, mainly aimed at overcoming vulnerability to climate change and natural disasters.

Among the countries surveyed, Grenada (GND) is the most advanced, with its Funding Proposal approved in March 2018, and the "G-CREWS" project, the largest ever in the country's water sector, to be implemented from 2019 to 2025. Following GND, significant progress can be seen in St. Christopher and Nevis (SKB) and St. Vincent and the Grenadines (SVD). SKB is expected to submit the Funding Proposal for the "SKN TransWater Project" within the Project Preparation Facility starting in 2024¹. SVD, which submitted a Concept Note in March 2020, experienced delays due to the COVID-19 pandemic and a volcanic eruption, but resumed in late 2023 and plans to submit the Funding Proposal in the first half of 2024 (see the Chapter 7 for details). Other countries, such as St. Lucia (SLU), Antigua and Barbuda (ANU), and Dominica (DOM), are all working to finalize their Concept Notes before submitting Funding Proposals, and show a similar level of progress.²

In the case of GND, it took more than three years from the submission of the Concept Note in May 2016 to the start of the project in November 2019, highlighting the lengthy process involved in implementing such projects.

(2) Other ongoing and planned projects

Donor agency-supported projects include large-scale facility development and technical assistance in DOM, supported by the Caribbean Development Bank (CDB) and the United Kingdom Caribbean Infrastructure Partnership Fund (UKCIF). GND also launched a

¹ In March 2020, SKB submitted a Concept Note titled "Building Resiliency in the Water Supply Sector in St. Christopher and Nevis" to the GCF fund. According to the hearing with SKWSD, the "SKN TransWater Project" is the same project.

² In St. Lucia (SLU), the Readiness and Preparatory Support Program is currently being implemented to finalize the Concept Note submitted in April 2023.

similar project in February 2024 with support from CDB and UKCIF. SLU has a planned technical cooperation project with CDB support. SVD is implementing two small projects with support from the World Bank (WB) and the International Atomic Energy Agency (IAEA). In SKB, a small-scale seawater desalination facility is being developed with support from the UAE government.

In countries severely affected by climate change, such as SLU, ANU, and SKB, seawater desalination plants are planned or underway to secure more stable water sources. ANU is developing these facilities with its own funds and is expanding existing ones through public-private partnerships (BOT method). SKB is constructing a seawater desalination facility with a capacity of approximately 9,100 m³/day, which is expected to be completed and operational in 2024 with funds from the national budget.

(3) Unaddressed areas

Table 10-10 and Table 10-11 reorganize the content of ongoing and planned projects in each country by area. Areas not listed are considered unaddressed (including planned) areas.

Table 10-7 Outline and implementation status of projects currently under application for GCF funds in each country

Target country	Project name (※1)	Implementation status	Project budget (USD)	Description of Businesses	State-designated agency (NDA)	Certificate Authority (AE)	Implementing agency	Date of submission
SLU	Readiness Proposal Mainstreaming Climate Resilience into Water Sector Planning, Development and Operations in St. Lucia	In progress (2 years)	850,000	The aim is to support capacity building and functional enhancement of WASCO for climate resilience enhancement in planning, development and operation, with particular emphasis on the improving resilience and reliability of water supply and sewage services and the planning and development of water supply and sewage projects for resilience enhancement. The three expected outcomes are as follows. 1. The relevant organizations establish appropriate capabilities, systems and networks to support the planning, organization and implementation of GCF Fund's activities. 2. Improving the quality of concept notes to be prepared and submitted (at least one concept note in the water field is finalized and submitted and approved) 3. Increase the number of PPF (Project Preparation Facility) requests and approved rate of Funding Proposal.	Department of Economic Development	—	<i>Implementing Partner:</i> CDB	Approved in February 2023
	Concept Note Mainstreaming Climate Resilience into Water Sector Planning, Development and Operations in St. Lucia	Planned	50,000,000 (43,000,000 for GCF grants; 7,000,000 for CDB and WASCO cofinancing)	It is composed of the following four contents. 1. Strengthening climate-resilient water governance 2. Strengthening Integrated Water Resources Management Resilient to Climate Change 3. Strengthening water supply systems to withstand climate change Reconstruction and improvement of water supply systems (intake, water purification plants, distribution reservoirs, etc.); implementation of water leakage reduction programs using smart meters and water leakage monitoring and reduction software; promotion of energy-efficient water supply facilities; development of asset management (AM) plans; and asset management by GIS · SCADA. 4. Enhancement of climate change resilience and sensitivity of residents Funding aid for the installation of rainwater harvesting systems, and resident enlightenment and education	Department of Economic Development	CDB	<i>Executing Entity:</i> UNOPS <i>Implementing Partner:</i> WASCO, WRMA, NURC, SLDB	First draft submitted in April 2023
ANU	Concept Note Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda	Planned	65,000,000 (32,000,000 are GCF grants, 10,000,000 are subordinated loans, and 23,000,000 are planned for grant funding from governmental and other sources.)	It consists of the following six items. 1. Increased use of surface and groundwater resources: Improving the storage capacity of Portworks dams and supplying water to agricultural communities 2. Strengthening institutional arrangements for water resources and water supply management, including implementation of integrated water resource management 3. Improvement of distribution network to reduce water loss 4. Introduction of 2 MW scale off-grid electricity for pumping and power generation aiming at realizing carbon neutral 5. Expansion of sewage treatment in McKinnon's areas. Reuse of wastewater from hotels and households 6. Expansion of seawater desalination facilities	Ministry of Finance and the Department of Environment	Department of Environment	Executing Entity will be decided in Funding Proposal	First draft submitted in April 2018 <u>Scheduled to be re-submitted in May 2024</u>
DOM	Concept Note Dominica - Climate Elucidation for Adaptive Resilience in the Water Sector (D-CLEAR-Water)	Planned	71,633,942 (45,510,650 are GCF grants, 24,700,000 are DfID-UKAID grants, and the remainder is planned with internal funding from DOWASCO)	DOWASCO and Climate Resilience Execution Agency of Dominica (CREAD) are designed to complement and support the ongoing Water Sector Strategic Development Programme (WSSDP). The program contents are as follows. 1. Hydrological information tools for water resources management Tools for hydrometeorological monitoring and data acquisition and integrated water resource management 2. Water supply management resilient to climate change Building a water supply system management model, utilizing hydraulic information, and introducing a decision support system for climate change 3. Water services resilient to climate change Enhancement of water security through NRW reduction, renewal of pipe networks and expansion of distribution reservoirs, utilization of renewable energy, introduction of community water supply systems, etc. 4. Capacity building for climate change adaptation management 5. Public awareness and communication	Ministry of Health	CCCCC	DOWASCO	First draft submitted in December 2020 <u>After re-submission in August 2023, after comments, it is submitted again.</u>

Target country	Project name (※1)	Implementation status	Project budget (USD)	Description of Businesses	State-designated agency (NDA)	Certificate Authority (AE)	Implementing agency	Date of submission
SKB	Concept Note Building Resiliency in the Water Supply Sector in St. Christopher and Nevis	Planned	41,800,000 (38,300,000 are planned for GCF grant funds and 3,500,000 are planned for private fund utilization)	It is composed of the following four contents. 1. Development of water supply facilities with superior reliability and resilience Development of new water sources including seawater desalination, integration of water delivery systems, expansion of water distribution reservoirs, introduction of water distribution monitoring systems, conclusion of preliminary agreements on power supply, etc. 2. Strengthening the organizational capacity of water supply entities for effective and efficient operation Updating management methods such as governance, KPI monitoring, and planning, and introducing a business administration system 3. Development of legal and institutional environments for efficient performance of water utilities Establishment of National Water Strategy, Guidelines and Action Plans, Support for corporatization of water utilities, Establishment of Sewage Management Strategy, Updating of Emergency Response Plans, Support for Establishment of New Water Charges, etc. 4. Project management and coordination	Department of Economic Affairs and Public Sector Investment Planning (PSIP), Ministry of Sustainable Development	CDB	<i>Executing Entity:</i> Ministry of Sustainable Development	First draft submitted in March 2020
	Project Preparation Funding Application Transitioning the Water Supply in St. Kitts and Nevis to a Low Carbon, Climate Resilient Sector (SKN TransWater Project)	In progress (2 years)	1,089,625 (972,425 is funded by GCF and 117,200 by CCCCC)	PPF includes the following activities, as well as the preparation of Funding Proposal. 1. Pre-FS, FS and project-planning (technical) project-assessment, assessment of drought impacts and sea-level rise risks, water balance analyses, mapping and assessment of groundwater sources, FS of two seawater desalination facilities, etc. (Operation) Water leakage detection, evaluation of customer information systems, water audit, evaluation of water supply enhancement and water demand management, water demand prediction, and formulation of O&M plans, etc. (Law and system) Support for the establishment of water resources management authorities, water fee survey, investigation of intention to pay fees, evaluation and advice on laws, finances, taxes, regulations and governance, etc. Economic and Financial: Analysis of Economic, Financial, and Cash Flows 2. Implementation of environmental, social, and gender surveys 3. Risk assessment 4. Other project preparation activities	Department of Economic Affairs and Public Sector Investment Planning (PSIP), Ministry of Sustainable Development	CCCCC	Ministry of HealthWSD, NWD/IWRM, SKELEC, NEVLEC, NEMA	Approved in December 2023
SVD	Concept Note Climate Elucidation for Adaptive Resilience in the Water Sector in St. Vincent and Grenadines (SVG-CLEAR-Water)	Planned	53,945,883 (44,657,841 planned for GCF grants, with the remainder planned for CWSA internally and for GEF-IWEco projects)	It consists of the following six items. 1. Water source management that is resilient to climate change Groundwater mapping, monitoring and evaluation, surface water monitoring and evaluation, water quality monitoring, hydraulic data management, integrated water resource management tools 2. Water supply management resilient to climate change Building a water supply system management model, utilizing hydraulic information, introducing asset management tools, and introducing a decision support system for climate change 3. Water services resilient to climate change Incorrect water reduction and groundwater source development, renewal of pipe networks, expansion of distribution ponds, renewal of water intake facilities, promotion of introduction of domestic water storage tanks, introduction of community-based water supply systems, etc. 4. Capacity building for climate change adaptation management 5. Public awareness and communication 6. Project management	Ministry of Finance, Economic Planning, Sustainable Development and Information Technology	CCCCC	CWSA	First draft submitted in October 2020 <u>Restart in late 2023 and Funding Proposal is now being prepared</u>
GND	Funding Proposal Climate Resilient Water Sector in Grenada(G-CREWS)	In progress (6 years) ※Until 2025	EUR €42,057,000 (35,290,000 are GCF grants, 2,500,000 are BMUB grants, and the remaining 4,267,000 are	It consists of the following five items. 1. Water governance resilient to climate change Establishment and authorization of water resources management units, cross-sectional introduction of climate resilience to water sector policies, planning and regulations, and the introduction of climate change adaptable water rates 2. Climate-resistant water customers Challenge Fund for Commercial Water Users (Tourism and Agriculture), Resident Enlightenment and Education	Department for Economic and Technical Cooperation (DETC) of the Ministry of Finance, Energy, Economic	GIZ	<i>Executing Entities:</i> • MoFE, Grenada Development Bank (GDB), GIZ <i>Beneficiaries:</i> NAWASA, Grenada public	Approved in March 2018

Target country	Project name (※1)	Implementation status	Project budget (USD)	Description of Businesses	State-designated agency (NDA)	Certificate Authority (AE)	Implementing agency	Date of submission
			funded by Grenada)	<p>3. Water supply systems resilient to climate change Water supply systems resilient to climate change (expansion of distribution ponds, sustainable use of groundwater sources, development and implementation of maintenance and management plans for existing and new facilities, joint rainwater storage systems) Medical centers resilient to natural disasters and water supply systems resilient to natural disasters (improvement of Sabo dams and river water intakes, introduction of SCADA systems, formulation of emergency response plans)</p> <p>4. Additional contributions of the water sector to the GHG-reduction target (Grenada's NDC) Utilization of renewable energy. Implementation of NRW reduction. (NRW management based on water balance, introduction of GIS based facilities/customers management system. Effective pipe renewal)</p> <p>5. Regional Learning and Lateral Deployment (Lateral Deployment of Lessons Obtained in Caribbean Countries)</p>	Development, Planning & Trade (MoFE)			

※1 GCF Secretariat provides feedbacks and advice to Funding Proposal of Concept Note as a preliminary step in its Funding Proposal to Concept Note fund, so GCF can be efficiently finalized. Additional support menus include Readiness and Preparatory Support Programme, including Concept Note creation support, and Project Preparation Facility, including Funding Proposal creation support.

Table 10-8 Overview and implementation status of other planned and ongoing projects

Target country	Project name	Implementation status	Project budget (USD)	Description of Businesses	Fund Source	Implementing agency
SLU	Caribbean Action for Resilience Enhancement (CARE) Programme	Planned	749,619	This is a technical assistance project with CDB support aimed at improving the reliability, resilience, and sustainability of water supply and sanitation services. Develop a master water supply and sewerage plan resilient to climate change, strengthen the capacity to assess climate change risks, and implement plans for capital investment resilient to climate change. It is implemented by Caribbean Action for Resilience Enhancement (CARE) Programme of CDB.	CDB	WASCO
	—	—	—	As a measure to cope with the growing demand for water and the impacts of climate change, the plan is to introduce 20,000 m ³ /day of seawater desalination facilities into the Gross Eilet located in the northern part of the island in the future. However, no concrete movement has been observed at this point.	Undetermined	Undetermined
ANU	—	In progress	—	A Bethesda seawater desalination facility (facility capacity: approximately 14,500 m ³ per day (3.2 million gallons per day)) is being constructed under APUA's own budget, and is expected to be completed by the end of 2024.	Self budget	APUA
	—	In progress (from March 2024)	—	In March 2024, APUA and Seven Seas Water Group signed a 12-year partnership agreement with PPP, and Ffryes Beach and Ivan Rodrigues are planning to carry out expansion work for two seawater desalination facilities using BOT method. This is expected to increase capacity by approximately 13,500 m ³ per day (3 million English gallons per day). According to interviews with APUA, Ffryes Beach and Ivan Rodrigues are expected to be completed in October 2024 and April 2025, respectively.	PPP contract (Private Funds)	APUA
	—	Planned	—	APUA is considering the introduction of smart meters and the request for financing assistance to donors for pipe renewal. For the latter, APUA is preparing a pipeline renewal plan, which requires approximately US\$ 20 million for pipe renewal, but currently has only US\$ 4 million in internal funding. It should be noted that the schedule for the time of request, etc. has not yet been determined at the present time.	Unfixed (Scheduled to be requested by a donor organization)	APUA
DOM	Water Sector Strategic Development Plan (WSSDP) Project	In progress (2019-2025)	39,536,050	Technical cooperation: Technological collaboration projects aimed at improving the effectiveness of water infrastructures and climate change resilience, expanding the climate change resilience and treatment capacity of sewerage systems, and enhancing the operating capacity of DOWASCO. Specifically, it will formulate medium-to long-term business strategies for the water sector and identify water supply and sewerage development projects that are resilient to climate change. In addition, the detailed design of priority projects will be implemented. Facility development: 1. Construction of DMA (mains, pressure reducing valve) 2. Maintenance of six water purification plants (packaged water purification plants with minimal flow 250m ³ per hour, SCADA systems, distribution reservoirs, and small hydroelectric power generation) 3. Development of new water supply systems for Roseau Valley and Calibishie (DMA construction, water supply and distribution pipes, pumping stations, water distribution reservoirs, and water intake facilities) 4. Development of new West Coast water supply systems (DMA construction, water pipes, pumping stations, water distribution reservoirs, and water intake facilities) 5. Development of new East Coast water supply systems (DMA construction, water pipes, pumping stations, water distribution reservoirs, and water intake facilities) 6. Preparation of Jimmit sewerage processing facilities (packaged sewerage processing facilities, sewer pipes, and SCADA systems with minimum flow 320m ³ per day)	CDB United Kingdom Caribbean Infrastructure Partnership Fund (UKCIF)	DOWASCO
SKB	—	In progress	—	A desalination plant with a capacity of approximately 9,100 m ³ per day (2 million gallons/day) will be constructed in Vasetail by December 2024.	Government budget	SKWSD
	—	In progress	—	A deep well of approximately 4,500 m ³ /day (1 million gallons/day) is being constructed in Cayon area, which has a serious water shortage.	Government budget	SKWSD
	—	In progress	—	With UAE's support, a solar-panel-equipped desalination plant with a capacity of 136 m ³ /day (30,000 gallons/day) is under construction at two locations, St. Christopher and Nevis.	UAE governments	SKWSD
SVD	Country Programme Framework (CPF) for 2022–2027	In progress (from January 2023)	—	With the loan from IAEA, the groundwater source survey of the whole Vincent island was started from January, 2024, and it is scheduled to be carried out in the future 3 years. CWSA intends to develop groundwater sources in advance of the development of seawater desalination facilities in order to maintain a low-cost structure.	International Atomic Energy Agency (IAEA)	CWSA
	North Windward Water Supply Project - Saint Vincent and the Grenadines Volcanic Eruption Emergency Project (VEEP)	In progress (2022-2026)	42,000,000 ※ Total budget, including	The North Windward Water Supply Project is being implemented as a subproject of the Water Sector Volcanic Eruption Emergency Project supported by the World Bank. In order to strengthen resilience to volcanic eruptions, small-scale water purification plants (with a facility capacity of 70 m ³ /hour) and distribution reservoirs are being developed.	WB	Ministry of Finance, Economic Planning, and Information Technology CWSA

Target country	Project name	Implementation status	Project budget (USD)	Description of Businesses	Fund Source	Implementing agency
			non-water supply			
	—	In progress	—	In order to complement the Dalaway water purification plant and to meet the water demand including commercial water in the dry season, a new water purification plant and distribution pond are being constructed in the François area through CWSA's own budget.	Self budget	CWSA
GND	Water Supply Expansion and Sewerage Improvement Project	In progress (2024-2026)	20,700,000 (Grant Aid)	It will be implemented with the aim of increasing water supply and improving water resources management, mainly in the southern region of the capital city St. Jozu, where the influence of water supply restrictions is especially large during the dry season due to housing, tourism and commercial activities. Includes water purification plant renewal, expansion of the water distribution network and sewerage development in the capital city of St. Georges.	CDB UKCIF British Government	NAWASA

Table 10-10 Unaddressed fields by donor project (Financial assistance)

Target country	SLU	ANU	DOM	SKB	SVD	GND	
Financial Assistance	Water intake	(Restructuring and improvement)	(Improvement of water storage capacity)	Development of new water supply systems in two areas (water intake, water pipes, water distribution reservoirs, pumping stations, and DMA)	Deep well under construction (4,500 m ³ /d) Groundwater source mapping (Water source development)	(Groundwater mapping, monitoring and evaluation) (Surface Water Monitoring and Evaluation) (Groundwater source development) (Renewal of intake facilities) Groundwater source	Sustainable use of groundwater sources Improvement of Sabo Dam and River Intake
	Water Treatment	(Restructuring and improvement)		Six packaged water treatment plants (SCADA, distribution reservoir, small hydroelectric power generation)		Being constructed (1,700 m ³ /d) and a distribution reservoir Under construction (water treatment plant + distribution reservoir)	Renewal of water treatment plant
	Seawater Desalination		Under construction (14,500 m ³ /d) (Expansion of facilities) Scheduled expansion of 2 places (13,500 m ³ /d)		FS 2 places Scheduled construction (9,100 m ³ /d) Under construction (136 m ³ /d) (Seawater desalination facility development)		
	Distribution Reservoir	(Restructuring and improvement)		(Expansion of distribution reservoir)	(Expansion of distribution reservoir) (distribution monitoring system)	(Expansion of distribution reservoir)	Expansion of distribution reservoir
	Water Pipe		(Improvement of pipe network to reduce water loss) (Renewal of water pipes)	(Renewal of water distribution network) Construction of DMA (mains, pressure reducing valve)	(Integrated Water Distribution System)	(Hydraulic data management) (Renewal of pipe network)	Water pipe renewal plan Water distribution network expansion
	Water supply area communication						
	Water supply pipe/Water meter	(Smart meter)	(Smart meter)			(Introduction of Household Water Storage Tank)	
	Water quality					(Water quality monitoring)	

N.B.: () is under planning and application.

Table 10-11 Unaddressed fields by donor project (Technical Cooperation)

Target country	SLU	ANU	DOM	SKB	SVD	GND	
Technical Cooperation	Organization			(Organizational Capacity Enhancement) (Establishment of legal regulations and systems) (Support for incorporation into business entities) Assessment of laws, finances, regulations and governance			
	Management			(Updating of Management Method) (Business Management System) Customer information system evaluation Economic, financial and cash flow analysis			
	Planning	(Master Plan for Water Supply and Sewerage)		Water demand management evaluation Water demand forecasting O&M planning Risk assessment (Establishment of National Water Strategy and Action Plan)	(Water supply system management model) (Utilization of hydraulic information) (Community-based water system)	Facility maintenance plan	
	Water Rate			(Support for establishment of new rates) Water Tariff Study Investigation of toll payment		Introduction of water charges adaptable to climate change	
	Natural Disasters/Climate Change	Enhancement of capacity to assess climate change risks Enhancement of climate resilience capabilities		(Capacity Enhancement of Climate Change Adaptation Management) Assessment of drought and sea-level rise risk	(Renewal of emergency response plan) Assessment of drought and sea-level rise risk	(Climate Change Decision Support System) (Capacity Enhancement of Climate Change Adaptation Management)	Introduction of climate resilience to policies, planning and regulations Emergency plans
	Non-revenue water measures	(Smart Meter and Monitoring Software Program for Water Leakage Reduction)		(Non-recovery water reduction)	Water leakage detection	(Non-revenue water reduction measures)	Non-Revenue Water Reduction: Non-revenue water management based on water balance
	Asset Management	(Planning)				(Asset Management Tool Introduction)	
	GIS	(Asset Management)					GIS based facilities and customers control
	SCADA	(Asset Management)					Introduction of SCADA
	Rainwater Utilization System	(Funding aid for facility installation)					Stormwater storage system
	Integrated Water Resources Management		(Strengthening water resources and water supply management systems)	(Introduction of hydrological information tool, construction of water supply system management model, utilization of hydraulic information)	Water balance analysis Support for the establishment of the Water Resources Management Bureau	(Hydraulic data management) (Integrated Water Resource Management Tool)	Establishment and Authorization of Water Resource Management Unit
	Sewerage	(Water Supply and Sewerage Master Plan)	(Expansion of sewage treatment in some areas)	Sewer (320 m ³ /d), sewer, SCADA	(Strategy for sewage management formulated)		Sewage pipe and drain maintenance
	Water from sewage processing		(Reuse of Hotel and Household Wastewater)				
	Public Awareness	(Climate Change, Education)		(Communication)		(Communication)	Public awareness and education
Environmental Society				Gender survey		Horizontal development of lessons learned from Caribbean countries	

N.B.: () is under planning and application.

10.1.5 Importance of each issue for "water security" in the target area

As shown in "2.3.3 Indicators for water security" in this report, UNU-INWEH lists the 10 items listed in the table below as indicators that measure the current level of water security in each country. In relation to this, the evaluation of the degree of importance of a qualitative problem in the target area and the reasons for the evaluation and, as well as an outline of the status of the efforts being made in the planned or implemented projects in each country are shown in the same table.

Table 10-12 Indicators of water security and efforts by country

Indicator name/Indicator content	Importance	SLU	ANU	DOM	SKB	SVD	GND
1. Drinking water Access to safe water	★★★	△	○	○	○	○	○
2. Sanitation Status of access to safe health equipment	★						
3. Good health Fatality rate due to water-related illnesses	★						
4. Water quality Sewerage connection ratio	★★		△	○			○
5. Water availability Availability of freshwater resources	★★★	△	○		○	○	
6. Water value Efficient water-use USD/m ³	★						
7. Water governance Degree of implementation of IWRM	★★	△		△	○	△	○
8. Human safety Fatality rate due to water-related disasters	★★						○
9. Economic safety Economic losses from floods and droughts	★★						
10. Water resource stability Stability of water resources and water storage capacity	★★★	○	○	△	○	△	○

Note: ○ (in progress), △ (planned)

1. Drinking water: ★★★

The water supply coverage ratio is already high in each country, and rainwater harvesting and water supply tankers are used even in regions where the water source is not widely used, and remote resort facilities often have their own seawater desalination facilities. On the other hand, water is cut off during natural disasters and droughts, and access to water is compromised for temporary and frequent use.

In addition, there are areas where the 24-hour water supply is not achieved even in normal times, and it can be said that improving the stability of the water supply situation is a major issue.

In order to improve access to water during drought periods, some type of facility development is planned or underway in all target countries. Large-scale seawater desalination plants are under construction in Antigua and Barbuda, St. Christopher and Nevis, where surface water sources are scarce, and in planning in St. Lucia. Dominica, St. Vincent and the Grenadines, and Grenada, which have relatively abundant surface water sources, are developing new water treatment plants of varying scales.

2. Sanitation, 3. Good health: ★

In the target region, big problem in the sanitary aspect of the degree which is related to the illness and human life is not observed.

4. Water quality: ★★

In Antigua and St. Lucia, where untreated sewage is discharged into port facilities where cruise ships call, there is concern about the impact on the tourism industry. On the other hand, since there is no direct impact on water sources in each country, the urgency of sewerage development tends to be low.

STPs are being developed in Dominica and sewage pipes are being stretched in Grenada. Antigua and Barbuda will apply to the GCF Fund for the development of sewage treatment systems for sewage reuse.

5. Water availability: ★★★

The availability of surface water sources in Antigua and Barbuda and St. Christopher and Nevis, which have less rainfall and have no natural rivers, is less than that in other countries. The former relies on seawater desalination, while the latter mainly depends on groundwater as a water source. In either case, it can be said that water stress levels are high throughout the year. Other countries, with the exception of Dominica, which has abundant surface water sources, also face problems such as water shortages during the dry season.

With the exception of Dominica, which has abundant surface water sources, water stress is high, and there is no room for the development of groundwater sources to reach the Antigua and Barbuda. On the other hand, groundwater sources are being explored in St. Christopher and Nevis, St. Vincent and the Grenadines. Assuming that the reserves of groundwater sources remain constant, it is essential that water governance efforts be made in tandem to ensure the sustainability of groundwater use, as new sources are developed to exacerbate water stress.

6. Water value: ★

This is an indicator of the economic value generated by water use, and although there is no public data, it is assumed that it is comparatively high in the target countries mainly for tourism, and it is not a particular problem.

7. Water governance: ★★

In many Eastern Caribbean countries, there are no large rivers, and water sources are upstream and dams. For example, there is little concern that the discharge of sewage water upstream will affect the use of water sources in downstream areas. In addition, there is no large-scale agricultural irrigation, and most of the agriculture is rain-fed, so the imbalance in water resource allocation is not a major concern. The importance of integrated water resource management is high given the limited use of water resources, and although both countries are highly concerned, securing a stable water supply is considered to be the first priority.

Currently, only St. Lucia has an independent water resources management organization, and in other countries, water utilities play a role in water resource management. On the other hand, since there are many stakeholders in water resource management, it has become an international consensus that there is a responsibility to coordinate interests and promote the sustainable use and conservation of water resources in a rational manner. In St. Christopher and Grenada, the establishment of a water resources management authority is under way underway as part of the donor assistance project. In addition, St. Lucia, Dominica, St. Vincent, and the Grenadines are planning measures to improve water resources management.

8. Human safety: ★★

Over the last 20 years, 90% of the fatalities caused by natural disasters in the target area were caused by hurricanes, and the remaining 10% were caused by floods. In addition to the strengthening of infrastructure to protect human life, the strengthening of resilience to natural disasters in water supply systems can be regarded as a common issue in each country.

The G-CREWS Project in Grenada is working to increase the water storage capacity of community health facilities. This will allow hospitals to accommodate a certain number of patients even if the water supply is interrupted during natural disasters or droughts.

9. Economic safety: ★★

In terms of water-related disasters, flooding and wind disasters during hurricane seasons can cause direct economic losses to homes and industries. On the other hand, from the perspective of the water supply business, there are only a small number of tourists during the hurricane period, when the flood can be cut off due to damage to facilities, for example, and the impact on the tourism industry is not high. In addition,

they often have water storage tanks and seawater desalination facilities in preparation for water cutoff, so even in the dry season, when the season is high, the impact on the tourism industry is not so great.

10. Water resource stability: ★★★

In relation to the water stress level mentioned above, water supply in the dry season drops to approximately 80% of the wet season supply (in Antigua and Barbuda, the dependency rate on seawater desalination increase during their dry season). Therefore, it can be said that the stability of water resources is low. It can be said that the water supply situation is likely to improve even in the dry season by improving the current situation where the water leakage rate ranges from 30% to 50% in each country.

All target countries are planning or implementing some type of measure. The main measures are to improve seawater desalination facilities and securing the stability of water sources through measures to reduce NRW, and to increase water storage capacity through the expansion of water distribution reservoirs and the introduction of storage tanks. Antigua and Barbuda and St. Christopher and Nevis are working on the construction and expansion of seawater desalination facilities, and Grenada is working on the implementation of a pilot project to reduce NRW and expand distribution reservoirs. On the other hand, the St. Lucia, Dominica, and St. Vincent and the Grenadines are planning to reduce NRW, increase the number of distribution reservoirs, and promote the introduction of storage tanks.

10.2 Identification of Priority Issues in the Water Sector in the Target Regions

Considering the current state of the water sector in the Eastern Caribbean countries, ensuring a stable water supply under both normal and emergency conditions, such as natural disasters and droughts, is a highly pressing water security issue. The population trends in the countries surveyed are either stable, slightly increasing or slightly decreasing. Continuing to develop new water sources without addressing the high leakage rates would likely result in excessive investment. Therefore, it is critical to prioritize improving the current high leakage rates before developing new water sources. In addition, for the water utilities in the Eastern Caribbean countries that suffer from chronic financial shortages, reducing NRW is an urgent issue that cannot be ignored to ensure the sustainability of water operations. In addition to improving leakage conditions, commercial losses must be addressed quickly and effectively.

On the other hand, a common problem among small island states is the lack of resources (human, material, financial), which poses a risk to the sustainability of water operations. Particularly in the Eastern Caribbean, financial constraints lead to fundamental operational problems, such as:

- 1) Insufficient budget for staff recruitment,
- 2) Insufficient budget for facility development and renewal,
- 3) Insufficient budget for purchasing equipment and systems for operation and maintenance,
- 4) Insufficient budget for disaster response and recovery.

Improving operational finances is a major challenge. In addition, as noted above, there is a significant shortage of human resources in each country, and the necessary staff are not being allocated to activities. Although the water utilities take advantage of training programs offered by CAWASA to improve the skills of their limited staff, these programs do not fully address the detailed needs of each country. Even if regional technical training is expanded, there is a risk of brain drain, so it is important to retain skilled personnel in the region. Based on the above discussion, three main priority areas for intervention are detailed below:

10.2.1 Securing human resources and enhancing staff capabilities

As noted above, securing human resources are critical for the water utilities in the Eastern Caribbean. They face challenges in both hiring and retaining staff. Despite high unemployment rates (SVD: 21.6% in 2021, ILO; SLU: 17.4% in 2022, ILO), staffing is a challenge. Reasons include financial constraints for new hires and a lack of applicants with the required civil engineering skills required for water utility jobs. This issue of retaining engineering personnel is particularly challenging for water utilities in the Eastern Caribbean.

Another factor in chronic staff shortages is the inability to retain staff. Employees often leave for higher-paying jobs abroad after gaining experience and skills, leading to repeated cycles of hiring and training new staff. To improve staff retention, it is necessary to provide incentives beyond salaries within the limited budgets.

To their improve water services with the current limited number of staff, it is essential to enhance the capabilities and productivity of each employee. Although water utilities utilize external training programs such as those offered by CAWASA, they lack internal training systems. Knowledge transfer relies on on-the-job training (OJT) without standardized operating procedures (SOPs). Therefore, it is necessary to utilize external training while developing internal training systems to continuously improve staff knowledge and skills. In addition, formalizing the knowledge and experience of skilled staff into SOPs and manuals is critical to maintaining technical skills amid frequent staff turnover.

10.2.2 Improvement of system operations with facility information

To achieve water security and provide a stable and sustainable water supply, the proper operation of water utilities and the maintenance of water facilities are essential. In the Eastern Caribbean, frequent leaks from aging pipes and reduced accuracy of old water meters are becoming evident. These problems stem from inadequate management of basic facility information (year of construction, specifications, location) and maintenance records (accident and leak repairs, customer complaint handling). This inefficiency extends to responses to customer complaints, prolonged water outages during disasters, and inaccurate assessments of financial status.

Asset information should support top management decisions in water utilities by assisting in the development of asset replacement plans, budget acquisition, and justifying water rate revisions, which are common challenges in the Eastern Caribbean. This information can significantly improve water utility operations.

Moreover, water distribution facilities (pipelines) in the Eastern Caribbean are vulnerable to damage from natural disasters such as landslides and flooding. Pre-identification of facility location information (location, pipe type, diameter) of facilities is critical for recovery. Currently, pipeline information is only partially recorded in location information systems and is not regularly updated. Given the high risk of disasters, managing water facility information, especially pipelines, is extremely important.

Even in normal times, integrating and sharing not only asset information, but also customer information, complaint incidents and responses, leak repairs, and billing status across the organization can increase productivity and enable efficient customer complaint handling, thereby improving customer satisfaction through better water service.

10.2.3 Financial improvement and securing water supply through NRW reduction

NRW reduction directly improves the management of water utilities, making it a critical issue for the financially strapped water utilities in the Eastern Caribbean. Addressing this issue can have a significant impact. In addition, from a water security perspective, improving the efficiency of water resource use contributes to ensuring a stable water supply, making this a highly meaningful challenge.

The main current issues related to NRW in the Eastern Caribbean water utilities are as follows:

- Inadequate distribution volume management and the absence of necessary monitoring and control systems or measuring equipment, leading to a lack of accurate baseline NRW data.
- Lack of NRW reduction plans or unimplemented plans due to financial constraints.
- Improper water pressure management in distribution systems, causing frequent leaks in high-pressure areas.
- Insufficient leak detection equipment, aging equipment, and lack of operators, rendering leak detection activities ineffective.
- Leak repairs are done reactively, with shortages of replacement pipes and repair materials.
- Decreased accuracy of water meters (especially domestic meters) due to aging and failure, resulting in increased commercial losses. Meters are used until complaints or failures are detected, with no regular replacement system, resulting in cumulative readings lower than actual consumption.
- Regular replacement of water meters is necessary to maintain quality and accuracy, but budget constraints for purchasing meters and maintaining inventory are issues.

10.2.4 Requests for cooperation projects from each country

During the second survey interviews, the following potential areas of cooperation were presented to the water utilities in each country to determine their priority needs for assistance. The water utilities' prioritization is summarized in Table 10-13, showing a particular focus on NRW reduction, related smart meter implementation, integrated management systems for asset and financial information, and expanded training programs for human resource development.

Table 10-13 Priority of water supply utilities for each area of cooperation

No.	Cooperative field	Priority evaluation for the proposed cooperation					
		SLU	ANU	DOM	SKB	SVD	GND
1	Support for Implementation of the Project for Reduction of Unpaid W	2 nd	1 st	2 nd	1 st	1 st	1 st
2	Support for expanding the training system	3 rd	4 th	4 th	2 nd	2 nd	1 st
3	Support for introduction of reclaimed sewage water use	-	-	-	-	3 rd	5 th
4	Technical support for the utilization of rainwater	-	-	5 th	-	-	6 th
5	Supporting the introduction of smart meters	5 th	2 nd	3 rd	3 rd	1 st	1 st
6	Support for the introduction of integrated management systems	1 st	3 rd	1 st	-	-	2 nd
7	Strengthening support for disaster resilience	4 th	-	6 th	-	2 nd	3 rd
8	Support for introduction of seawater desalination technology	5 th	-	-	4 th	3 rd	4 th

Source: Prepared by JST

10.3 Proposals for cooperation projects

10.3.1 Defining the goals and risks of water security in the Eastern Caribbean

Characterized by small land areas and limited resources, the Eastern Caribbean countries face development challenges common to small island states, such as geographic isolation from international markets. They are also highly vulnerable to natural disasters, such as hurricanes and floods, and the effects of climate change, including prolonged droughts and sea level rise. Water utilities in these countries operate under these constraints, making the importance of water security increasingly important.

Various indicators of water security have been proposed. The UNU-INWEH's 10 indicators include drinking water, sanitation, health, water quality, water availability, water value, water governance, human security, economic security, and source stability. The ADB proposes scoring in five areas³: (i) meeting the water and sanitation needs of all rural communities; (ii) supporting productive economies in agriculture, industry, and energy; (iii) developing vibrant, livable cities; (iv) restoring healthy rivers and ecosystems; and (v) building resilient communities capable of coping with water-related emergencies.

To define water security specifically for water utilities, the basic concept proposed by Mr. Yoshimura, representative of Global Water Japan, is that "*Water security means ensuring sufficient water quantity and safe water quality at the required place and time.*"⁴ This definition includes the elements of place, time, quantity, and quality. In addition, the term "security" implies a strong nuance of addressing not only current risks, but also potential future risks.

Given the various definitions and indicators of water security, the ultimate goal for water security in the Eastern Caribbean, as defined in this survey, is as follows:

[Water Security Goal for Water Utilities in the Eastern Caribbean]

Water utilities in the Eastern Caribbean aim to stably and sustainably supply water with safe drinking quality to all customers nationwide, both now and in the future, through optimized water systems and sound water utility management.

The goal consists of two parts: the goal of providing water to all customers nationwide, and the means to achieve this goal through optimized water systems and sound water utility management. The intention is to ensure the physical stability of the water supply through the optimization of water systems and to guarantee the sustainability of the water supply through the sound management of water utilities.

³ Ref: Asian Water Development Outlook (AWDO) <https://www.adb.org/what-we-do/topics/water/asian-water-development-outlook-dashboard>

⁴ Ref: "Water Security and the SDGs" by Kazunari Yoshimura (2022)

Furthermore, to ensure the stability and sustainability of water supply, risks are classified into three categories: (i) internal environmental risks of the water utilities, (ii) natural disaster risks, and (iii) climate change risks. The basic policy for future cooperation will focus on overcoming internal environmental risks, mitigating natural disaster and climate change risks, or adapting to these risks to ensure the stability and sustainability of water supply.

10.3.2 Basic policies for the cooperation projects

(1) Positioning of support for "Water Security" and growth support for water utilities

The support for "Water Security" in this study can be regarded as support within JICA's Global Agenda No. 19 "Securing Sustainable Water Sources and Water Supply". Considering the description of the cluster strategy, which focuses on "growth support for water utilities," overcoming internal environmental risks within water utilities by strengthening human, material, and financial resources contributes to the sustainability of water services. It can also be seen as a growth-enhancing activity that promotes a growth spiral for water utilities based on improved water services. On the other hand, measures to mitigate and adapt to external environmental risks (climate change and natural disasters) address these risks as barriers to the growth spiral of water utilities⁵ and are effective in emergencies. For water utilities in developing countries in the Eastern Caribbean, support from both "Water Security" and "growth support for water utilities" perspectives is essential.

(2) Consideration of country-specific characteristics in the water sector

In the Eastern Caribbean region, individual countries are small, making it difficult to form capital intensive projects. Therefore, one approach in the water sector is to focus on common issues within the region, such as governance, management systems, and human resource development of water utilities, and to formulate projects targeting the entire Eastern Caribbean region. However, when considering the specific content of technical assistance, it is necessary to take into account the characteristics of the water sector in each target country. For example, countries like Antigua and Barbuda, which rely primarily on rainwater and seawater desalination due to a lack of rivers, face different water security challenges than countries like Dominica and St. Lucia, which rely on surface water. Even common problems vary in severity depending on the characteristics of each country's water sector. From this perspective, we will describe cooperation plans

⁵ The virtuous cycle advocated in JICA Global Agenda No. 19 "Securing Sustainable Water Sources and Water Supply" cluster strategy "Support for Growth of Water Supply Business Systems" for the autonomous growth of water supply businesses consists of "① Improving the level of water supply services ⇒ ② Enhancing customer satisfaction and increasing the number of customers ⇒ ③ Expanding revenue through rate increases, improving operational efficiency, and revising rate levels to improve management and finance and create investment capacity ⇒ ④ Expanding water supply facilities through investment activities ⇒ ①⇒②⇒③⇒④..."

that focus on common issues for the Eastern Caribbean region as a whole, and cooperation plans that focus on individual issues for each country or group of countries with similar challenges. In principle, we consider cooperation plans focusing on common issues as the main candidates but also consider phased cooperation projects for each country based on the severity of the issues and the status of their efforts.

(3) Phasing of Cooperation Projects and Horizontal Deployment within the Region

There are two possible approaches to implementing cooperation projects: (i) dividing a single project into multiple phases, and (ii) implementing multiple phases as separate projects. In the case of (i), it is necessary to finalize target countries, TOR content, budgets, etc., for each phase in advance. This may lead to concerns that a lack of project budget in Phase 1 may affect the support and procurement content of Phase 2. In the case of (ii), there is scope to revise the TOR to apply lessons learned from Phase 1 to Phase 2 as separate projects. Therefore, the approach of selecting target countries based on the need and urgency of support in the first project and then horizontally applying the support to other countries in the second project is considered effective.

(4) Basic policies for the cooperation projects

Based on the results of organizing the priority issues so far, we propose the following three pillars as the main cooperation plans. Details on the content of assistance are described in the next section. As for the efforts of each country, including support from other donors related to the above cooperation plans, as shown in Table 10-10, there are no examples of initiatives for (I) and (II), and support for (III) remains sporadic.

I. Support for securing human resources and improving staff capacity

Although capacity development in specific areas such as operation, maintenance, and water resources management is being implemented through support projects, there are no examples of initiatives aimed at establishing the training system itself, which is an issue related to the shortage of human resources.

II. Support for improving the operational capacity of water utilities through the introduction of asset management

Although some efforts are being made in each country to enter facility information into GIS systems, these initiatives are at an early stage and have not yet reached the stage where the information is being used for decision-making, such as formulating facility renewal plans or securing budgets from top management.

III. Support for implementing NRW reduction plans

The support situation varies. For example, there are cases of support for the formulation of NRW reduction plans, the provision of equipment such as leak

detectors, and the implementation of NRW reduction pilot projects linked to facility improvement projects. However, this is still sporadic, with problems such as unimplemented plans due to lack of budget, broken leak detectors due to lack of maintenance, lack of knowledge on how to use leak detectors, and unestablished NRW reduction teams. Addressing these issues requires medium- to long-term technical support that is closely aligned with the water utilities.

10.3.3 Cooperation plans focused on common issues among the countries

The following details the support content for the three main pillars of the cooperation plans, which focus on common issues in the water sector of Eastern Caribbean countries that are strong candidates for future cooperation plans.

(1) Cooperation plan I: Support for securing human resources and improving staff capacity

Water utilities have difficulty recruiting civil engineers and cannot easily increase their civil engineering staff. Therefore, improving the skills and productivity of existing staff and increasing the retention rate of current staff (preventing turnover) are necessary to compensate for staff shortages. Proper O&M (Operation and Maintenance) conducted by trained staff will enable the provision of high-quality water services to customers.

To ensure the sustainable development and operation of water utilities, the goal is to internalize training so that human resource development can continue. To internalize the training, the following surveys and activities are required:

- 1) Training Needs Assessment
- 2) Organizational and Staff Capability Evaluation
- 3) Evaluation of Existing Training Programs and Systems
- 4) Identification of Challenges in Water Utilities

Based on the results of these surveys, a training program (establishing curricula and training instructors) and the development of SOPs (Standard Operating Procedures) will be implemented. In addition, a career path that serves as an incentive will be designed and presented to staff to improve retention.

The following outlines the necessary information needed to develop the training program: 1) Results of the Training Needs Assessment, 2) O&M measures for responding to natural disasters, and 3) Policies for collaboration with external training institutions.

a) Requests for training topics obtained from each country

Through the first and second field surveys, a training needs assessment was conducted with water utilities in each country, and the requests for training topics are

organized in Table 10-14. The most frequently requested training topics by the countries include:

- In the fields of planning and basic knowledge: IWRM (Integrated Water Resources Management) and hydraulic calculations
- In the field of maintenance technology: NRW reduction, equipment maintenance, GIS utilization, and water quality management
- In the field of management: project, customer, and labor safety management methods

These specific topics highlight the varied needs and focus areas for training among the water utilities in the Eastern Caribbean region.

Table 10-14 Training topics requested from each country

Large item	Small item		Saint Lucia	Antigua Barbuda	Dominica	St. Christfirst Navis	Saint Vincent and Grenadines	Grenada
Planning and basic knowledge	Integrated Water Resource Management and Water Resource Management	4	•	•		•		•
	Hydraulic computation (WaterGEMs)	4	•	•		•	•	
	Water, meteorology, and water science	2	•				•	
	Characterization of animals and plants in rivers	1	•					
	Impacts of climate change on water resources	2		•			•	
	Design of sewerage facilities	2	•		•			
	KPI setting	1		•				
	Literacy Improvement Program (for elementary education)	1		•				
	Environmental and social considerations	1	•					
	Maintenance technology	Water distribution management	4	•	•		•	
Piping technology		2	•	•				
Non-revenue water management		4	•	•			•	•
Equipment training for water leakage detection		5	•	•	•	•		•
GIS manipulation		4	•	•	•	•		
Investigation of wastewater at intake facilities (survey of water source quality)		1					•	
Maintenance and management of equipment, pumps and private power generation		5	•	•	•	•	•	
Membrane filtration operation control (MOC)		1		•				
Water quality management and water quality analysis		4	•	•			•	•
Chlorine disinfection control		1		•				
Management-related	Project management and leadership	5	•	•	•		•	•
	Operation of a waterworks project	1				•		
	Results-based management (RBM)	2		•	•			
	Procurement management	1	•					
	Human resources management	2	•				•	
	Customer Management	5	•	•	•	•		•
	Financial management and project finance	3	•		•	•		
	Asset management	1			•			
	Cost accounting	1						•
	Conflict management	3	•	•		•		
	Communication skills	2	•			•		
	PR	1					•	
	Female empowerment	1		•				
	Data recording and management	3			•	•	•	
	Safety management and occupational health and safety	5	•	•	•	•		•
	Construction management	4	•			•	•	•
	Disaster management	3	•			•		•
	First aid drill	1		•				

b) Support for developing and improving BCP during disasters

Strengthening resilience to natural disasters includes effective hard measures to improve disaster prevention functions against external forces. However, to maintain water supply functions, it is not sufficient to target only a part of the system. Therefore, an extensive water supply system is targeted, which tends to increase duration and cost. Such interventions are already planned or underway through GCF funding and other donor projects.

On the other hand, the disaster BCP (Business Continuity Plan), formulated as a soft measure for disaster prevention, provides measures and action procedures to minimize the impact and continue business operations in the event of a large-scale disaster affecting the water supply business. This manualized approach is effective in areas where securing human resources is difficult because it does not rely on individual skills. Based on best practices from water utilities, the manual begins by collecting and referencing existing disaster and disaster recovery manuals. It will then be revised to suit the specific water utility. It is also important to establish a training system to prevent the manual from becoming a mere formality, and regular training should be conducted in conjunction with the training system.

c) Collaboration with CAWASA

Working with CAWASA, which provides training programs in the target countries, is effective in expanding the training system to achieve a broad positive impact. CAWASA offers certification exams in areas popular with participants, such as water distribution and water treatment. Training and certification in water supply, sewage, and water quality analysis are available at four levels, from Class I to Class IV, which allows for basic learning, and is effective for new employees or those who want to retrain. As an incentive, certificates are issued upon successful completion of post-training exams to maintain motivation.

By completing CAWASA training, participants can learn from basics to applications, contribute to the development of appropriate SOPs, and be appointed as trainers. Providing career paths for skills acquisition by water utilities can provide incentives for staff retention. CAWASA, which has many contracted trainers, can oversee manuals and SOPs developed by water utilities to make them more effective. Using the knowledge gained from training in the Caribbean, manuals and SOPs can be improved from a broader perspective. There are local trainers in the Caribbean, and if internalized training can cultivate trainers to become CAWASA trainers, it can motivate staff and be part of their career path.

In order to promote staff retention, it is proposed to institutionalize a clear career path within the water utilities, with participation in training (establishment of a training system), which strongly justifies the establishment of the training system and

contributes to the improvement of staff skills and retention. In addition, participation in training can be an incentive for appropriate assignment of staff to tasks.

Table 10-15 The number of participants and the number of successful candidates per course in the certification exams provided by CAWASA

Course	Level	Participants	Certified Operators	Pass Rate
Water Treatment	I	30	14	47%
	II	4	3	75%
	III	3	2	67%
	IV	2	1	50%
Water Distribution	I	24	8	33%
	II	14	8	57%
	III	5	2	40%
	IV	4	1	25%
Water Laboratory	I	2	1	50%
	II	1	0	0%
Wastewater Laboratory	I	2	2	100%
	II	1	1	100%
Wastewater Treatment	I	28	12	43%
	II	10	3	30%
	III	2	1	50%
	IV	1	0	0%
Wastewater Collection	I	35	16	46%
	II	2	1	50%
	III	1	0	0%
Very Small Water System	I	1	1	100%
Small Wastewater System	I	1	0	0%
Industrial Waste	I	1	1	100%
Plant Maintenance	I	1	0	0%
	II	1	1	100%
Total		176	79	45%

Source: CAWASA ANNUAL REPORT July 2022 – June 2023

Note: Color categories in the table indicate the number of participants by course.

d) Use of training program in Japan

In the past, Eastern Caribbean countries have sent personnel for in-country training conducted by JICA. JICA provided training on "Water Resources Management and Water Utility Operations in the Pacific Islands and Small Island Developing States" from 2010 to 2018, providing knowledge and technology from Okinawa's water utilities in four main areas: understanding water policy and legal systems necessary for safe and stable water supply; understanding water source development and conservation methods necessary for utilizing limited water resources; understanding and acquiring management techniques for water treatment by biological purification

(slow sand filtration) with low cost and easy maintenance; and water utility operations such as leak prevention, NRW countermeasures, and citizen services.

Trainees developed action plans after the training and implemented them after returning home. Interviews were conducted with returning trainees, and the results are recorded in Chapter 2.7 on the activities and opportunities for collaboration of returning trainees in the water sector. It is important to transform the experience and knowledge gained from previous in-country training into knowledge, not only by sharing training reports and materials but also by sharing and revising the action plans created during the training. Some returning trainees have incorporated their responsibilities into their plans, engaged stakeholders, and implemented their responsibilities. Feedback from these activities is important not only for action, but also for improving manuals and SOPs.

e) Required areas for capacity building

The training content includes both the perspective of individual water utility perspective and the sustainable development perspective of water utility operations. In order to understand the areas where water utilities lack skills and where they need skills, the following should be done:

- Organizational and individual self- assessments
- Setting KPIs and conducting objective operational assessments
- Analyzing customer complaints
- Evaluating existing training and materials
- Studying and considering the introduction of best practices from other countries' water utilities

Identifying the current situation involves confirming discrepancies through self-assessment and objective operational assessments. Issues can be extracted not only from water utilities, but also from customer complaints, providing many opportunities for improvement. Identifying the content, frequency, and location of complaints allows for consideration of improvement methods and preventive measures. Existing training materials should be revised based on reference materials and best practices. Training internalization requires instructor development, and current staff should be involved from the training material improvement stage to deepen their knowledge as instructors.

Based on the results of the analysis, training programs, including training materials, will be developed. The training items listed in Table 10-14, especially those needed to improve business operations, are listed below:

- Asset management
- Facility maintenance methods (inspection and maintenance of equipment and facilities)

- Utilization methods of GIS (customer complaints, leak repair history, asset management)
- Leak detection and repair methods for NRW reduction
- Customer response and complaint handling
- Inventory management (water meters, leak repair materials, chemicals)
- Water rate revision (simulation, explanatory materials, resident explanations)
- Pipe network analysis methods using tools like WaterGEMS

In order to efficiently acquire the necessary training, it is beneficial to utilize both the training offered by CAWASA and the training offered in Japan (Okinawa). CAWASA's training programs offer courses on water treatment, distribution management, and facility maintenance (from basic to advanced levels). By acquiring this basic knowledge, it becomes easier to develop and improve manuals and Standard Operating Procedures (SOPs) related to the operation and maintenance of water supply systems. In addition, by learning about the unique challenges and solutions of island nations during the training in Japan (Okinawa), it becomes possible to incorporate these insights into the manuals and SOPs to address the issues in one's own country.

As shown in Figure 10-2, linking CAWASA's training programs with Japan's (Okinawa's) training programs with the cooperation strengthening points can lead to a synergistic effect in developing training programs adapted to local conditions.

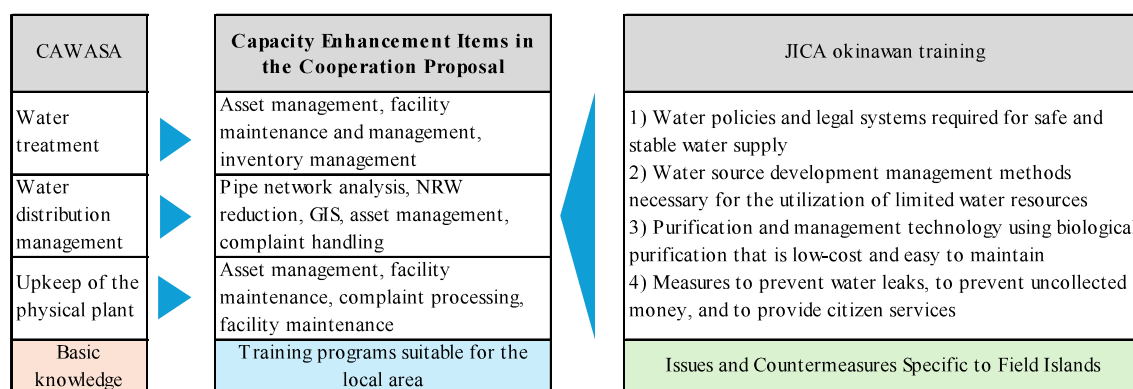


Figure 10-2 The relationship between external training programs and capacity enhancement items

f) Establishment of a liaison committee

Currently, the six target countries are positioned within the OECS framework, but there are no opportunities for all countries to meet. While there are individual links among returning trainees from JICA's domestic training for island countries, there is no organizational contact network, and no meetings are held at the departmental level. Many of the issues identified in Table 10-3 are common and similar, suggesting cooperation in addressing them.

Therefore, when setting up a training system, it is crucial to create a place (liaison committee) to exchange problems and know-how faced by each country is crucial. Interviews with returned trainees showed positive responses to the establishment of liaison committees, and a desire for exchange. The expected roles of the liaison committee are as follows:

- Sharing technology and know-how (natural disaster measures, climate change measures, etc.)
- Introducing good practices of each country (contents shown in Table 10-5)
- Introducing overseas training results, including domestic training, and sharing materials
- Sharing SOPs/manuals of each country
- Dispatching training instructors between countries (including online and on-site training)
- Presenting training achievements and sharing improvement points
- Lending spare parts and supplies in emergencies

The target countries are six Eastern Caribbean countries, CAWASA, and other countries and organizations as needed. Participants include water utility staff, returning trainees, and CAWASA staff, with the chairmanship rotating. The meeting format will be a combination of face-to-face and online, depending on budget and schedule. Information will be shared through an online repository accessible to each organization. The benefits and significance of cooperation with CAWASA in the liaison committee are as follows:

- All six water utilities are full members of CAWASA and have interactions.
- CAWASA's board includes representatives from Eastern Caribbean water utilities, understanding the activity policies.
- CAWASA has expertise in training on water and sewage technology.
- CAWASA understands the development needs of water utilities in detail.
- CAWASA focuses on developing practical skills (technical and managerial) necessary for working in the water sector and certifying professional operators.
- CAWASA plays a role in network building in the water sector.
- CAWASA acts as a training provider for water utilities.
- CAWASA has training instructors in the Caribbean, the United States, and Canada.
- CAWASA aims to develop a regional system where all water utilities can share information and compare performance and good practices.
- CAWASA intends to expand its training instructors.

The purpose of the liaison committee is to strengthen the links between the water utilities through regular meetings, to improve, maintain, and sustain water utility the operation and maintenance of the water utilities, and to contribute to "water security". It is also expected that the liaison committee will stimulate the motivation of each water utility and lead to a spiral-up of business operations. In technical cooperation projects, the liaison committee will be effective in facilitating technology transfer, training, achievements, feedback, and promoting ownership.

(2) Cooperation plan II: Support for improving the operational capacity of water utilities through the introduction of asset management

To achieve water security through a stable and sustainable supply of piped water, it is essential to ensure the sound operation of water utilities and to maintain the functionality of water assets both now and in the future. To maintain the functionality of water assets, it is necessary to promote the proper management of assets information and maintenance management information, as well as the use of information for decision-making, including the allocation of budgets for asset renewal. Supporting the implementation of asset management in water utilities is an effective means to this end. Based on this assumption, this proposal aims to support the longevity (maintenance of functionality) of water assets through the introduction of asset management, thereby enhancing the operational capacity of water utilities.

The current status of asset management in water utilities in various countries is as follows:

- The management of basic information on water asset (year of construction, specifications, location information, etc.) and maintenance records (accidents, customer complaint handling, leak repairs, etc.) is inadequate. In particular, many water utilities have not registered most of their distribution network information in GIS systems.
- Functional degradation due to facility aging is evident, such as frequent leaks from old pipes and declining water meter accuracy.
- The lack of pipeline location information leads to longer restoration times and increased water outage impacts during disasters or accidents.
- Information sharing between departments is inadequate, resulting in inefficient handling of customer complaints.
- The budget required for facility renewal is not identified, and the required budget is not systematically secured.
- There is no effort to use facility management information and various data to improve business operations. For example, there is potential to develop facility renewal plans and budget measures based on them, and to use them as an objective basis for necessary water rate revisions.

Considering the current state of information registration in GIS systems, the use of information and data for top management decision making requires considerable time. Therefore, it is considered to implement the Cooperation Plan II in two phases: Phase 1 focuses on "Implementing Asset Management," with the aim of "reducing the lifecycle cost of water facilities and extend their lifespan", which includes nine activities and two outcomes. Phase 2 focuses on "Strengthening Financial Management," with the aim of "ensuring the sound operation of water utilities", and includes three activities and three outcomes. Details of each activity and outcome are provided in Figure 10-6.

As a tool to support the implementation of asset management, the implementation of a facility ledger management system is effective and recommended. From a facility management perspective, it enables the efficient management of maintenance information, such as field inspections and repairs, using water asset information. In addition, data analysis allows water utilities to independently perform highly accurate simulations of future asset replacement costs, facilitating the optimization of medium- to long-term business plans from a comprehensive perspective, rather than repeatedly performing fragmented emergency actions.

(3) Cooperation plan III: Support for implementing NRW reduction plans

Reducing NRW is directly linked to improving the management of water utilities. For water utilities in the Eastern Caribbean, which face chronic funding shortages and have significant potential for NRW reduction, addressing this issue can have a substantial impact. From a water security perspective, improving the efficiency of water resource use also contributes to ensuring a stable water supply, making this issue highly relevant.

Regarding the current status of NRW reduction efforts, as mentioned above, the support from various donors is sporadic, and detailed assistance is needed to implement NRW reduction plans. The Japanese technologies introduced locally, such as leak repair tools and leak detection devices, are highly valued and expected by the counterparts, and greatly enhance the efficiency of NRW reduction implementation. Therefore, the potential for their introduction is high.

In addition to reducing physical water loss, it is also necessary to reduce commercial water loss. Maintaining the measurement accuracy of water meters is particularly important. Institutionalizing the regular replacement of water meters, rather than replacing them only when they fail or malfunction, can reduce commercial water loss by ensuring accurate billing based on accurate readings. To achieve this, it is necessary to increase water rates to secure the funds needed to replace water meters and maintain the inventory, use asset management for efficient replacement, and manage the inventory appropriately.

Although the demand for Cooperation Plan III among water utilities is high, building a sustainable implementation framework requires a broader impact. Therefore, the implementation of a cooperation project combining Cooperation Plans I and II is

desirable. While the background and problems faced by water utilities in each country are different, the approach to solving problems and performing tasks is common. Improving the management of a sustainable and developing water utility in one country can serve as a successful example for horizontal extension to water utilities in other countries.

The requirements for improving the management of a sustainable and evolving water utility are as follows:

- Understanding and cooperation from top management
- Staff understanding of the project's objectives and activities
- Active willingness to participate in the project, as it is focused on technology transfer
- Water utilities securing the budget and staffing necessary for project implementation

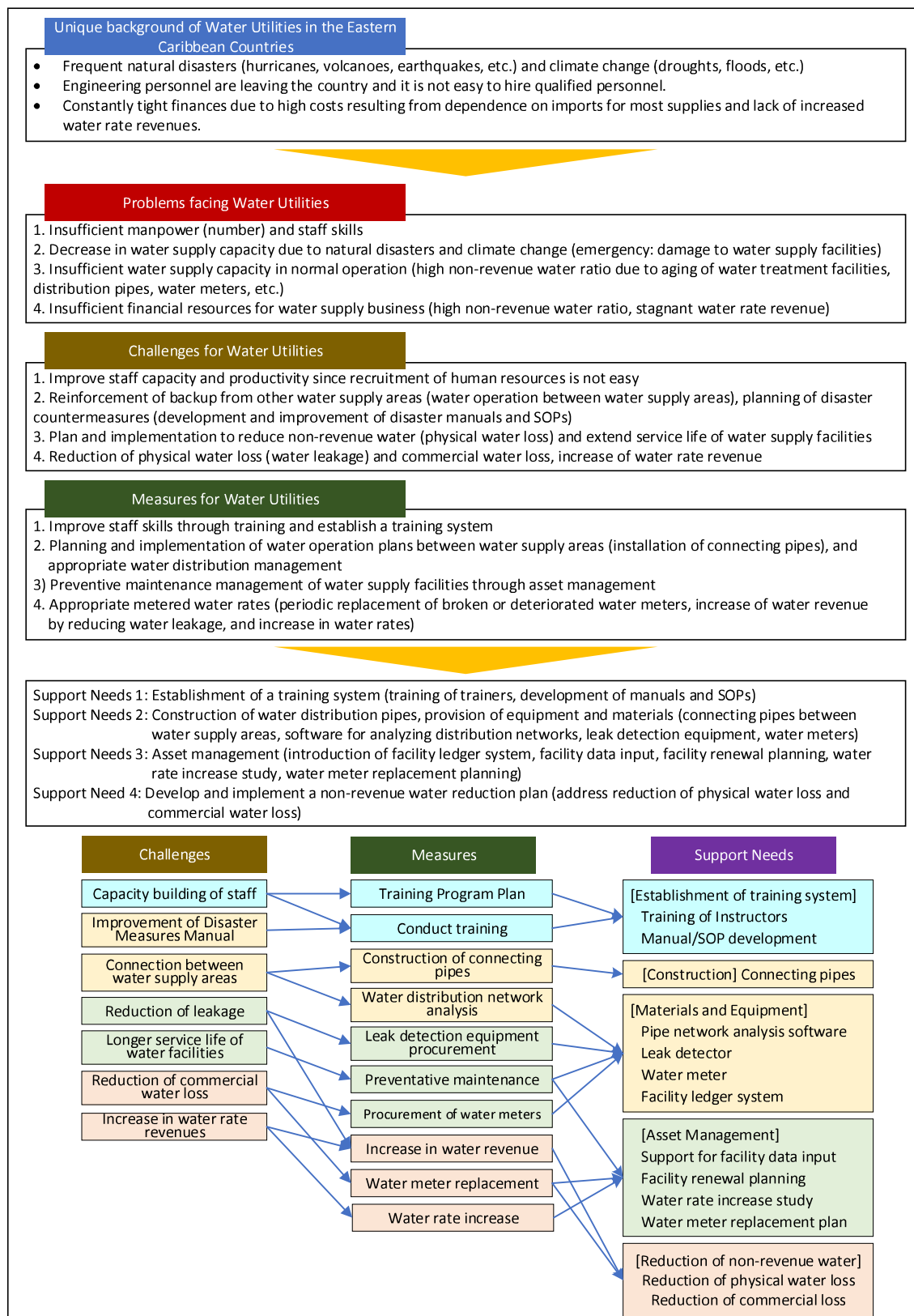
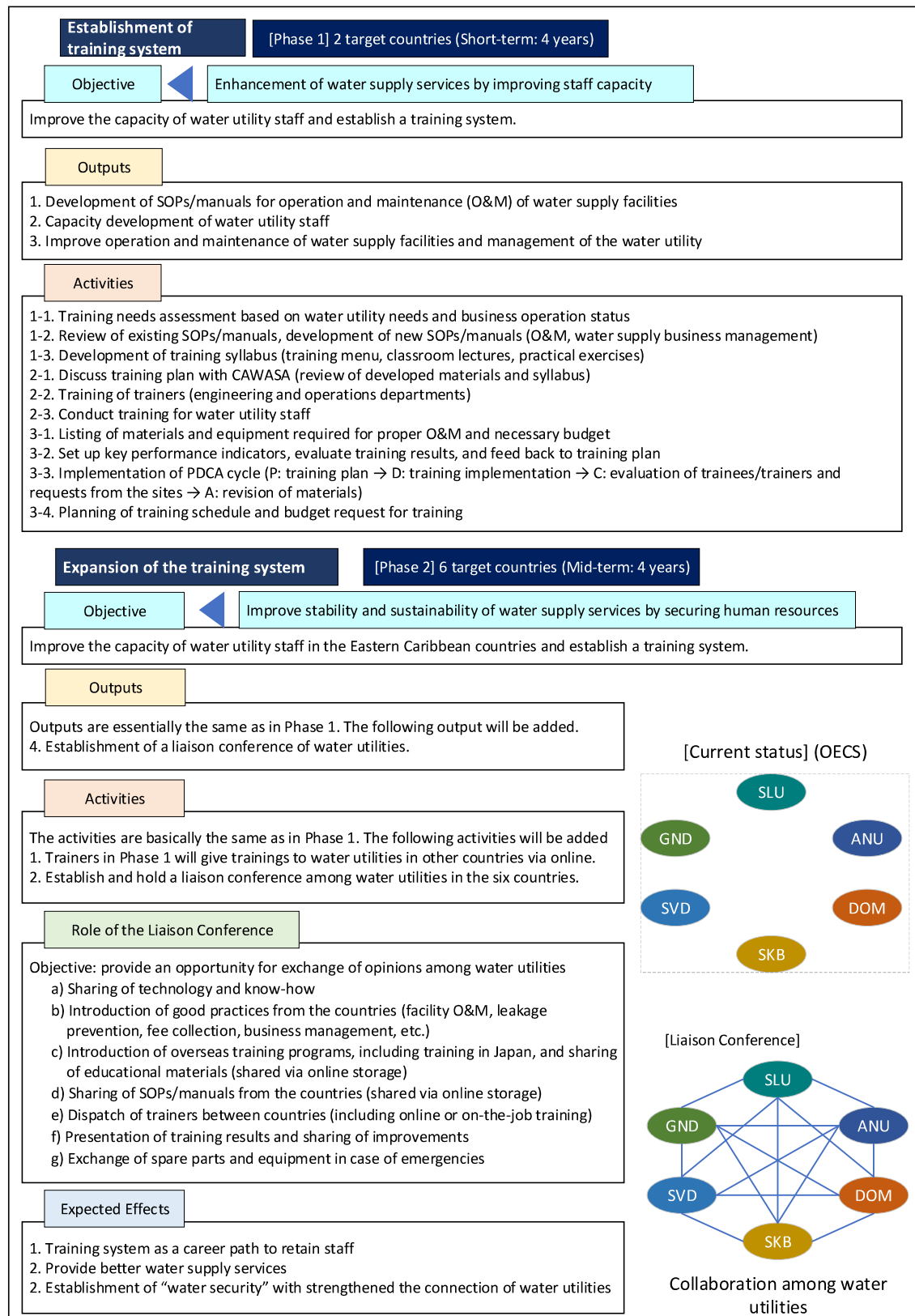


Figure 10-3 Support needs for Eastern Caribbean countries



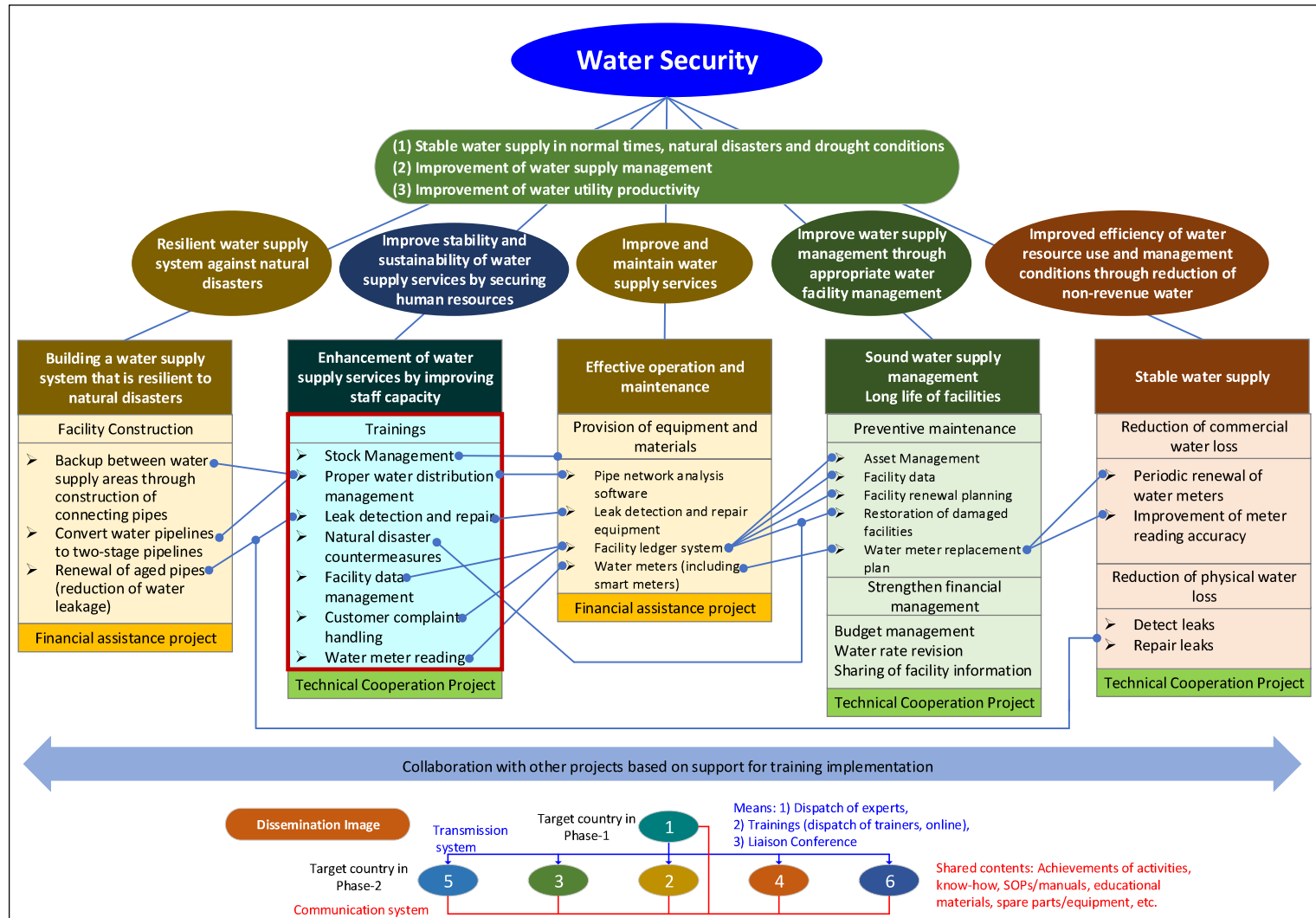


Figure 10-5 Coordination between training support and other cooperation plans

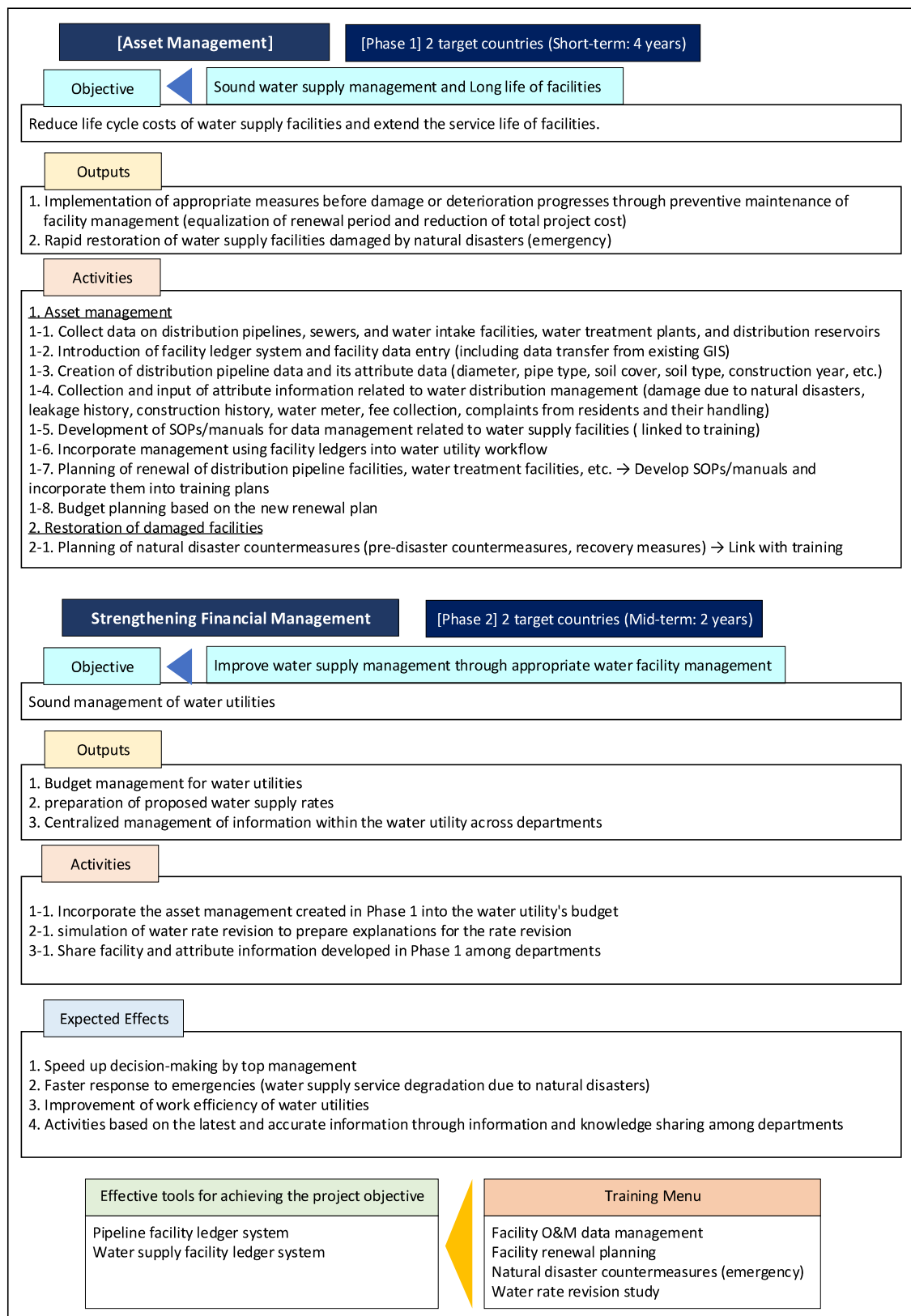


Figure 10-6 Cooperation Plan II: Support for improving the operational capacity of water utilities through the introduction of asset management

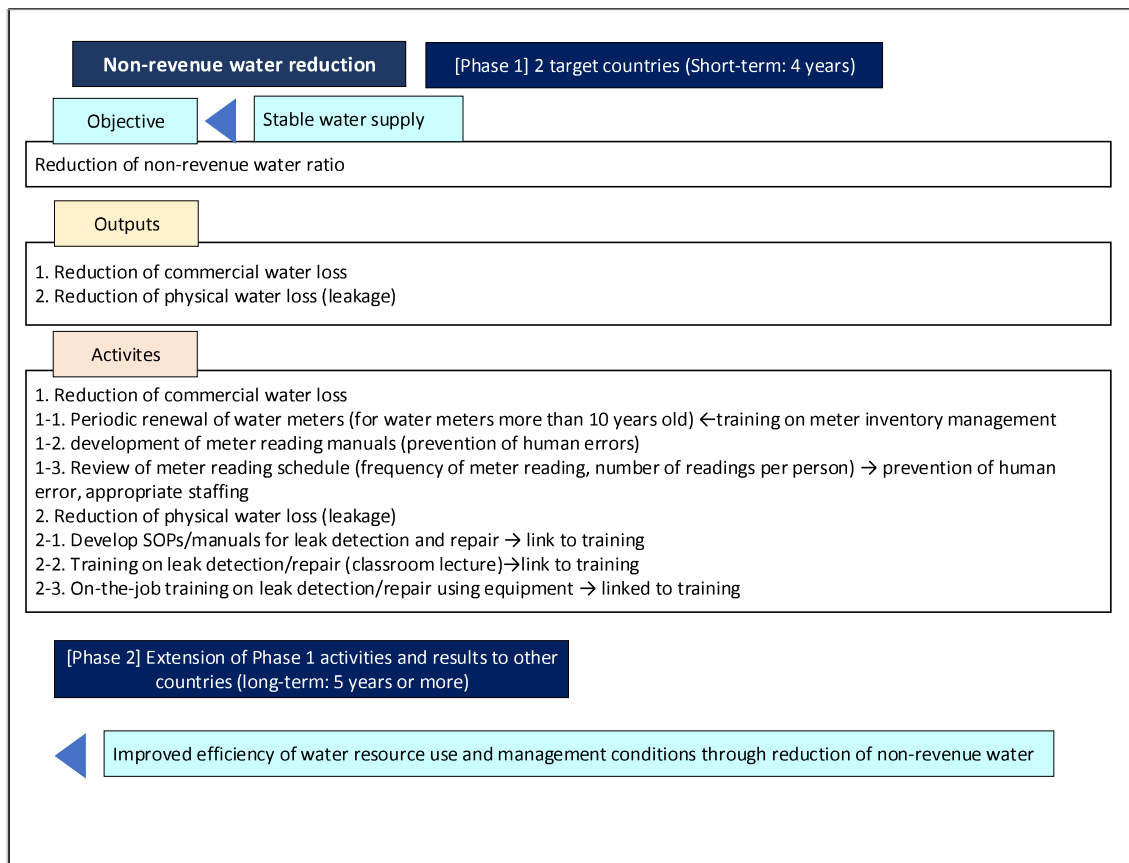


Figure 10-7 Cooperation Plan III: Support for implementing NRW reduction plans

10.3.4 Cooperation plans focused on common issues among the countries

The implementation schedule for the three cooperation plans is shown in the figure below.

No.	Project	Phase	Target country	Short term					Medium term					Legend	Outline of Implementation of Cooperation
				'25	'26	'27	'28	'29	'30	'31	'32	'33	'34		
1	Cooperation Proposal-1 Securing human resources and improving staff capacity	Ph-1	Country A	[Blue bar from '25 to '29]											1) Examination of training contents and preparation of training materials 2) Implementation of instructor training 3) Monitoring of training implementation status 4) Establishment of liaison council
			Country B		[Blue bar from '26 to '29]										
		Ph-2	Other four countries					[Blue bar from '30 to '34]							
2	Cooperation Proposal-2 Improve management capacity of water utilities through introduction of asset management	Ph-1	Two countries	[Blue bar from '25 to '29]										1) Construction of facility ledger system 2) Facility data entry support 3) Support for establishment of facility renewal plans 4) Reflected in the budget plan of the asset management plan 5) Revision of rates and sharing of facility information	
		Ph-2	Two countries					[Blue bar from '30 to '31]							
		Ph-3	4 other countries (longer than 5 years)								[Blue bar from '32 to '34]				
3	Cooperation Proposal-3 Support for implementation of non-revenue water reduction plan	Ph-1	Two countries		[Blue bar from '26 to '29]									1) Measures against commercial loss: Water meter replacement 2) Establishment of meter reading plan 3) Classroom training in water leak detection and repair techniques 4) Practical training for repairing water leaks and monitoring for improvement	
		Ph-1	Two countries			[Blue bar from '27 to '30]									
		Ph-2	4 other countries (longer than 5 years)						[Blue bar from '31 to '34]						

Figure 10-8 Short-term and medium-term implementation schedules for each cooperation plan

(1) Implementation schedule for Cooperation Plan I

This plan will be implemented in two phases as follows:

Phase 1: Establishment of a Training System

- Conduct training needs assessments, review existing training materials, and develop a training syllabus.
- Select two countries with different water supply conditions, treatment methods, and distribution systems to increase the versatility of the manuals and SOPs being developed or revised.
- Select instructors in various fields and train them through an instructor training program. Improve manuals, SOPs, and teaching methods in collaboration with CAWASA.
- Conduct training using the PDCA cycle. In the Check phase, evaluate the trainers and trainees, and consider field issues. In the Act phase, revise the training plan, update materials, and review training methods.
- Create a list of necessary equipment and supplies needed to make the training effective and to rehabilitate the water facilities, and request their procurement (budget request).
- Demonstrate training impact and build consensus for training participation (prerequisite for moving to Phase 2).

Phase 2: Expansion of the Training System

- Share the training results (human resource development, operations, O&M improvement) from Phase 1 with four target countries.
- Revise the manuals and SOPs developed in Phase 1 according to the water service conditions of each water utility.
- Conduct training (online training, instructor dispatch type training).
- Build consensus for participation in coordination meetings.

(2) Implementation schedule for Cooperation Plan II

This plan will be implemented in three phases as follows. Phase 1 and Phase 2 target the same two countries, while Phase 3 and beyond will target four countries.

Phase 1: Implementation of Asset Management

- Collect and organize facility data on distribution pipelines, sewage pipes, and intake, treatment, and distribution facilities. Input this data into an asset ledger system (or GIS).
- Identify and create data for sections of distribution pipeline data that have not been updated (location, diameter/type of pipe, soil cover, soil type, year of construction, etc.).
- Collect and organize data on disaster history, leak repair history, water meters, fee collection, and complaint handling, and input this data into the ledger system.
- Develop and conduct training on manuals and SOPs for data management using the asset ledger system.
- Formulate replacement plans for distribution pipelines and treatment facilities based on asset data. Incorporate replacement plans into budget planning.
- Incorporate facility information into disaster preparedness (prevention and recovery) efforts.

Phase 2: Strengthening Financial Management

- Incorporate the asset management plan established in Phase 1 into the budget of the water utilities.
- Perform simulations for water rate revisions, develop appropriate rate proposals, and prepare explanatory materials.
- Share the facility information and its attribute information organized in Phase 1 with the internal water utility departments.

(3) Implementation schedule for Cooperation Plan III

This plan will be implemented in two phases as follows. Phase 1 targets two countries and focuses on reducing commercial water losses and physical water losses (leakage). Phase 2 and beyond will target four countries.

Phase 1-1: Reduction of Commercial Water Losses

- Develop a regular renewal plan for water meters that have been in place for over 10 years.
- Develop and conduct training on meter reading manuals, and formulate an efficient meter reading plan by reviewing meter reading schedules (human error prevention measures).

Phase 1-2: Reduction of Physical Water Losses (Leakage)

- Develop and conduct training on manuals and SOPs for leak detection and repair.
- Procure leak detection equipment and repair equipment, and conduct on-site training using the equipment.

Phase 2

- Implement Phase 1-1 and 1-2 in the remaining four countries.

10.3.5 Other cooperation plans focusing on specific issues

In addition to the cooperation plans mentioned in the previous sections, this section describes cooperation plans aimed at solving specific problems for individual countries or groups with similar problems in the Eastern Caribbean countries.

(1) Recycling water

Of the target countries, only St. Lucia reuses treated sewage water and sells it for use by private businesses, such as irrigation water for golf courses. Treated sewage water serves as an alternative source of new water supply, thereby reducing reliance on potable water sources.

In contrast, in the capital city of Castries in St. Lucia, sewage is collected but discharged untreated directly into the harbor. This untreated discharge has led to complaints of foul odors from residents and tourists, as well as a deterioration of the scenic quality of the central tourist area. To address this problem, there is growing momentum in the country to improve the sewerage system, and other donors are currently planning STPs.

Reuse of treated sewage water does not require potable water quality for uses such as toilet flushing and irrigation, making it a highly viable option. It can reduce reliance on potable water, allow for its reallocation and prevent over-development of water sources, thus maximizing the use of limited water resources. Sewage treatment and reuse can reduce environmental impact and provide a new approach to addressing water scarcity.

Regarding sewage treatment in Castries, the construction and use of multiple energy-saving MBR (Membrane Bioreactor) plants in areas of high water demand, such as toilet flushing and irrigation, can provide wastewater treatment and distribute treated wastewater to appropriate locations. Energy-efficient MBR plants are compact and do not require large areas of land like the standard activated sludge process or the stabilization

pond process used at the Rodney Bay STP in St. Lucia, making construction easier. In addition, the facilities for collecting sewage (sewage pipes) and distributing treated sewage water can be installed with minimal investment, making the reuse distribution feasible. For example, the introduction of MBR facilities at large commercial complexes or airport facilities could improve the suitability of sewage treatment and recycled water use and potentially extend reuse by incorporating surrounding facilities.

The development of sewerage systems that take into account the reuse of treated sewage can improve the water environment and reduce the burden of developing drinking water sources in countries or regions with limited water resources, while also promoting the formation of a circular society at home and abroad.

(2) Desalination facilities

In the case of the island of Antigua, there is an existing building for seawater desalination facilities, and Japanese-made products were installed under a grant aid project by JICS as additional equipment in the available space within the building. This made it possible to utilize existing facilities, including the seawater intake system, and enabled efficient and rapid implementation of the cooperation project. Based on this successful experience, the following guidelines are proposed for seawater desalination cooperation projects.

a) Utilizing Existing Seawater Desalination Facilities

Similar to the above method, additional equipment can be added to existing seawater desalination facilities. Even if there is no space available in the building, the equipment can be housed in a container, providing great versatility.

b) Utilizing Existing Water Treatment Plant Facilities

If the water source of an existing water treatment plant has become saline, a seawater desalination facility can be installed there. This method can address cases where groundwater has become saline due to excessive extraction or river water has become saline due to saltwater intrusion, by adding desalination equipment to the purification process to lower salinity levels. Existing intake and water supply facilities can still be used, and lower salinity levels may allow the use of smaller desalination equipment.

c) Deploying New Small-Scale Desalination Facilities

For example, the product supplied to the island of Antigua under the JICS project includes small seawater desalination units with a water production capacity of 6 cubic meters per day. There are also smaller portable desalination units available. These can be distributed to provide drinking water during droughts or disasters, or to small coastal villages that lack water supply facilities.

(3) Other support

Each country's water utilities face unique challenges, and the following support plans are proposed:

a) Survey of buried distribution pipes

While existing distribution pipe information is managed using GIS, not all information is known. In northern St. Lucia, about 20% of the distribution pipes are managed with GIS, while the remaining 80% are not entered into the database. The lack of as-built drawings for distribution pipes hampers reconstruction and restoration efforts. Similarly, in Dominica, some distribution zones lack information on existing pipes. It is therefore desirable that existing distribution pipes are surveyed and managed using GIS and asset ledgers.

b) Pressure reduction in distribution pipes

In Dominica, due to the hilly terrain, there are significant variations in distribution pressure, which contributes to high leakage rates. The elevation of the Antrim WTP is 989 feet (301 meters), and the maximum static pressure in the lowest part of the supply main is 2.7 MPa. According to Japanese standards, the maximum static pressure in the distribution pipes at the point of branching to the service pipes is 0.74 MPa. Methods for reducing pressure in distribution lines include 1) installing pressure reducing valves and 2) installing pressure relief tanks. St. Vincent and the Grenadines, with similar hilly terrain, also requires similar measures.

c) Replenishment of filtration sand and introduction of sand washing machines

The Dalway WTP in St. Vincent and the Grenadines uses slow sand filtration. CWSA does not have a sand washer, resulting in significant time and labor to clean and replenish filtration sand. In addition, there are quality issues with the filtration sand. Previous imports of filtration sand from Guyana have had problems with grain shape and uniformity. Therefore, there is a need to source properly specified filtration sand and to install a sand washer.

d) Dredging and prevention of sedimentation in water source dams

In St. Lucia, 100% of WASCO's water source is surface water, with no groundwater sources. Over 50% of the capacity of the John Compton Dam, a water source dam, is buried in sediment. Although sediment around the intake has been removed with CDB support, improving intake capacity, sediment continues to accumulate in the dam. With five tributaries upstream of the John Compton Dam, sediment continues to enter the dam. Although sediment control dams were constructed with CDB support, they have not completely prevented sediment from entering the dam. Therefore, dredging of the

dam to restore storage capacity and construction of additional sediment control dams to prevent sediment intrusion is required.

e) Rainwater Harvesting

One of Grenada's policies is to improve access to and use of water resources. The use of rainwater as an alternative to water resources is being considered as a drought countermeasure in the climate change. Therefore, there is a need to provide rainwater collection, storage, and utilization systems.

f) Extension of discharge channels for untreated sewage

The capital of St. Lucia, Castries, has a sewer network in place, but no STP, resulting in untreated sewage being discharged into the sea. The outfall channel is short and visible from the park's embankment, leading to complaints about water quality degradation and foul odors from residents and tourists. While the construction of a STP to discharge treated sewage is highly desirable, it requires significant time and construction costs. As an urgent measure, extending the outfall channel to the sea can restore the scenic quality and reduce foul odors. By upgrading the sewage pump located upstream of the discharge point, it would be possible to discharge sewage further away.

10.3.6 Japanese technologies expected to contribute to the water sector

(1) Policy for Introducing Japanese Technologies

When introducing Japanese technologies, it is necessary to examine the current and anticipated future needs of each country and select the most appropriate approach from various options, such as support projects, PPP, and private projects, within an appropriate time frame.

(2) Japanese Technologies Expected to be Introduced

The major issues faced by water utilities in the Eastern Caribbean countries include high NRW rates (mainly due to leakage), insufficient water sources, budget shortfalls for operation and maintenance, restoration of facilities after natural disasters, and inefficient business operations (such as lack of information sharing and delays in water rate increases). To address and mitigate these issues, Japanese-developed technologies have been introduced to the water utility companies.

Table 10-16 shows the interest levels of each water utility company in the 12 technologies presented during the local briefings. In general, there is a high expectation for NRW reduction technologies, such as leak repair and leak detection, as well as efficient asset management through integrated infrastructure management systems.

It should be noted that the assessment shown in the table is a quantified representation of the overall expectations of water utilities' representatives, calculated to understand general trends. The potential for technology adoption should also take into account demand from sectors other than water utilities.

Table 10-16 Assessment of Japanese technologies by each water utility

No.	Technical Field	Evaluation						Ave.
		SLU	ANU	DOM	SKB	SVD	GND	
TECH-1	Leak repair equipment	5	5	5	5	3	5	4.7
TECH-2	Rainwater storage/Initial rainwater diverter	1	5	3	4	4	4	3.5
TECH-3	Rainwater storage/Pipe-pillared rainwater storage system	1	2	4	4	1	2	2.3
TECH-4	Reclaimed water utilization/Distributed water recycling system	1	3	3	4	3	3	2.8
TECH-5	Reclaimed water utilization/Automated low-energy MBR system	1	3	3	4	2	3	2.7
TECH-6	Leak detector/Advanced leak detector	5	5	5	5	4	5	4.8
TECH-7	Leak detector/4-points real-time correlated leak detector	5	5	5	5	4	5	4.8
TECH-8	Desalination/Advanced battery-powered desalination system	1	5	2	3	4	5	3.3
TECH-9	Desalination/Unit-type desalination plant	1	5	3	4	2	5	3.3
TECH-10	Smart water meter	3	5	5	5	4	5	4.5
TECH-11	Training technology/Digital Twin simulation and VR training	3	5	5	5	2	5	4.2
TECH-12	Cloud-based integrated infrastructure management system	5	5	5	5	3	5	4.7

Note: JST requested 5-step evaluation after the presentation of the 12 technologies

10.4 Recommendations on the implementation of cooperation projects

10.4.1 Project collaboration and co-financing

When considering project cooperation and co-financing with other international organizations related to water security in the Eastern Caribbean countries, the following points should be considered:

(1) Collaboration with regional water sector organizations

In order to appropriately formulate and implement project activities that take into account the unique characteristics of each country's water sector, it is essential to work with regional water sector organizations that are knowledgeable about the water security issues in the Eastern Caribbean, as well as the situation of water management agencies and water utilities. The regional water sector organizations covering the Eastern Caribbean are CWWA and CAWASA. CWWA has influenced a wide range of water sector entities, including central government ministries of Caribbean countries, at annual general meetings where major water sector issues are discussed and decided. On the other hand, CAWASA has a full membership of water utilities in the Eastern Caribbean islands and has a more detailed understanding of the development needs of each country and region. With these characteristics in mind, it is critical to function as a coordinating body to appropriately involve and engage stakeholders from central government, water utilities, academia, and regional alliances in project design and implementation.

(2) Co-financing schemes with other agencies

The eight agencies mentioned in this chapter have adopted various co-financing schemes with different organizations.

a) CDB financing

As noted above, the CDB is a major donor agency in the Caribbean region, providing financial support to specific countries within the OECS. However, its support in the water sector is relatively small in scale. For projects requiring large-scale funding, CDB works with western donor agencies through funds for higher categories such as climate change, disaster risk reduction, and infrastructure development, while itself taking on the role of the implementing agency.

b) Collaboration with IDB

Since the six OECS countries covered in this survey are not IDB borrowing member countries, the use of IDB funds for projects in these countries requires the formation of projects that include IDB borrowing member countries⁶ in the target region. The

⁶ Barbados is the only IDB borrowing member country in the Eastern Caribbean region.

IDB has shown some interest in the "CORE: Cooperation for Economic Recovery and Social Inclusion"⁷ for the Latin American and Caribbean region during the discussions, but there are significant hurdles to implementation due to the lack of credit history for the six OECS countries.

c) Utilization of UN and World Bank Frameworks

The UN's GCF and the World Bank's GEF are funding frameworks for climate change mitigation and environmental protection efforts, making them useful resources for financing water sector development projects. Among the agencies surveyed, JICA, IDB, CDB, CCCCC, and the Environment Department of the Ministry of Health, Wellness, and the Environment of Antigua and Barbuda are accredited entities of the GCF. In addition, IDB is also a GEF Implementing Agency. These agencies can organize projects and apply for funds from the GCF or the GEF, and there are many actual cases of use.

d) Collaboration with regional alliances and related sector agencies for financing

Among the surveyed agencies, OECS and CAWASA are regional alliances/organizations of the Eastern Caribbean islands. In the context of the water sector, they require extensive technical and financial support from larger organizations for project design and implementation of projects, as well as for activities related to human resource development, awareness, and disaster preparedness. Effective collaboration, particularly in project financing, involves having CWWA as the water sector organization, CARICOM as the regional alliance, CDEMA for disaster management, and CCCCC for climate change as the implementing or regional coordinating bodies under the CARICOM umbrella.

Seven agencies⁸ confirmed their interest in JICA's involvement in water security projects through project design, implementation, and financing roles using such coordinated systems. In order to contribute to water security in the Eastern Caribbean region, it is crucial for JICA to utilize its extensive cooperation experience and rich knowledge gained from long-term cooperation with island countries in the Pacific region, which share similar values as SIDS, through project cooperation and co-financing with other agencies.

⁷ Within the framework of the partnership agreement concluded between the IDB and JICA in 2011, the target amount for JICA's concessional loan cooperation will be expanded from USD 3 billion to USD 4 billion in January 2024, and the validity period of the framework will be extended from 2026 to 2028.

⁸ This excludes the CCCCC, with whom a requested meeting was not conducted.

10.4.2 Proposal of project target countries

As mentioned in 10.3.2(3), Table 10-17 shows the target countries for support in each phase and the reasons for their proposals in the case of a two-project approach.

Table 10-17 Target countries for Ph-1 and Ph-2 projects (Draft)

Country name	Water utilities	Ph-1	Ph-2	Reason for selection
SLU	WASCO	✓		There are JICA local offices and WRMA · CAWASA as well as major organizations involved in the implementation of the project, which makes it easier to establish an implementation system. The urgency of support is high due to the lack of 24-hour water supply, and there is also an intention to establish a NRW reduction team internally, which further underscores the necessity of implementation support for that.
ANU	APUA		✓	Although there are actual conditions of intermittent water supply in some regions, the situation may improve as projects to secure water sources, such as the installation of additional fresh seawater facilities, are being promoted. Since this is also an organization that has been successful in raising water rates, such as in NAWASA, it will seek future support while paying close attention to future trends, as there is their own movement to improve the business. In addition, since the information provided in this survey was limited, it is realistic to continue to conduct additional surveys, particularly on the financial side, to provide future support.
DOM	DOWASCO		✓	As the country has abundant water resources compared with other countries, it has achieved 24-hour water supply even in the dry season, and it can be said that the need and urgency of support at the present time is low. However, the ratio of unproductive water is extremely high at approximately 60%. Since the depreciation burden is high and the business is in the red, it is necessary to provide support for management improvement in the future.
SKB	SKWSD		✓	Because of the strong involvement of ministries and agencies as government organizations, it is difficult to take physical steps as a water utility and the possibility of doing so with external support is limited.
SVD	CWSD	✓		The establishment of NRW reduction unit is being studied internally, and the supporting organization is in an undetermined situation. The urgency of the support is also high, as will provide 8 hours of water supply in multiple regions during the dry season.
GND	NAWASA		✓	Currently, G-CREWS including technical support is underway, and immediate coordination is considered difficult, because it is also at the end of the project. In addition, the profitability and financial stability of the business is the best among the target countries this time, and the urgency of support is low. It is desirable to wait for the completion of the project in 2025 and implement it in Ph-2 based on the results and lessons learned.

Appendix 1 Japanese technology expected to be introduced Part 1

(1) Leak repair equipment

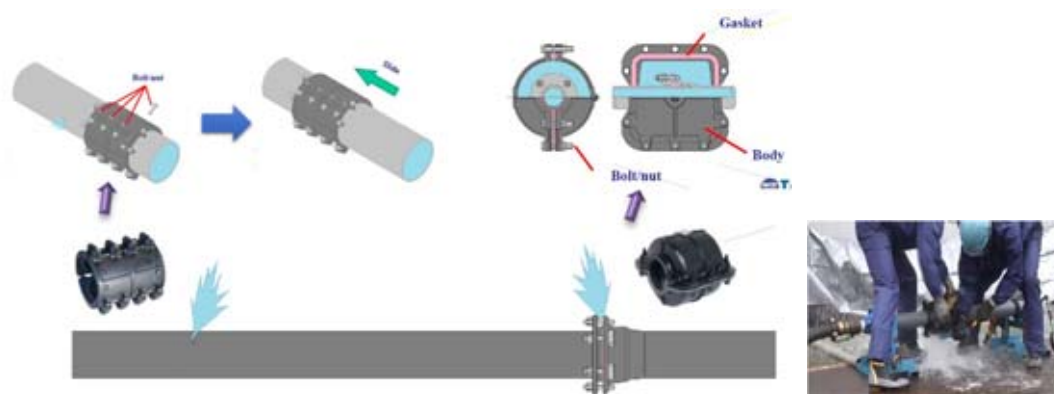
[Technical Overview]

When water leaks occur from in old or high-pressure water pipes, a significant amount of manpower is required to repair them. In many cases, it is necessary to temporarily stop the water supply of the object pipeline, due to the high pressure and the need to remove joints.

In Japanese products, by combining the split fittings and cramping them together with bolts and nuts, simple and permanent repairs can be made while the water supply continues.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Currently, Japanese manufacturers offer materials that conform only to JIS standard water pipes. It is necessary to conduct further investigation of pipe specifications, demand quantities, etc. in the East Caribbean countries, as it is expected to be several thousand pieces in order to consider the customized materials according to the local water pipe standards. At present, the water supply is interrupted for the repair work at the time of water leakage, and the largest number of complaints from customers concerns the time of water supply. Adopting this leakage repair without stopping the water supply would contribute to improving the water supply service and customer satisfaction.



Source: Technical Data of a manufacturer

Figure A1-1 Use of repair equipment

(2) Initial rainwater diverter

[Technical Overview]

Rainwater is inherently clean because it is made up of evaporated moisture from rain. However, since the initially harvested rainwater¹ contains dust from roofs, gutters, and floating in the atmosphere, collection of water without shunting will cause deterioration of the water quality in the storage tank, including foul odors. By installing a device between the tank and the gutter to divert and remove dust from the rainwater at the initial stage of rainfall, the water quality of the collected rainwater can be maintained clear and used efficiently.

In the case of large storage tanks, sedimentation basins are often installed at the intake section as a countermeasure against an inflow of foreign matter intrusion. However, the problem of sediment entering the storage tank is likely to occur due to agitation in the basin. As a countermeasure, there is also a debris removal product that can cut the initial rainwater, and when combined, it becomes possible to maintain the water quality of the rainwater storage tank for a long time.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Rainwater harvesting is recommended in countries except for DOM. However, rainwater is being used for potable purposes in ANU where water shortage is severe. There is a high demand for equipment to maintain the quality of harvested rainwater.



Source: Brochure of a manufacturer

Figure A1-2 Usage of initial water diverter

¹ Initially harvested rainwater: rainwater collected for 5 to 10 minutes after the rainfall begins

(3) Pipe-pillared Rainwater Storage System

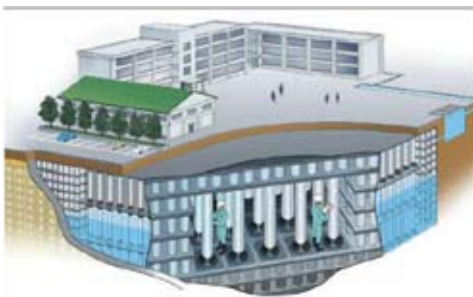
[Technical Overview]

This rainwater storage system uses storage materials that are strengthened by using the spacer pipe as a column structure. By constructing a water storage tank by combining PVC spacer tubes with a lightweight element such as a partition plate, you can also construct a large storage tank (the concrete structure is only the bottom plate) with a minimum of heavy equipment. It is even possible to build even under the parking lot or in a limited area by combining the units according to the topography. In addition, since the columnar spacer pipe inside the tank can store water inside, the storage rate per volume of the tank is as high as 90% or more. The structure is spacious enough to enter inside for inspection.

[Compatibility with the Eastern Caribbean Countries and Considerations]

The construction cost is less expensive than the precast concrete structure but is more expensive than the cast-in-place concrete structure. It may be suitable when the high water storage rate is required in limited land area.

The evaluation score in Table 10-16 is relatively low for this technology, but in some countries, rainwater harvesting is outside the purview of water supply utilities. Note that this may not reflect the public needs of the countries.



Source: Technical Data of a manufacturer

Figure A1-3 Overview of pipe-pillared rainwater storage system

(4) Distributed water recycling system (a pilot project in progress)

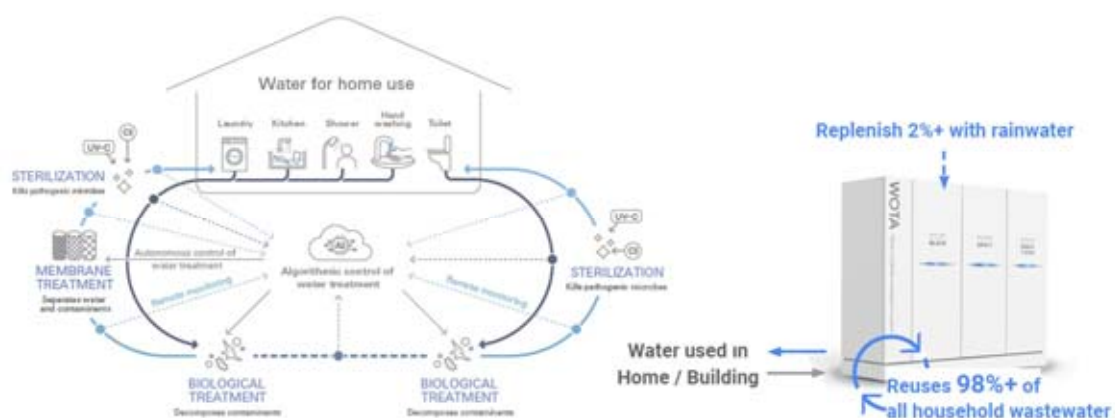
[Technical Summary]

This technology aims to provide an independent water circulation system for each house without connecting to the water supply and sewerage system. As of 2024, Japanese startup is demonstrating the technology for a government-led housing development project in the ANU. The treatment process is “Filtration → biological treatment → membrane treatment → disinfection”. One cubic meter of water is circulated and used. Optimal operation by AI can extend the life of filters and reduce the frequency of sludge collection by controlling sludge generation.

[Compatibility with the Eastern Caribbean Countries and Considerations]

The technology would complement a conventional large-scale centralized water and sanitation system by substituting its function for low population density areas in the countries where the investment costs for connection would not be justifiable. In addition, building an independent water circulation system can be a solution to the risk of water scarcity due to climate change and pipeline damage from natural disasters.

The company of the system shown above has already commercialized a portable shower-water-reuse equipment. This product allows 100 cycles of showers with only 100 L of water, by recycling and reusing 98% of the water used for showering². Although the commercialization was in 2019, it has been used in many areas suffering from natural disasters. Recently, in the Noto Peninsula earthquake at the beginning of 2024 in Japan, it was widely used and attracted a public attention. At that time, a cooperative relationship was observed in which local governments in Chiba Prefecture, which had stocks of the products as a part of their BCP, lent them to the disaster-stricken areas. By establishing a disaster agreement between local governments, it will contribute to maintaining the quality of life of victims in the event of a natural disaster while suppressing an investment.



Source: WOTA technical data

² The circulation rate may vary depending on the quality of the wastewater.

Figure A1-4 Overview of water recycling system



Source: Manufacturer catalogue

Figure A1-5 Potable shower-water reuse equipment

(5) Automated low-energy consumption MBR

[Technical Overview]

Construction of sewage treatment plants requires large amounts of capital and land, and in the case of recycled water use, it is also necessary to consider the transportation of the wastewater to its destination.

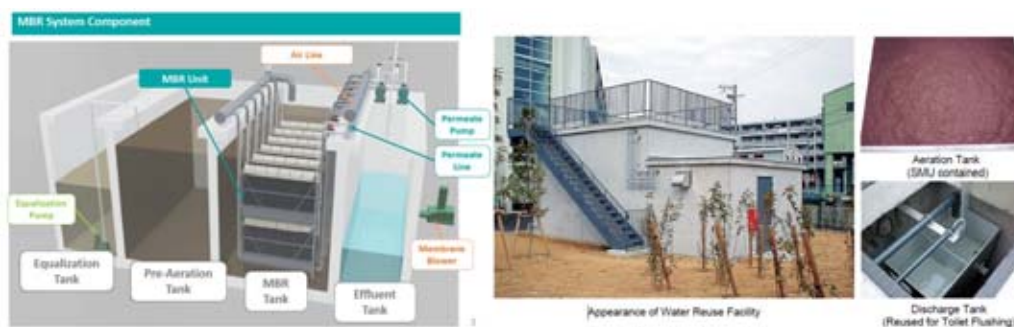
MBR (Membrane Bio-Reactor method) is more compact than a sewage treatment plant. And the treated water of MBR is easier to use as recycled water because it provides better water quality than that of a typical sewage treatment plant (secondary treatment). In addition, this Japanese system has succeeded in saving energy by suppressing pumping power by using the water level difference based on the siphon principle for the pressure of the submerged membrane passage³.

In Japan, wastewater from buildings is treated and used to flush toilet to reduce sewage and water costs⁴.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Some countries and regions are reluctant to the reuse of treated sewage, but if it is used for flushing toilets, there is an opportunity to expand reuse. According to one of the officials, a legal obligation for the use of recycled water will be put up for discussion if the appropriate technology is found.

Where foul odors and health hazards occur, installing the system for mid-to-large commercial facilities and accommodations can help them solve the problems and reduce their water bills.



Source: Technical Data of manufacturer

Figure A1-6 Energy-saving MBR

³ 55% less power than conventional MBR (KUBOTA)

⁴ The annual reduction effect of JPY 3.3 million was confirmed for a treatment facility of 30 m³/day.

(6) Advanced leak detector

[Technical Overview]

It takes time to acquire the skill to decipher the sounds of water leakage from another. The latest leak detector can pick up the leakage sound from the wide sound range by setting filters, and it becomes a technology that complements the lack of experience for handling the detector. In addition, the latest models reduce the physical burden on workers by smartphone apps, reducing their weight, and universal design for a long-term use.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Throughout the entire Eastern Caribbean region, they are facing challenges such as inadequate training and talent drain. Water leak detection technology gives them a leg up.⁵



Source: Manufacturer's catalog

Figure A1-7 Overview of using a water leakage detector

⁵ FUJITECOM, which manufactures and sells water leak detectors, provides hands-on training for pipe maintenance and management. Since they offer courses in English, it is also possible to consider this as a training destination in Japan.

(7) Four-point real-time correlated leak detector

[Technical Overview]

When narrowing down a water leak from an area to a pipe, it is necessary to narrow down the water leak area in more detail from the approximate leak area.

The traditional way to use a correlation-type water leak detector is for the inspector to place two sensors sandwiching the expected leak points and narrow them down one by one. However, this method required changing the sensor for each route, and it was very labor intensive. The new technology surveys up to six routes simultaneously by using four sensors with built-in preamplifiers. The results can be confirmed immediately in the field, speeding up the survey process.

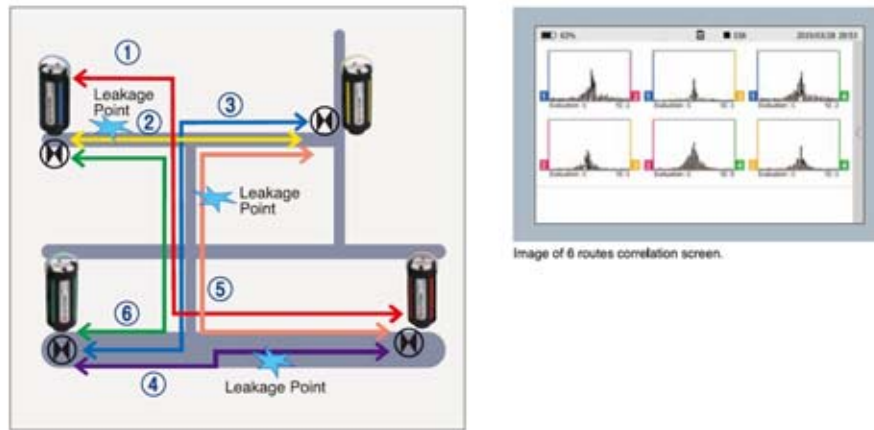
[Compatibility with the Eastern Caribbean Countries and Considerations]

In the East Caribbean region in general, the workload of each employee is too heavy to handle their tasks efficiently. In order to improve the efficiency of their work, it is necessary to minimize the subsequent work to identify the water leakage point as shown in "Japanese Technology (6)" by narrowing the water leakage range from an area to a line (specific area → specific pipeline). With this technology, it is possible to reduce the amount of detection work and shorten the time, thereby contributing to reducing the workload of the personnel and improving the efficiency of the work.



Source: FUJITECOM catalog

Figure A1-8 Overview of the correlated leak detector



Source: FUJITECOM catalog

Figure A1-9 Concept of four-point real-time correlated leak detection

(8) Advanced Battery-powered Desalination System (demonstration project in progress)
[Technical Overview]

A pilot project of off-grid type seawater desalination using solar power generation and NAS cell battery⁶ are being carried out in the Maldives⁷. In combination with solar panels, this technology can produce fresh water by RO (Reverse Osmosis Membrane) even at night or in bad weather, with a battery storage system to store excess power during fine weather. The technology provides all the energy needed for water production through solar power, while eliminating greenhouse gas emissions. In addition, it is possible to produce water continuously even if the power grid is disrupted by a disaster.

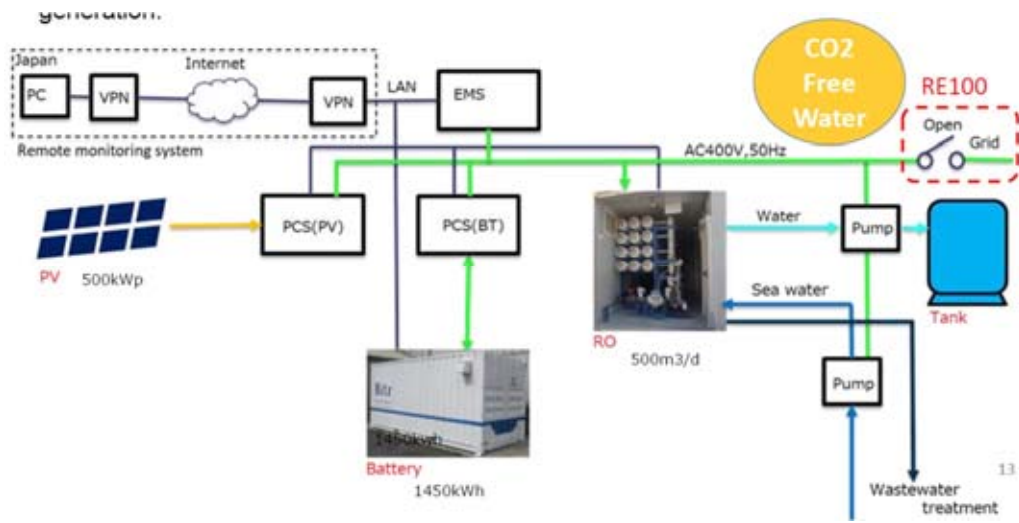
There are already plants operating off-grid desalination systems powered by solar PV and batteries, installed by Caribbean Water Technology in ANU. However, with the Japanese technology, the RO treatment, which is assumed to produce constant output at all times, can follow the output of solar power generation, and fresh water can also be produced at night or during periods of no solar radiation, to match the remaining battery charge and reservoir levels. In addition, the use of long-life, high-capacity NAS batteries makes it possible to predict a reliable return on investment.

[Compatibility with the Eastern Caribbean Countries and Considerations]

It is particularly suitable for countries where the "Climate-Change Application Target" is off-grid (independent power supply) for the water sector. In addition, electricity tariffs for power generation projects in the Eastern Caribbean countries are generally high due to high dependence on imported fossil fuels. By providing the power for the desalination off-grid, it is possible to reduce operating costs and reduce greenhouse gas emissions while contributing to the financial health of water utilities.

⁶ NAS battery: a registered trademark of NGK. The expected lifetime is 20 years. The Maldives business is expected to recover its investment in 10 years. In the early 2010s, the NAS battery suffered from ignition phenomenon due to battery failure, and there were safety concerns. At present, a built-in safety system is being standardized, and the system is now highly reliable. It is noteworthy that Japan has established a safety standard for grid-connected batteries, JIS C 4441, ahead of the rest of the world.

⁷ The Maldives is an island nation in the Indian Ocean with scarce water resources and has a similar challenge to the Eastern Caribbean region in that it relies heavily on diesel generators for power generation and the cost of electricity is high.



Source: Hitachi Zosen Technical Data

Figure A1-10 Schematic system configuration

(9) Unit type Desalination Plant

[Technical Overview]

Unitized seawater desalination facilities. This is a seawater desalination system that facilitates operation and maintenance (O&M) by using fewer chemicals and by simplifying operation. In addition, by using pressure-resistant resin-coated pipes, it does not corrode even with high concentration of salt water, reducing the cost of replacement.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Chemicals, along with electricity, account for a certain amount of the operating costs of the desalination plant. In addition, the easy-to-operate equipment is said to be a suitable technology for the Eastern Caribbean region where training for operators tend to be in short supply. In addition, because in the East Caribbean countries import spare parts and chemicals from overseas, it has been necessary to take measures such as securing a large amount of inventory in order to prepare for the uncertainty of supply. This technology can also reduce such risks and burdens.



Source: Technical data from desalination equipment manufacturers

Figure A1-11 Unit-type desalination plant introduced in ANU

< RO MEMBRANE LIFE >			< COATED HIGH PRESSURE PIPE > JAPANESE MANUFACTURE STANDARD	
DOSING ITEM	OTHERS DOSING	JAPANESE DOSING	Specifications	
PRE-CHLORINATION	REQUIRED	NOT REQUIRED	Fluid	Seawater, Brine
DE-CHLORINATION	REQUIRED	NOT REQUIRED	Max. pressure	7.0 MPa
COAGULANT	REQUIRED	NOT REQUIRED	Piping materials	STPG
ANTI-SCALANT	REQUIRED	NOT REQUIRED	Coating materials	Hylon 11
POST-CHLORINATION	REQUIRED	REQUIRED	Coating place	Inside and outside
RO MEMBRANE LIFE	3-5 YEARS	3-5 YEARS	Coating thickness	0.3mm or larger
			Coating color	White

Source: Technical data for desalination manufacturers

Figure A1-12 Comparison of RO membrane agents used and resin-coated pipes

(10) Smart water meter

[Technical outline]

The most basic benefits of the smart meter are labor savings and increased efficiency in meter reading. Previously, meter readers had to visit the meter display and read the numbers. But the remote communication technology, such as LPWA⁸, collects daily water consumption data without the meter readers visiting the site. In addition, instead of reading the meter once a month, it is possible to obtain water consumption data of every hour daily. This can be used for early detection of water leaks and left-on taps, as well as for optimization of the water distribution network.

Most of the water smart meters use ultrasonic principle, but Japanese manufacturers specialize in conventional impeller type or electromagnetic type. The ultrasonic type is superior to the electromagnetic type in terms of price, while it tends to be weak in air intrusion. It is necessary to study whether it is suitable for the local water supply conditions. For example, the ultrasonic reflection plate inside the bore may cause scale accumulation, which may lead to clogging and inaccuracy.

Japanese manufacturers offer cloud monitoring capabilities to provide value-added services such as billing functions and eldercare monitoring services.⁹

In Japan, demonstrations of water meters made of plastic are progressing, and it is possible to use them as smart meters by adding a communication device. This product was originally developed as a countermeasure against salt damage, but it also has the advantages of being cheaper and lighter (about 1/3 of that of brass) than the conventional brass water meter.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Currently, water utilities in the Eastern Caribbean are preparing or implementing projects that include the introduction of smart meters. They are reluctant to deploy conventional impeller meters to the other types because of their susceptibility to scaling due to the region's water quality, or overbilling due to air idling. However, improper installation and aging due to long-term use may be the root causes. When selecting the type of water meter, it is recommended to study the most appropriate equipment without excluding the options of a relatively inexpensive plastic meter, or a conventional mechanical meter that can be used repeatedly when the internal equipment is replaced.¹⁰

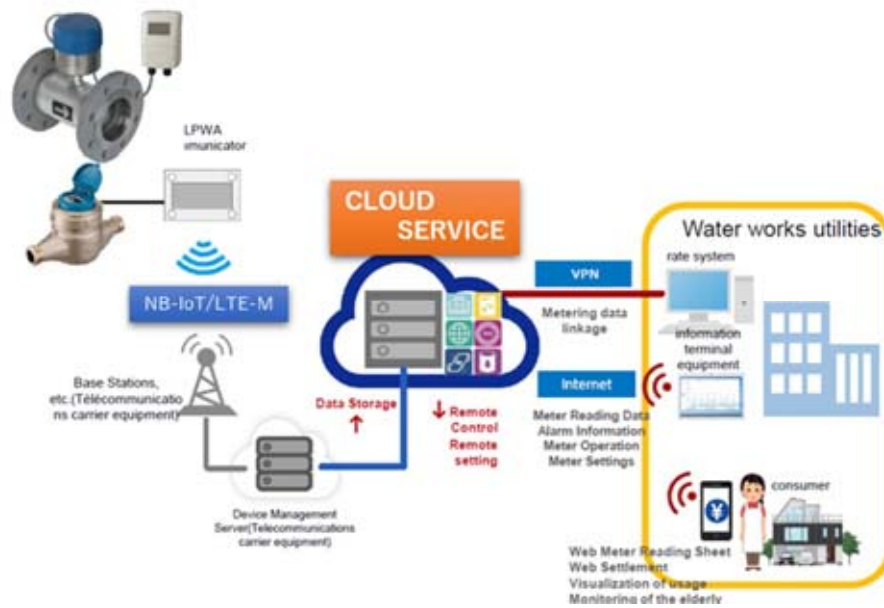
Note that there are differences in meter specifications between Japan and the Eastern Caribbean countries, such as flow rate units, required accuracy, pressure resistance

⁸ LPWA: Low Power Wide Area; Communication technology that enables wide area communication with low power. It is used for instrumentation equipment, etc., and the operation over 10 years is possible only by the battery, which does not require power supply and signal wiring.

⁹ In general, the amount of water consumption and the time zone do not change from day to day compared to electricity and gas, and it is suitable to detect abnormalities in the living styles due to dementia or health problems.

¹⁰ In Japan, the water meter is used for 8 years ×3 cycles by replacing and cleaning an internal module.

standards. In order for Japanese manufacturers to enter the local market, customization is required.¹¹



Source: Technical Data from manufacturer

Figure A1-13 Introduction of water smart meter



Source: Technical data from manufacturer

Figure A1-14 Smart plastic water meter under demonstration

¹¹ The standard Japanese water meter specifications are as follows: "Flow rate unit: m³ or liter, Accuracy: R100, Pressure resistance standard: 1.5 times the water pressure used" 1 minute. On the other hand, in the East Caribbean, it is considered that "flow rate units: British gallons, accuracy: R160, pressure resistance standard: 1.6 times the specified water pressure for 1 hour".

(11) Digital Twin Model Simulation and Training System powered by VR
[Technical Overview]

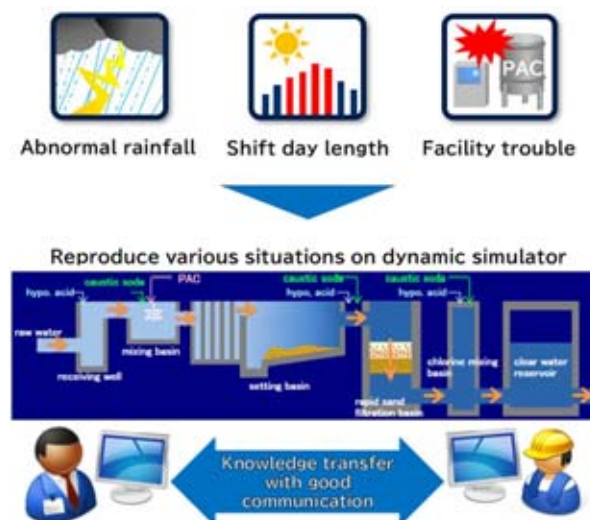
In the water supply and sewerage industry, SCADA has been widely used to monitor and control the operation of facilities. While operational monitoring can be centrally managed, it now requires operators to have advanced skills to handle it.

Digital Twin technology for water treatment plants has been jointly researched by a Japanese company and the Osaka City Waterworks Bureau. It consists of a two-layer model that combines a Plant Model with a Monitoring/control model to optimize operation. The accuracy of simulation can be improved by comparing actual operation data with simulation data. And it supports the operation index prediction and appropriate operation management under irregular conditions.

There is also an Operator Training Simulator using VR technology. The system can move and manipulate the equipment in the 3D models by wearing VR goggles and operators can experience immersive training. Combined with an application for making flowcharts of the operation procedure combined, you can conduct training in case of abnormality as well as normal operation.

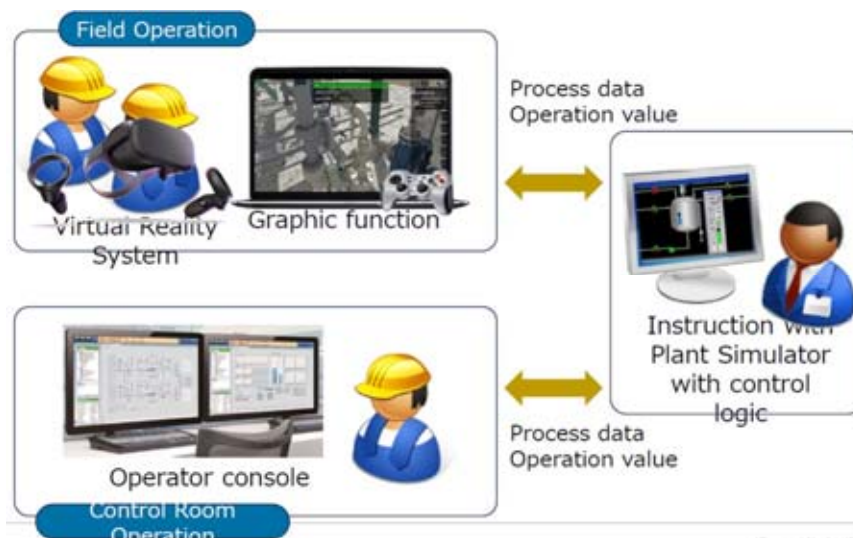
[Compatibility with the Eastern Caribbean Countries and Considerations]

In the Eastern Caribbean region, water facilities have been repeatedly damaged by tropical cyclones and hurricanes. Although it is necessary to repeatedly train and develop O&M manuals for disaster preparedness, it is difficult to deliberately create the abnormal condition (power failure, malfunction, etc.). The digital twin technology makes it possible to train emergency response procedures in advance in a realistic environment.



Source: Technical Data of manufacturer

Figure A1-15 Overview of simulation with digital twin model



Source: Technical Data from manufacturer

Figure A1-16 Outline of operator training system

(12) Cloud-based integrated infrastructure management system

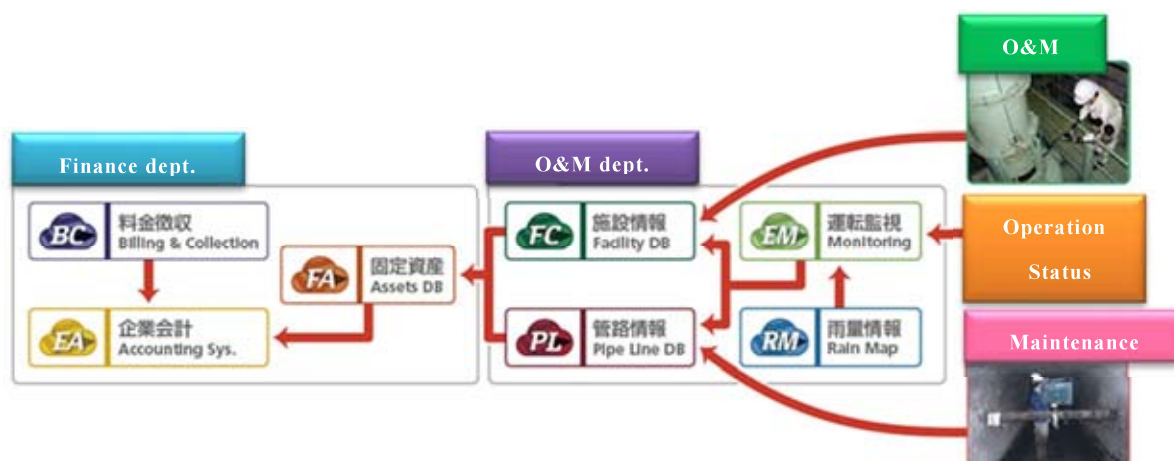
[Technical Summary]

In general, the finances and the O&M of facilities are managed by separate departments, and the information is often not integrated. Most management systems specialize in either financial or asset management, and lack of the capability to integrate them.

A cloud-based integrated business management system, which is increasingly being introduced in Japan, collectively manages functions such as asset information, field inspection and repair records, and operations. An integration of financial, accounting, toll collection, and asset information makes it possible to develop an optimized business plan and renewal plans by using a service that performs highly accurate business simulation.

[Compatibility with the Eastern Caribbean Countries and Considerations]

For water utilities in the Eastern Caribbean countries, as for many utilities in the world, the revision of water tariffs is a controversial issue and the justification with substantial reasons is essential. The integrated management system can simulate the future demand for renewal of facilities in the medium and long term, and it can be used for a decision making by top management as a supporting material in proposing the budget allocation and also the water tariff revision.



Source: JST

Figure 1 A1-17 Integrated cloud-based infrastructure management system

Appendix 2 Japanese technology expected to be introduced Part 2

This chapter introduces Japanese technologies that are not explained in the survey but are expected to meet the current/future needs in the region.

(1) Johkasou (septic tank with aeration)

[Technical Overview]

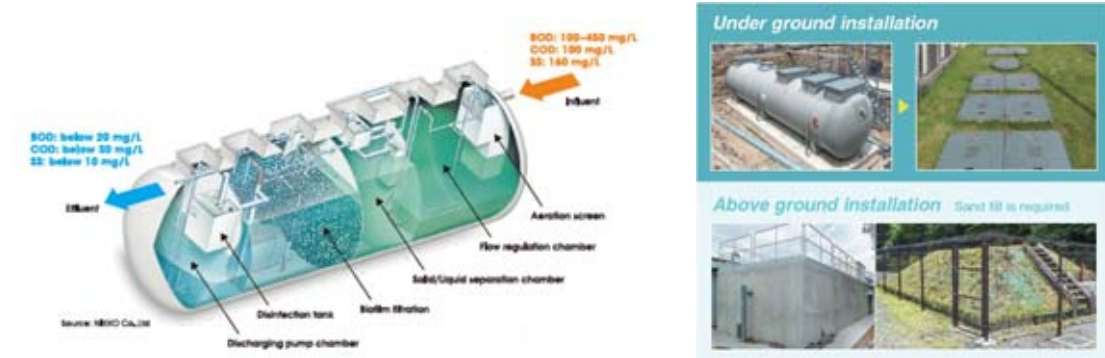
Different from large-scale sewerage system, this technology is a decentralized treatment facility that performs wastewater treatment on a building and community basis. In Japan at present, Johkasou is widely implemented in areas where sewerage systems are not popularized.

In many countries including the Eastern Caribbean region, general septic tanks are common which perform only "pre-treatment + anaerobic treatment", but Johkasou improves the treated water quality with aerobic treatment. Depending on the water quality after treatment, the treated water can be used for landscaping and other water, depending on the variety of treatment specifications and its water quality.

[Compatibility with the Eastern Caribbean Countries and Considerations]

Johkasou was originally developed in Japan and has been introduced to over 7 million households or communities. It has been introduced in dozens of countries around the world through the sales effort of the private sector and governmental supports. Implementation records have demonstrated a notable upward trend since 2015, with particularly consistent progress observed in China, the United States, Australia, Vietnam, and other countries. Notably, even a small island nation like Palau, similar to the Eastern Caribbean countries, have unwavering implementation records.

At present, the need for water reuse is not great in the Eastern Caribbean countries, but in some countries, sewage is not treated, and unpleasant odors have been detected in the waterways and seashores of the island. In addition, there is a trend of groundwater development due to a decrease in surface water caused by the climate change. Nitrogen pollution of the groundwater may become a problem in the future, which has not been apparent so far. It is also worth considering to conserve groundwater sources and expand the use of Johkasou in the future by conducting pilot projects before the problem becomes apparent, and studying the adaptation and establishment of a certification system.



Source: Left- “Characteristic of Johkasou”; Ministry of Environment, Japan
Right- Technical Data of manufacturers

Figure A2-1 Overview of Johkasou

(2) Prediction of water pipe degradation by AI

[Technical Summary]

The installation of the water pipe network is often carried out at one time, a time-based renewal plan requires renewal work in a concentrated period, which has a major impact on the financial condition of the utilities. On the other hand, a progress of deterioration of water pipes varies greatly depending on the installation conditions, and there are some cases where the pipes come to have a service life of 30 years, and another case where they remain in good condition even after 60 years of installation.

The AI-based diagnostic service analyzes the probability of future damage to water pipes with high accuracy by combining data on water pipes owned by water utilities with data on soil, climate, population, etc. It helps to create a pipe replacement plan through predictive maintenance and extend the service life of water pipes in good condition.

[Compatibility with the East Caribbean Countries and Considerations]

Currently, many countries in the Eastern Caribbean are faced with surface water leakage, which is being addressed by staff. Since this technology also requires data on the original water distribution network layout, it is desirable to consider implementing this technology after the water distribution network management system is well established in the future.



Source: Technical data from the service provider web site

Figure A2-2 Outline of prediction of water pipe deterioration by AI

(3) Waterproof sheet with canopy for rainwater reservoir

[Technical Overview]

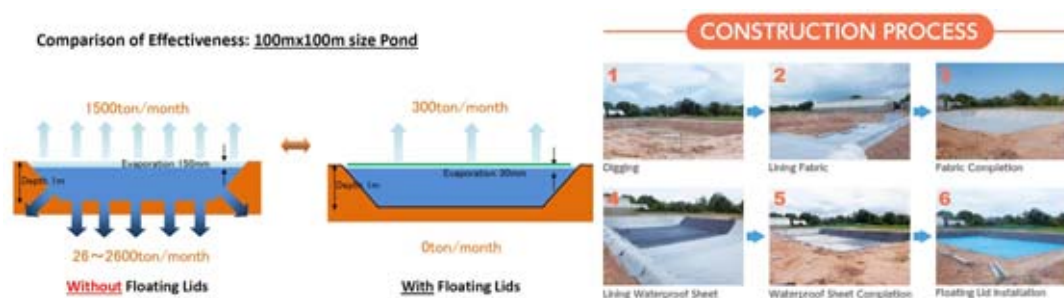
Rainwater reservoirs exist throughout Japan, especially in the western part to provide water for agricultural use, and they play a role in providing water for regions that often suffer from water shortages. However, there is a possibility that more than 40% of rainwater may be lost due to seepage and evaporation under certain conditions. Rainwater is not being used as effectively as it could be. Sunlight causes unwanted algae blooms and unpleasant odors, and there is also a risk of quality degradation due to discoloration of agricultural crops.

A waterproof sheet reservoir with a canopy prevents soil infiltration through a waterproof sheet buried in the underground and controls evaporation through the canopy. This product suppresses the water loss to less than a tenth of a reservoir without countermeasures. As the canopy suppresses algae bloom, it can also contribute to ensure the stable water quality.

[Compatibility with the East Caribbean Countries and Considerations]

In many regions where rainwater harvesting is recommended, there is a need to secure water for agriculture. The need for this technology is estimated to be high.

Since that the canopy system is designed to prevent from scattering by strong winds through the skirt structure, there was no scattering caused by the typhoon in Japan. However, it is necessary to study whether it is similarly prevented in case of hurricane in the region.



Source: Shibata Industrial Technical Data

Figure A2-3 Outline of reservoir with waterproof sheet and canopy

(4) Seawater desalination by FO membrane treatment

[Technical Overview] Japan Catalyst

As seawater desalination technology, MSF (Multi-Stage Flushing) method and RO (Reverse Osmosis) membrane method have been widely used. In recent years, the introduction of RO membrane method, which consumes relatively little energy, is remarkably increased. Although RO membrane method consumes less energy than MSF method, RO membrane method consumes a lot of electricity for pumping salty water for passing through the RO membrane. In islands where the price of energy is high due to dependence on imported fossil fuels, the cost of electricity is one of the major factors burdening the finances of water utilities.

Demonstration of seawater desalination by FO (Forward Osmosis) membrane is progressing as a technique to reduce the power consumption of seawater desalination. The DS (Draw Solution; osmotic pressure generator) is added to the filtered water so that the filtration treatment can be performed at a low pressure by utilizing the natural osmotic pressure^{12,13}.

DS in the filtered water must be separated by heat treatment, and NF (Nanofiltration) treatment must be carried out in the subsequent stage additionally. However, compared with the whole system, the FO method can be realized with about 1/3 of the electric power consumption. As a heat source for DS separation, other further energy-saving technologies are being studied, such as CSP (Concentrating Solar Power) or waste heat utilization in conjunction with thermal power plants.

In addition, the FO membrane method can increase the recovery rate of filtered water by more than 65% (up to approximately 15% of the salinity concentration limit)¹⁴. It is also a preferable technique from the point of view of ZLD discharge (ZLD: Zero Liquid Discharge) because the discharge quantity is greatly suppressed.

The demonstration project of a 500 m³/day plant in 2023 has confirmed a long-term operation with stable water quality. From 2024 onwards, the water produced will only be used for agricultural purposes. And another demonstration project is being carried out with the aim of providing it as drinking water within the next five years.

[Compatibility with the East Caribbean Countries and Considerations]

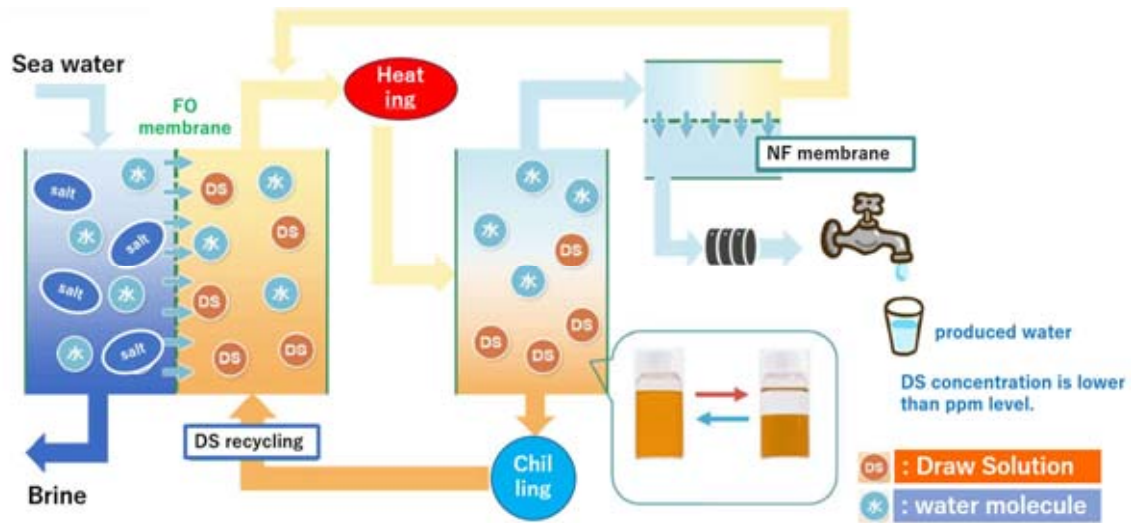
Although DS is removed below the ppm detection level, it is an unprecedented technology. For agricultural and drinking water applications, it is necessary to confirm each country's guidelines or drinking water standards, and to consider the public opinion. Public acceptance is also a major concern for the companies offering the FO

¹² The safety test of DS has also been carried out, and the safety in accidental swallowing and skin contacting has been confirmed.

¹³ Japanese companies have advanced technologies in developing and manufacturing membranes and DS, which are elemental technologies for FO.

¹⁴ Under RO membrane method, the recovery rate is about 40% and the concentration limit is about 7%.

membrane method. In order to expand the overseas market, it is necessary to study the trends in each country and to support through surveys and top-level sales.



Source: Technical Data from manufacturer

Figure A2-4 Diagram of seawater desalination Using FO technologies