North and Latin America
Central America and the Caribbean

Data Collection Survey for Water Security in the Eastern Caribbean Region

Final Report

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Japan International Cooperation Agency (JICA)

NJS Co., Ltd. (NJS)

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Abbreviations

Abbreviation	Official name
ACB	Antigua Commercial Bank
ANU	Antigua and Barbuda
APUA	Antigua Public Utilities Authorities
BGI	Barbados
BOO	Build Operate and Own
CANARI	Caribbean Natural Resources Institute
CARICOM	Caribbean Community
CAWASA	Carribean Water and Sewerage Association
CCCCC	Caribbean Community Climate Change Centre
CCRIF SPC	Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
CDF	CARICOM Development Fund
CIMH	Carribean Institute of Meteorology and Hydrology
CORE	Cooperation for Economic Recovery and Social Inclusion
CReW	Caribbean Regional Fund for Wastewater Management
CWSA	Central Water and Sewerage Authority
CWUIC SP	Caribbean Water Utility Insurance Collective Segregated Portfolio
CWWA	Carribean Water and Wastewater Association
DAC	Development Assistance Committee
DOM	Commonwealth of Dominica
DOWASCO	Dominica Water and Sewerage Company Limited
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amotization
ECCB	Eastern Caribbean Central Bank
ECCU	Eastern Caribbean Currency Union
XCD	East Caribbean Dollar
ECHO	European Civil Protection and Humanitarian Aid Operations
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIZ	Gesellschaft fur Internationale Zusammenarbeit
GND	Grenada
GNI	Gross National Income

Abbreviation	Official name
GWP	Global Water Partnership
GWSP	Global Water Security & Sanitation Partnership
HP	Home Page / Website
IAEA	International Atomic Energy Agency
ICR	Interest Coverage Ratio
IDB	Inter-American Development Bank
IFRS	International Financial Reporting Standards
IWRM	Intergrated Water Resources Management
JICA	Japan International Cooperation Agency
MAFFSRD	Ministry of Agriculture, Fisheries, Food Security and Rural Development
MESDISTVT	Ministry of Education, Sustanable Development, Innovation, Science, Technology and Vocational Training
MoC	Memorandum of Cooperation
MPWPUDE	Ministry of Public Works, Public Utilities and Digital Economy
NAP	National Adaptation Plan
NAWASA	National Water and Sewerage Authority
NDC	Nationally Determined Contribution
NEMO	National Emergency Management Organisation
NGO	Non-Governmental Organization
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
OECS	Organisation of Eastern Caribbean States
PUC	Public Utilities Commission
SDGs	Sustainable Development Goals
SIDS	Small Island Developing States
SKB	Saint Christopher and Nevis
SLU	Saint Lucia
SVD	Saint Vincent and the Grenadines
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WASCO	Water and Sewerage Company
WHO	World Health Organization
WRMA	Water Resource Management Agency
WSD	Water Services Department

Chapter 1 Introduction

1.1 Overview of operations

(1) Project name

Data Collection Survey for Water Security in the Eastern Caribbean Region

(2) Study area

Seven of the Eastern Caribbean countries listed in Table 1-1 and Figure 1-1 on the next page are subject to this survey. In the charts throughout this report, abbreviated country names are used for ease of description.

Table 1-1 Abbreviation of target country names

Abbreviated name	Country name (English)	Priority
SLU	Saint Lucia	★★★
ANU	Antigua and Barbuda	★★
DOM	Commonwealth of Dominica	★★
SKB	Saint Christopher and Nevis	★
SVD	Saint Vincent and the Grenadines	★
GND	Grenada	★
BGI	Barbados	☆

NOTE) "★" indicates the degree of priority given to the project formulation in the target country, and "☆" indicates that the main purpose of the visit is to meet with the international organizations established in the country.

(3) Establishment of priorities for surveyed countries

In performing this work, the investigation and examination work are carried out using the degree of priority set in the right column of the above table. The emphasis is not based on the water sector conditions in each country, but rather on the location of JICA's local offices and other locations, which are considered to be highly feasible for early projects, and on top of those countries that have not been investigated in the past.[1]

(4) Survey period

From December 7, 2023 to June 14, 2024

[1] Source: JICA (2019: Information-gathering and confirmation surveys on projects to strengthen water supply in the Caribbean region in North and Latin America)

Figure 1-1 Target countries in this study and the map of Saint Lucia

1.2 Background of the survey

(1) Overview of the issues facing the target region

The Caribbean is one of the world's most vulnerable regions to natural disasters, such as earthquakes, tsunamis, and volcanic eruptions, as well as frequent large hurricanes caused by climate change, flood damage caused by increased rainfall intensity and generation of high waves and storm surges caused by rising sea levels. In addition, the effects of climate change and the increasing number of tourists have a great impact on water supplies of each country.

Even in the countries subject to this survey, there is a tendency that the land area is small and the precipitation to the national land runs out from the river to the sea in a short time from the steep landform condition, and the water storage function of the island itself is insufficient. Although the water supply diffusion rate itself is high, water shortages are becoming normal due to a decrease in water supply capacity due to facility aging and a decrease in water source volume during drought seasons.

In addition, despite being one of the distinctive characteristics of small island developing countries, water shortages may have an impact on the livelihood of inhabitants, and unstable water supplies may have an impact on the socio-economic development of each country, as each country is highly dependent on tourism, and the tourism industry accounts for a large share of GDP and employment. For this reason, the establishment of water security through the stabilization of water supply and the strengthening of water supply projects is an urgent issue that will be common within the region.

(2) Trends and basic policy for Japanese aid to resolve issues

In this context, the Organization of Eastern Caribbean States (OECS), to which the Target Countries, with the exception of Barbados, belong in this study, cites "reinforcement of resilience" and "sustainable development" in the development strategy. In June 2023, the first Caribbean Water Conference (sponsored by the Barbados Government and USAID) was held in Barbados, and it was pointed out that the Caribbean region faced an unprecedented challenge in terms of water availability, use, and control. It was also mentioned that climate change had an adverse effect on the lives and survival of people in the Caribbean region, and the necessity of countermeasures was also suggested on the protection and resilience enhancement of water-related ecosystems in the Caribbean region, the efficiency improvement of water resource utilization, and the introduction support of water treatment technology.

In Saint Lucia, with the support of Japan in the Japan-Caribbean Climate Change Partnership, Japan has formulated a water-specific action plan for the country-specific adaptation plan (National Adaptation Plan, NAP). Japan's basic policy on cooperation with CARICOM member states also prioritizes "overcoming vulnerability," with "building resilient social infrastructure" being one of its key focus areas.

The relationship between Japan and CARICOM member states has been built over several decades, with official diplomatic relations beginning in the 1960s with specific countries like Jamaica and Trinidad and Tobago. Particularly noteworthy was the first official visit by a Japanese Prime Minister to the Caribbean region by then Prime Minister Shinzo Abe in 2014, marking the 20th anniversary of Japan-Caribbean exchanges, signifying a significant milestone in the relationship between Japan and CARICOM countries. Since then, Japan has been advancing cooperation with CARICOM countries in various fields such as energy, waste management, and disaster preparedness through JICA. Additionally, the year 2024, when this survey was conducted, marks the 30th anniversary of Japan-Caribbean exchanges, and the International Conference on Small Island Developing States (SIDS4) to be held in Antigua and Barbuda in May of the same year will address topics related to "water security," further highlighting the increasing importance of the region.

(3) Trends on JICA surveys in the target areas

In April 2017, JICA conducted the "Information Collection and Confirmation Survey for JICA-IDB Cooperation on Water and Sanitation Sectors in the North and Latin America Regions and the Caribbean Region" and the "Information Collection and Confirmation Survey on Water Supply Reinforcement Project in the North and Latin America Region Caribbean Regions" in June 2019 to collect and analyze information on existing water resource reserves, the current status of water supply systems, and the status of the introduction of desalination facilities. It was suggested that efforts to introduce seawater desalination facilities and take non-revenue water measures could be considered.

This survey covers the headquarters of OECS Commission, the largest population in the country in St. Lucia. The survey aims to analyze the current status of water security in the Eastern Caribbean region, issues, current administrative policies, legal systems, roles of related organizations, etc.; analyze the need for cooperation in this field; and examine and propose support policies for cooperation with other donors, including the IDB and CDB, as well as for the urgent water field.

1.3 Purpose of this study

The purpose of this study is to gather and analyze information on "water security" in the target countries, and to optimize the business portfolio of other donors, while considering cofinancing and business collaboration, and to consider and recommend a draft policy to support urgent water sector issues with a view to utilizing Japanese technology.

In carrying out the survey, we fully understand the studies conducted by JICA, governments, and other donors. We then review the literature, conduct on-site surveys

based on interviews with local and Japanese parties and online key personnel, and propose outlines for cooperation based on the findings.

Chapter 2 Basic Information on the Target Area

2.1 Summary of this report

2.1.1 Summary of challenges faced by the target area

Water security is defined as "ensuring an abundant and safe water supply where and when it is needed" in this report. The goals set to achieve this include: 1) ensuring a stable water supply (during normal times, natural disasters, and droughts), 2) improving the management of water utilities, and 3) enhancing the productivity of water utilities. Figure 2-1 organizes the common challenges and countermeasures faced by water utilities in each country. Detailed descriptions of the situations and problems of each water utility are provided in Chapter 10, Tables 10-2, 10-3, and 10-4.

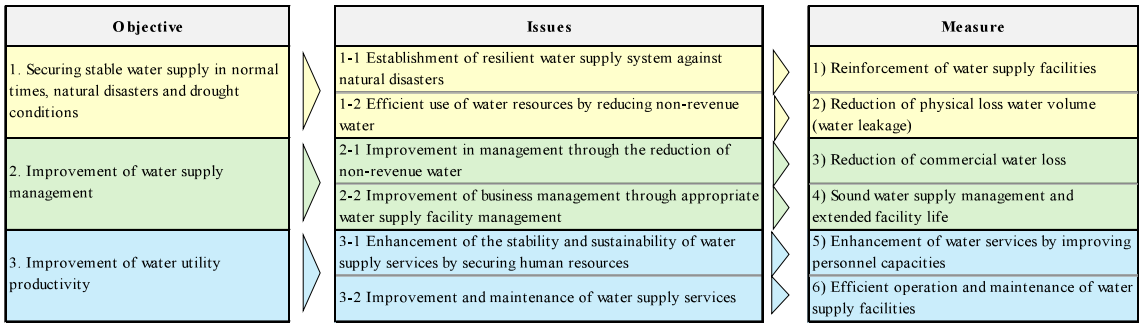


Figure 2-1 Challenges and countermeasures for the water utilities

2.1.2 Summary of proposed cooperation plans

To achieve the goals and sustainable development of water utilities, cooperation plans consisting of technical and financial assistance are proposed. The technical cooperation plan aims to horizontally expand the outcomes of technical cooperation in the Eastern Caribbean countries and this report propose three cooperation plans addressing common challenges across countries. Details are provided in Section 10.3. Figure 2-2 illustrates the goals, activities, and outcomes of the technical cooperation.

In addition to technical cooperation, financial assistance aims to restore and strengthen the functions of water facilities, expecting a synergistic effect with technical cooperation. The financial cooperation proposes common necessary support for each water utility. Furthermore, as water sources, terrain, water treatment methods, and the status of sanitation facilities vary, specific support needed by each water utility is also proposed. Table 2-1 presents the financial cooperation plans.

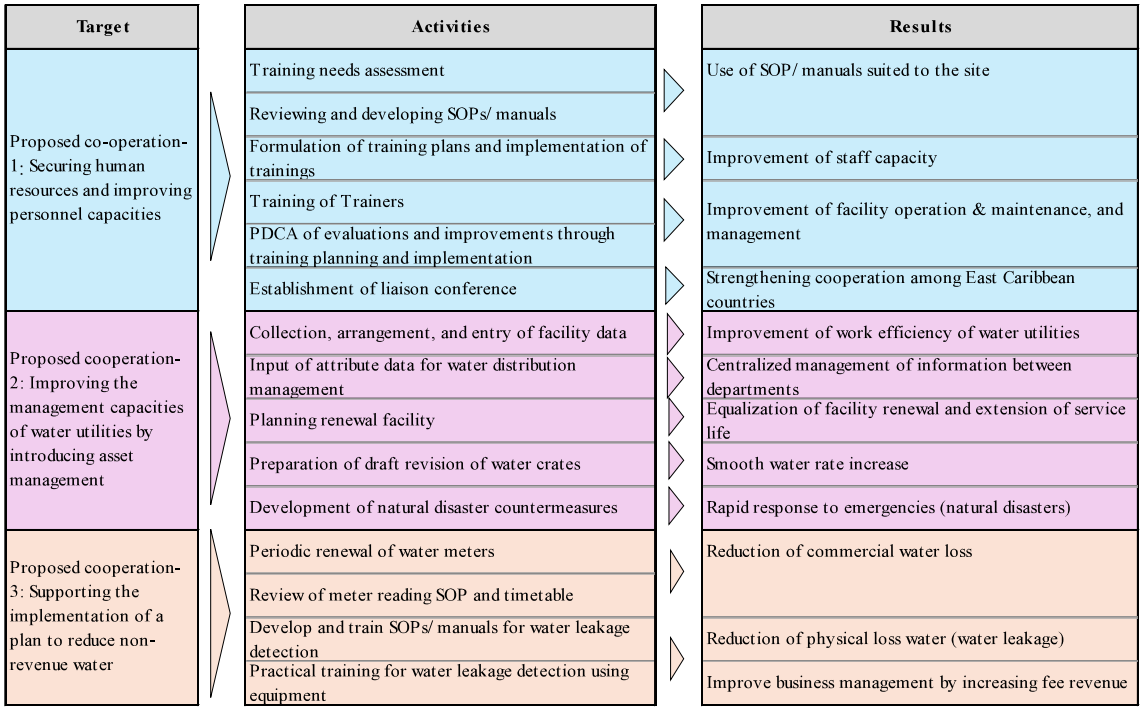


Figure 2-2 Three technical cooperation plans proposed in this study

Table 2-1 Financial cooperation plans for each water utility

Field	Support details	Purpose	Target country
Water piping	-Installation of connecting pipes between water supply areas -Double-section of water pipes -Replacement of aged pipes (reduction of water leakage)	-Back-up of the distribution water system -Securing water supply	Common
Sewerage	-Reuse of treated wastewater	-To reduce the burden on tap water sources	SLU, DOM
Water treatment plant	-Addition of desalination facilities	-Reducing the burden on surface water sources	ANU, SKB
Water piping	-Investigation of burial of existing water distribution pipes	-Renewal pipe plans and mitigation of emergencies	SLU, DOM
Water piping	-Decompression in the water piping	-Reduction of water leakage	DOM, SVD
Water treatment plant	-Filtration sand replenishment and sand washing machine introduced	-Maintenance of water treatment function by slow filtration	SVD
Water source	-Dredging in a dam and building sand control dam in a water source area	-Securing the amount of water sources	SLU
Rainwater harvesting	-Rainwater collection, storage and use	-Securing the amount of water sources	GND
Sewerage	-Extension of a sewage discharge drain	-Restoration of landscape and reduction of offensive odors	SLU

2.2 Outline of the target area

2.2.1 Regional overview

(1) Outline

The target countries are located in the Lesser Antilles in the Caribbean Sea, and are divided into the Leeward Islands in the north, the Windward Islands in the south, and the Leeward Antilles Islands in the southwest. Of the target countries, Antigua and Barbuda and St. Christopher and Nevis are classified as the Leeward Islands, and countries south of the Dominican Republic are classified as the Windward Islands.

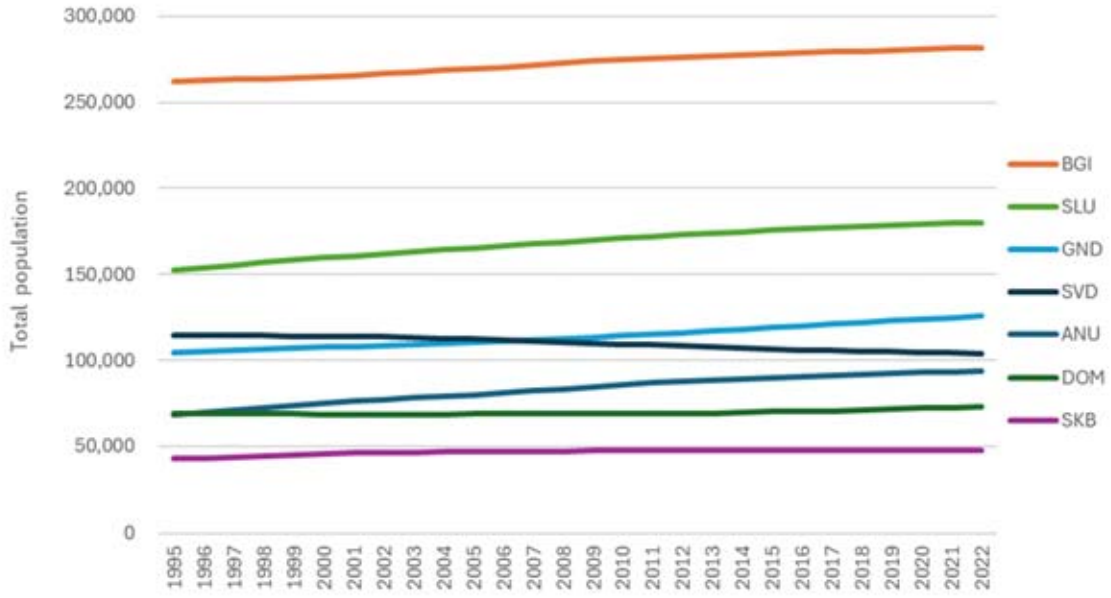
The Lesser Antilles is dotted with islands belonging to various countries, such as the United States, the United Kingdom, the Netherlands, and France, and only the seven countries covered in this report and Trinidad and Tobago are independent countries. All of them are small-scale states classified as SIDS.

Intergovernmental organizations in the region include the OECS, CARICOM, and the ACS. Six countries covered this time are members of each organization. In Barbados, the Barbados dollar is used, and in six other OECS countries, the Eastern Caribbean dollar is used.

(2) Comparison of social and economic conditions in each country

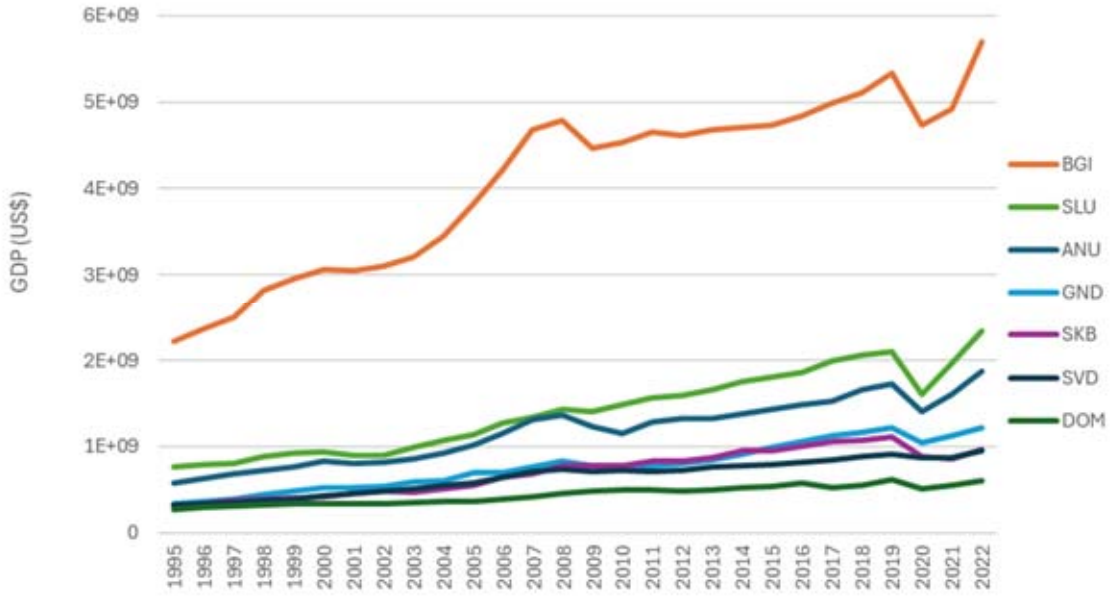
The social and economic conditions of each target country are described in detail in the following chapters, and here various data transitions in recent years are compared in order to grasp the outline of each country (Barbados is also shown as a benchmark for comparison in the region).

Looking at GDP trends in economic conditions (Figure 2-4), it shows an increasing trend in both countries, while St. Lucia and Antigua and Barbuda are relatively higher. Despite having the smallest population, St. Christopher and Nevis also belongs to the middle class, with a GDP per capita comparable to that of Barbados together with Antigua and Barbuda (Figure 2-5). GDP and GDP per capita are both lower in the Commonwealth of Dominica, and the economic disparities in each country can be read even in the region. During the period of COVID-19, the number of tourists declined sharply in each country, and GDP is expected to decline accordingly. The trend of GDP demodulation after 2021 is seen, but the impact on the economy of the tourism sector is estimated to be large.



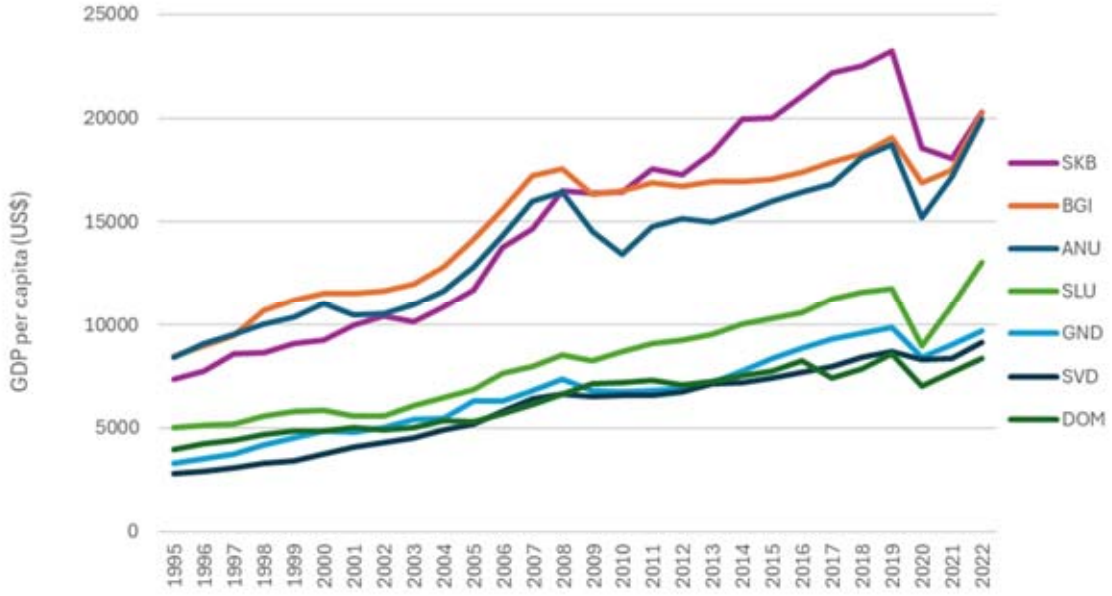
Source: Prepared by JST based on World Bank Open Data
Note: Legend is in descending order from the most recent data

Figure 2-3 Population trends in the target countries



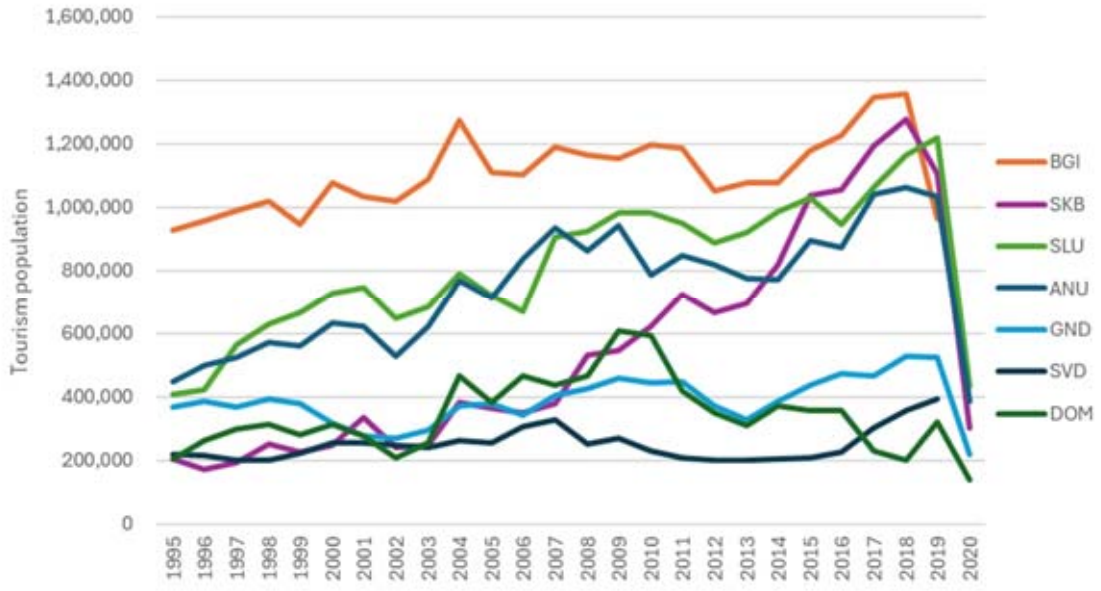
Source: Prepared by JST based on World Bank Open Data
Note: Legend is in descending order from the most recent data

Figure 2-4 Transition of GDP in the target countries



Source: JST based on World Bank Open Data
Note: Legend is in descending order from the most recent data

Figure 2-5 Transition of GDP per capita in the target countries



Source: Prepared by JST based on World Bank Open Data (2020 is the newest in this dataset)

Figure 2-6 Number of international tourists arriving in the target countries

2.2.2 Access to safe water and sanitation services

The Joint Monitoring Programme (JMP) conducted by WHO and UNICEF shows the status of each country in Table 2-2 and Table 2-3 (see Annotations on each page for the assessment methodology).

(1) Accessibility to safely managed drinking-water

Focusing on the percentage of the population that is “Safely Managed”, the average for Latin America and the Caribbean, to which the target countries belong, is relatively high compared to other regions except for Europe and the United States, but the improvement trend from 2015 to 2022 has been sluggish (75%→75%).

Focusing on the target countries in this study, only Grenada (90%) is showing "Safely Managed" due to missing data for other target countries, and it was up-to-date in 2017 and the latest data are unknown. “Basic” as the status of accessing basic water services, is higher in all of target countries.

(2) Accessibility to safely managed sanitary facilities

Similarly, focusing on the population share of "Safely Managed", the mean in Latin America and the Caribbean is still low (42% → 49%) although there is a tendency for improvement from 2015 to 2022, indicating that the state of sewage treatment has not improved.

In the target country, the status of "Safely Managed" cannot be read from this data because of data loss. Regarding the status of accessing basic sanitary facilities, "Basic (= latrines available within individual households)", St. Lucia (83%) is particularly low, and the percentage of open defecation can be seen in this data.

Table 2-2 Status of Access to Safe Water in Target Countries[1]

DRINKING WATER				TOTAL					TOTAL Proportion of population using improved water supplies					
COUNTRY, AREA OR TERRITORY	Year	Population (thousands)	% urban	At least basic	Limited (more than 30 mins)	Unimproved	Surface water	Annual rate of change (at least basic)	Safely managed	Accessible on premises	Available when needed	Free from contamination	Piped	Non-piped
SDG regions														
Australia and New Zealand	2015	28 411	86	>99	<1	<1	<1	0.01	-	>99	96	-	98	2
	2022	31 363	87	>99	<1	<1	<1		-	>99	96	-	-	-
Central and Southern Asia	2015	1 926 327	35	90	4	5	1	0.51	60	65	76	63	43	50
	2022	2 084 590	38	93	4	2	<1		68	73	75	73	43	54
Eastern and South-Eastern Asia	2015	2 268 355	56	92	1	5	1	0.75	74	86	89	74	68	26
	2022	2 344 325	62	97	<1	2	<1		79	92	94	79	75	22
Latin America and the Caribbean	2015	623 076	80	96	<1	2	1	0.31	75	92	79	76	90	6
	2022	660 269	82	98	<1	<1	1		75	95	78	78	92	6
Europe and Northern America	2015	1 100 651	76	99	<1	<1	<1	0.01	95	95	95	97	95	4
	2022	1 118 593	78	99	<1	<1	<1		94	95	96	95	97	2
Oceania	2015	11 992	22	56	2	18	24	0.36	-	42	36	-	34	24
	2022	13 676	23	60	2	21	17		-	48	38	-	30	33
Sub-Saharan Africa	2015	972 748	39	59	12	19	10	0.89	27	27	52	32	35	37
	2022	1 166 766	43	65	14	15	6		31	33	58	36	37	42
Northern Africa and Western Asia	2015	493 116	61	90	5	4	<1	0.38	75	83	75	77	83	12
	2022	553 690	63	92	6	2	<1		77	85	77	79	85	13

DRINKING WATER				TOTAL					TOTAL Proportion of population using improved water supplies					
COUNTRY, AREA OR TERRITORY	Year	Population (thousands)	% urban	At least basic	Limited (more than 30 mins)	Unimproved	Surface water	Annual rate of change in at least basic	Safely managed	Accessible on premises	Available when needed	Free from contamination	Piped	Non-piped
Anguilla	2015	15	100	97	<1	3	<1	-	-	88	88	-	97	<1
	2022	16	100	-	-	-	-		-	-	-	-	>99	-
Antigua and Barbuda	2015	90	25	98	<1	1	<1	-	-	38	91	-	98	<1
	2022	94	24	98	<1	1	<1		-	38	91	-	98	<1
British Virgin Islands	2015	29	47	>99	<1	<1	<1	0.21	-	98	-	-	96	4
	2022	31	49	>99	<1	<1	<1		-	98	-	-	-	-
Dominica	2015	70	70	95	<1	5	<1	-	-	81	52	-	94	1
	2017	70	70	95	<1	5	<1		-	81	52	-	94	1
Grenada	2015	119	36	96	1	<1	3	-	90	90	92	91	92	4
	2017	121	36	96	1	<1	3		90	90	92	93	92	4
Montserrat	2015	5	9	98	<1	2	<1	0.00	-	98	-	-	98	<1
	2022	4	9	98	<1	2	<1		-	98	-	-	98	<1
Saint Kitts and Nevis	2015	48	31	99	<1	1	<1	-	-	98	87	-	98	<1
	2017	48	31	99	<1	1	<1		-	98	87	-	98	<1
Saint Lucia	2015	176	19	96	2	3	<1	0.30	-	93	72	-	95	2
	2022	180	19	97	2	1	<1		-	94	73	-	97	2
Saint Vincent and the Grenadines	2015	106	51	98	<1	2	<1	-	-	96	72	-	94	4
	2018	105	52	98	<1	2	-		-	96	72	-	94	4

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Drinking water from an improved source that is accessible on premises, available when needed and free from faecal and priority chemical contamination
BASIC	Drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip, including queuing
LIMITED	Drinking water from an improved source, for which collection time exceeds 30 minutes for a round trip, including queuing
UNIMPROVED	Drinking water from an unprotected dug well or unprotected spring
SURFACE WATER	Drinking water directly from a river, dam, lake, pond, stream, canal or irrigation canal

Source: WHO-UNICEF, Joint Monitoring Programme for Water Supply, Sanitation and Hygiene

[1] Criteria: ① Available within buildings; ② Available when required; ③ Drinking water from sources free of feces or chemical pollutants is available. When all of these are met, "Safely Managed" is assessed and presented as a demographic percentage. In none of these cases, basic water accessibility is categorized as "Basic" if it takes less than 30 minutes to pump water to an improved source, including water supply facilities.

Table 2-3 Status of access to sanitary services in target countries[2]

SANITATION				TOTAL						TOTAL						
										Proportion of population using improved sanitation facilities (excluding shared)				Proportion of population using improved sanitation facilities (including shared)		
COUNTRY, AREA OR TERRITORY	Year	Population (thousands)	% urban	At least basic	Limited (shared)	Unimproved	Open defecation	Annual rate of change (at least basic)	Annual rate of change (open defecation)	Safely managed	Disposed in situ	Emptied and treated	Wastewater treated	Latrines and other	Septic tanks	Sewer connections
SDG regions																
Australia and New Zealand	2015	28 411	86	>99	<1	<1	<1	0.00	0.00	95	2	2	91	<1	8	91
	2022	31 363	87	>99	<1	<1	<1			96	1	1	93	<1	8	92
Central and Southern Asia	2015	1 926 327	35	60	11	6	23	2.44	-2.21	38	32	1	5	32	26	13
	2022	2 084 590	38	77	11	3	9			51	43	1	7	41	32	15
Eastern and South-Eastern Asia	2015	2 268 355	56	84	4	9	3	1.52	-0.28	52	14	3	35	18	27	44
	2022	2 344 325	62	94	3	2	1			64	16	3	45	16	33	48
Latin America and the Caribbean	2015	623 076	80	86	5	6	3	0.68	-0.40	42	11	3	28	10	17	63
	2022	660 269	82	90	4	5	1			49	10	3	36	8	16	70
Europe and Northern America	2015	1 100 651	76	97	<1	2	<1	0.08	0.00	83	4	6	73	6	10	82
	2022	1 118 593	78	98	<1	2	<1			84	3	5	76	5	8	85
Oceania	2015	11 992	22	35	5	47	14	-0.15	0.05	-	-	-	4	14	16	9
	2022	13 676	23	33	5	48	13			-	-	-	5	13	15	10
Sub-Saharan Africa	2015	972 748	39	30	17	31	21	0.56	-0.70	22	18	<1	4	32	9	7
	2022	1 166 766	43	35	18	31	17			24	20	<1	4	33	12	7
Northern Africa and Western Asia	2015	493 116	61	87	4	6	4	0.67	-0.38	56	10	5	42	11	19	61
	2022	553 690	63	93	3	4	<1			64	9	4	51	6	18	71

SANITATION				TOTAL						TOTAL						
										Proportion of population using improved sanitation facilities (excluding shared)				Proportion of population using improved sanitation facilities (including shared)		
COUNTRY, AREA OR TERRITORY	Year	Population (thousands)	% urban	At least basic	Limited (shared)	Unimproved	Open defecation	Annual rate of change in at least basic	Annual rate of change in open defecation	Safely managed	Disposed in situ	Emptied and treated	Wastewater treated	Latrines and other	Septic tanks	Sewer connections
Anguilla	2015	15	100	97	2	<1	<1	-	-	-	-	-	-	4	94	1
	2017	15	100	97	2	<1	<1			-	-	-	-	4	94	1
Antigua and Barbuda	2015	90	25	97	<1	2	<1	-	-	-	-	-	-	24	72	1
	2022	94	24	97	<1	2	<1			-	-	-	-	24	72	1
British Virgin Islands	2015	29	47	97	<1	3	<1	-	-	-	-	-	-	2	73	22
	2016	30	47	97	<1	3	<1			-	-	-	-	2	73	22
Dominica	2015	70	70	80	3	11	6	-	-	-	-	-	-	9	61	13
	2017	70	70	80	3	11	6			-	-	-	-	9	61	13
Grenada	2015	119	36	91	2	3	4	-	-	-	-	-	-	28	59	7
	2017	121	36	91	2	3	4			-	-	-	-	28	59	7
Montserrat	2015	5	9	87	10	1	1	0.34	-0.16	-	-	-	-	<1	78	19
	2022	4	9	89	11	<1	<1			-	-	-	-	<1	80	20
Saint Kitts and Nevis	2015	48	31	95	1	2	1	-	-	-	-	-	-	2	87	7
	2017	48	31	95	1	2	1			-	-	-	-	2	87	7
Saint Lucia	2015	176	19	83	10	<1	6	-0.07	-0.06	-	-	-	-	7	82	5
	2022	180	19	83	10	<1	6			-	-	-	-	7	82	5
Saint Vincent and the Grenadines	2015	106	51	90	2	6	3	-	-	-	-	-	-	15	69	7
	2018	105	52	90	2	6	3			-	-	-	-	15	69	8

SERVICE LEVEL	DEFINITION
SAFELY MANAGED	Use of improved facilities that are not shared with other households and where excreta are safely disposed of in situ or removed and treated off-site
BASIC	Use of improved facilities that are not shared with other households
LIMITED	Use of improved facilities that are shared with other households
UNIMPROVED	Use of pit latrines without a slab or platform, hanging latrines or bucket latrines
OPEN DEFECATION	Disposal of human faeces in fields, forests, bushes, open bodies of water, beaches or other open places, or with solid waste

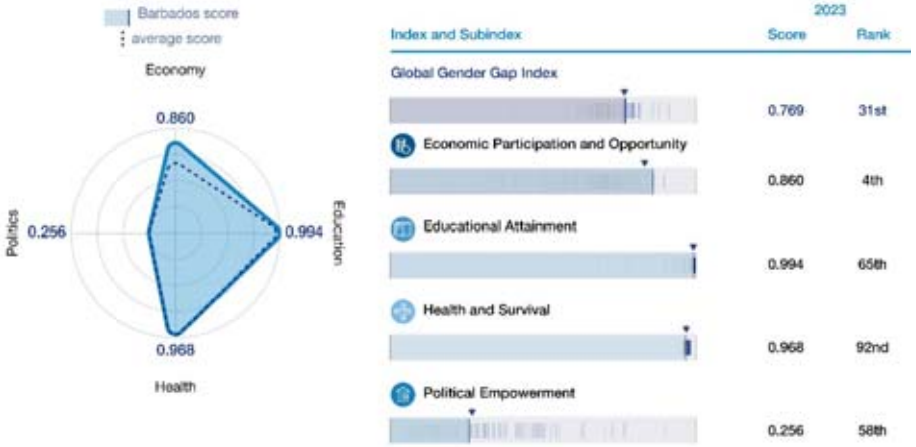
Source: WHO-UNICEF, Joint Monitoring Programme for Water Supply, Sanitation and Hygiene

[2] Criteria: ① On-site treatment is performed; ② Off-site treatment is performed after temporary storage at the point where sewage is generated; ③ Off-site treatment is performed after drainage is discharged through sewage pipes. When any of these conditions are met, "Safely Managed" is evaluated and indicated by population percentage. Even if none of them falls under this category, they are classified as "Basic" as accessible to basic sanitary facilities if they are not shared toilets among multiple households and if a toilet is available for every household.

2.2.3 Situation regarding the gender field

(1) Global gender gap index

The Global Gender Gap Index published by the World Economic Forum scores the gender gap in each country from the perspectives of economic participation, education, health, and political participation, and the closer the score is to 1, the less the gender gap is and the more gender equal the society is. In the latest report, only Barbados is available with a gender gap index of 0.769, ranking at 31st out of 146 countries.



Indicator	Rank	Score*	Compare with Global average	Difference F-M	Female vs Male	Min Max
Economic Participation and Opportunity	4th	0.860		-	-	-
Labour-force participation rate %	12th	0.896		-6.84	59.03 65.87	0-100
Wage equality for similar work 1-7 (best)	33rd	0.712		-	-	-
Estimated earned income Int'l $ 1,000	5th	0.881		-1.74	12.92 14.66	0-150
Legislators, senior officials and managers %	13th	0.971		-1.46	49.27 50.73	0-100
Professional and technical workers %	1st	1.000		15.33	42.33 57.66	0-100
Educational Attainment	65th	0.994		-	-	-
Literacy rate %	1st	1.000		-	-	-
Enrolment in primary education %	93rd	0.988		-1.15	95.13 96.28	0-100
Enrolment in secondary education %	1st	1.000		2.67	104.17 106.84	0-200
Enrolment in tertiary education %	-	-	-	-	-	-
Health and Survival	92nd	0.968		-	-	-
Sex ratio at birth** %	1st	0.944		-	-	-
Healthy life expectancy** years	102nd	1.022		-	-	-
Political Empowerment	58th	0.256		-	-	-
Women in parliament %	74th	0.364		-46.60	26.70 73.30	0-100
Women in ministerial positions %	56th	0.333		-50.00	25.00 75.00	0-100
Years with female/male head of state (last 50)	27th	0.137		-37.97	6.02 43.98	0-50

Source: Global Gender Gap Report 2023, World Economic Forum

Figure 2-7 Gender gap index for Barbados (2023)

(2) Literacy rate by sex for adults

Each country's literature rate is higher than the world average and the Caribbean average in both male and female, and no difference by sex is observed.

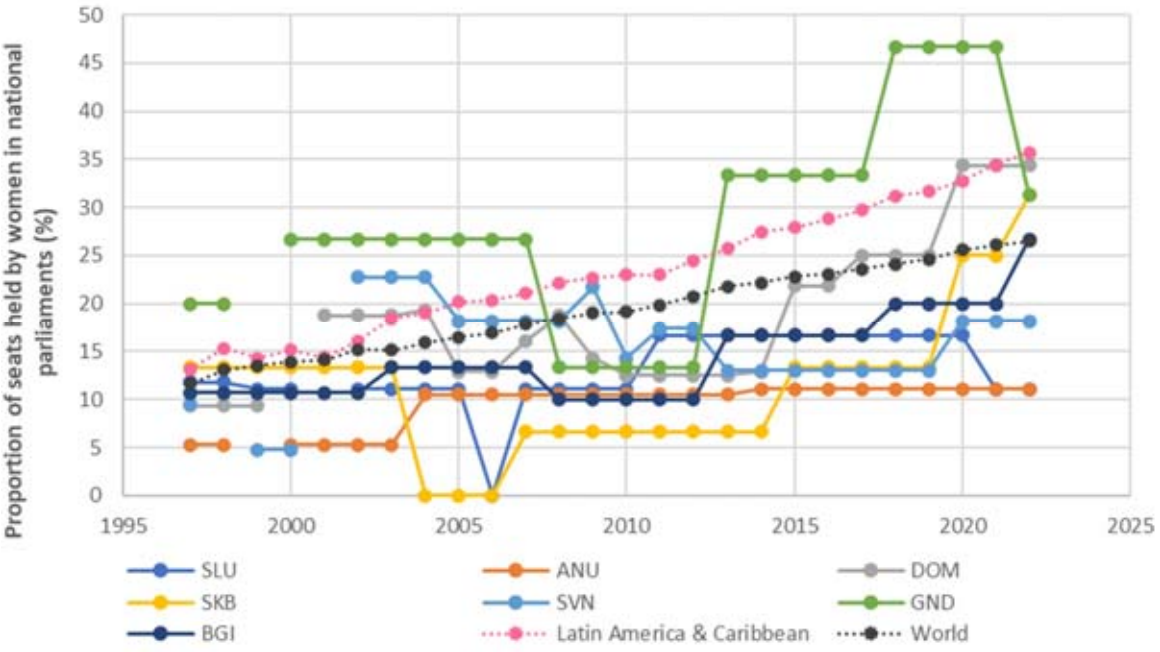
Table 2-4 Literacy rate of adults by sex in each country

Country name	Year	Male	Female
Antigua and Barbuda	2015	98.4 %	99.4 %
Grenada	2014	98.6 %	98.6 %
Barbados	2014	99.6 %	99.6 %
Caribbean countries' Average	2015	88.9 %	92.6 %
Global Average	2015	89.3 %	81.8 %

Source: Prepared by JST based on WB Gender Data Portal (shown only in available data)

(3) Women's Progress in Society

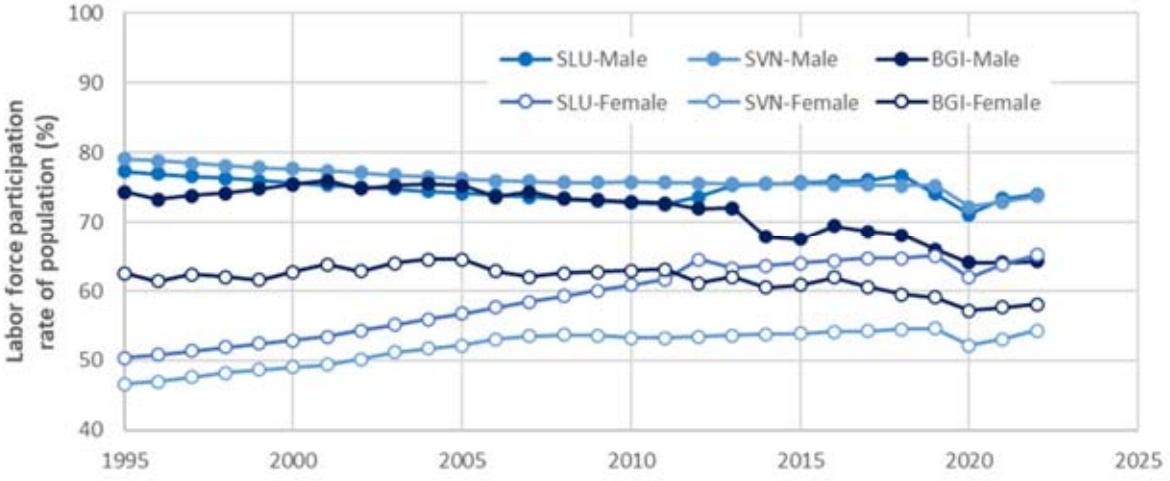
Looking at the share of women in national parliaments, the average for Latin America and the Caribbean is higher than the global average. On the other hand, most of the target countries are below the global average, although the proportions are in an upward trend. Among these, Grenada is at a high level. In addition, proportion of women in the labor force remains low, although the trend is upwards.[3]



Source: Prepared by JST based on WB Gender Data Portal

Figure 2-8 Transition of the percentage of women in each country

[3] In Grenada, the National Democratic Congress (NDC) has been in charge of the government from 2008 to 2012 and since 2022, and this change of government is presumed to be the sharp decrease and increase in the percentage of women in parliament.



Source: Prepared by JST based on WB Gender Data Portal (shown only in public countries)

Figure 2-9 Ratio of labor force by sex in each country

(4) Gender overview on the water sector

The proportion of female employees in the water utilities of the target countries is about 20-30% of the total workforce, as shown in the table below. The ratio of women in managerial positions varies between countries, ranging from 20% to 60%. However, the appointment of women to engineers and managerial positions within technical departments is relatively low. The CDB has made similar observations[4], noting that women have limited opportunities for roles such as management, facility construction, and facility management. Consequently, it is inferred that incorporating a gender perspective during the planning and design stages of water utility projects is challenging. Furthermore, the insufficient promotion of women's participation exacerbates the issue of workforce shortages faced by water utilities in each country.

Table 2-5 Proportion of female employees in water utilities

	SLU WASCO		ANU APUA		DOM DOWASCO		SKB WSD		SVD CWSA		GND NAWASA	
Total Employees	440		850		145		129		290		256	
Female employees	96	(22%)	258	(30%)	39	(27%)	25	(19%)	69	(24%)	51	(20%)
Total Managers	14		9		5		7		7		7	
Female Managers	6	(43%)	2	(22%)	3	(60%)	2	(29%)	3	(43%)	2	(29%)

Source: Prepared by JST (gender ratios of each department were not collected in this survey).

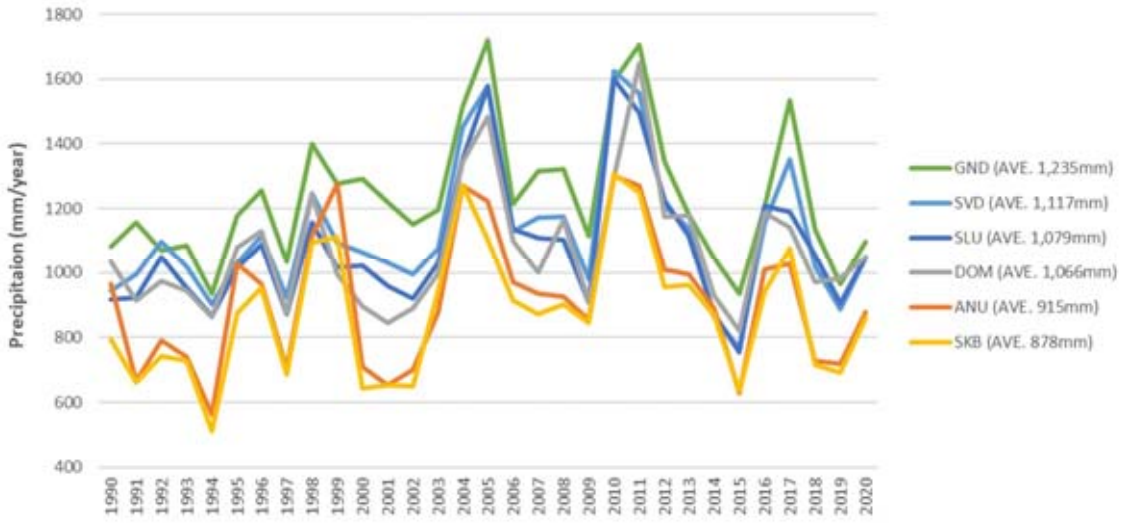
[4] Source: CDB (2018) Integrating gender equality into water sector operations

2.3 Status of integrated water resource management

2.3.1 Status of water resources

(1) Annual rainfall

Figure 2-10 shows the trend of annual rainfall over the period 1990 to 2020 in each country. As the legend of the table shows the country name in descending order of annual precipitation, the most precipitating amount is Grenada located in the southern part of the Lesser Antilles, and the least is St. Christopher and Nevis located in the northern part. Thus, the area located in the northern part of the islands tends to have less annual precipitation.



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

Figure 2-10 Annual precipitation trends in each country

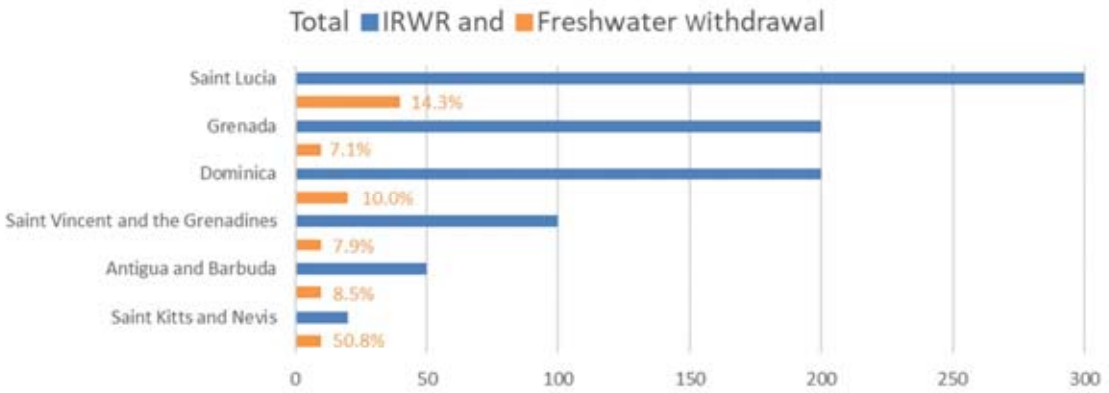
(2) Potential amount of available water resources

Figure 2-11 shows the potential amount of available water resource (IRWR: Internal Renewable Water Resources) and actual water withdrawals in each country. IRWR is proportional to land area and rainfall in the region.

When the water intake rate to IRWR exceeds 20%, a considerable burden is placed on the water resource, and when it exceeds 40%, a crisis situation is assumed. Based on this data, St. Christopher and Nevis has exceeded 50%, which means that its domestic water resources have become very tight.[5] In terms of actual water withdrawals, the specific result shows that the per capita water withdrawal is the highest for St. Christopher and Nevis, which is the most scarce water resource.[6]

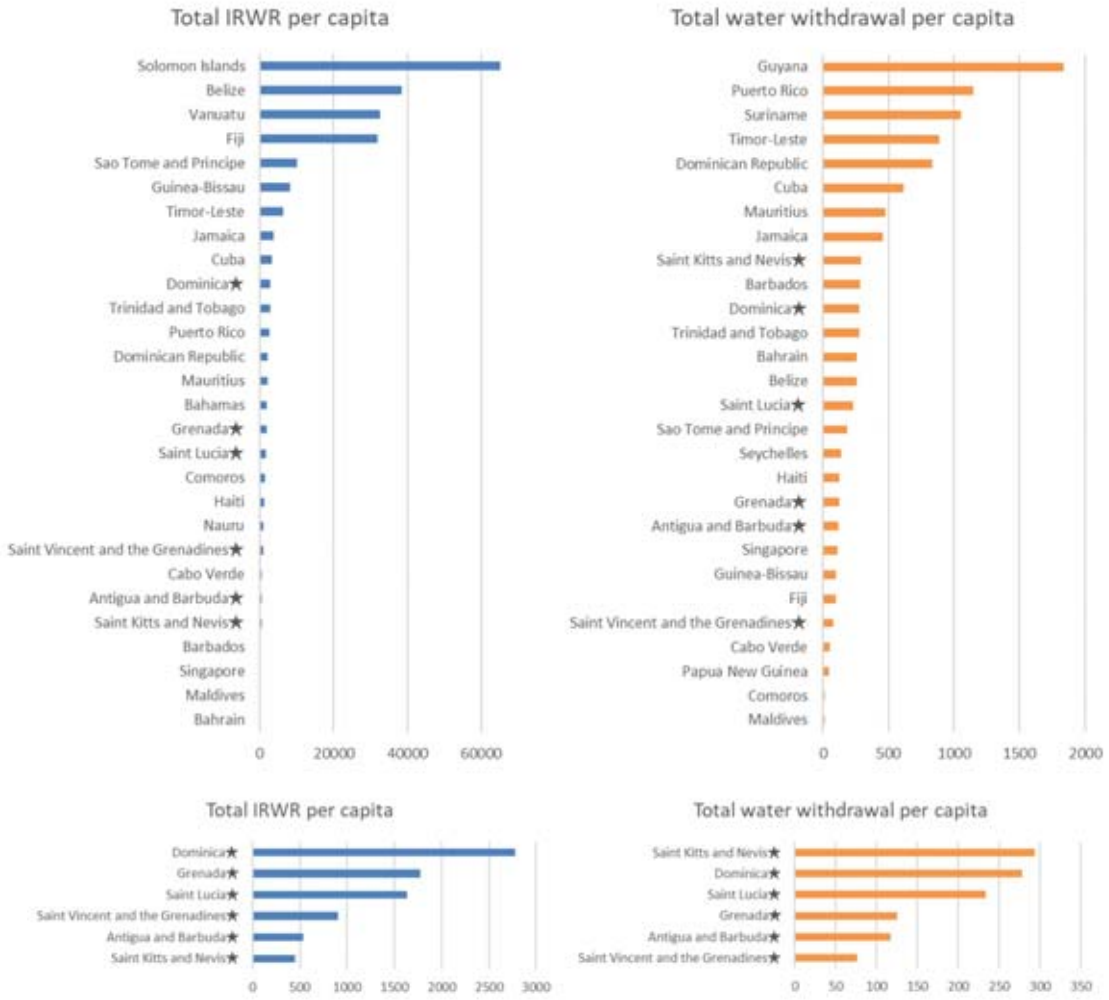
[5] Source: FAO (2005) The State of the World's Land and Water Resources for Food and Agriculture

[6] According to the interviews, St. Christopher and Nevis has the cheapest type of water tariff among the Caribbean countries, and wasteful use of water has resulted in the elimination of public faucets. Although the cause-and-effect relationship is not clear, the importance of water resources may not be easily understood due to this situation, and the volume of water intake may have increased.



Units: Millions of m^3/year (% in the figure is the water intake rate against IRWR)
Source: Prepared by JST based on FAO AQUASTAT (2020)

Figure 2-11 Annual IRWR and withdrawals in each country



Unit: m^3/person/year
Source: Prepared by JST based on FAO AQUASTAT (2020)

Figure 2-12 Annual IRWR and withdrawals per capita in the countries and SIDS

(3) Dam development status

Based on FAO AQUASTAT data, three of the six countries covered have domestic dams: Antigua and Barbuda, St. Lucia, and Grenada. In particular, Antigua and Barbuda has the most dams, with 18 in large and small sizes.

According to the results of the surveys described later, problems such as the depletion of dam water sources during the dry season in Antigua and the reduction of water storage capacity due to dam sedimentation caused by hurricanes and floods in St. Lucia were mentioned.

Table 2-6 Existing dams in the target countries

Country	Fig.	Name of dam	Reservoir capacity (ML)	Dam height (m)	River	Completed /operational since	Irrigation	Water supply	Flood control	Hydroelectricity (MW)	Navigation	Recreation	Pollution control	Livestock rearing	Other
SLU	✓	Roseau	**2,600**	91	Roseau River	1955		x							
ANU	✓	Potworks	**4,142**	20.42	Seasonal streams	1968		x							
ANU	✓	Collins	**342**	11.89	Seasonal streams	1966		x							
ANU		Wallings	**52**	150.88	Seasonal streams	N/A		x							
ANU		Fig Tree	**2**	112.78	Seasonal streams	N/A		x							
ANU	✓	Dunnings	**136**	30.38	Seasonal streams	N/A		x							
ANU		Brecknocks #1	**21**	73.15	Seasonal streams	N/A		x							
ANU		Brecknocks #2	**76**	39.93	Seasonal streams	N/A		x							
ANU	✓	Hamilton	**104**	46.94	Seasonal streams	N/A		x							
ANU		Body Ponds/Fisher/Fiennes	**101**	27.43	Seasonal streams	N/A		x							
ANU	✓	Bethesda	**537**	N/A	Seasonal streams	1968	x	x						x	
ANU		Red Hill	**46**	N/A	Seasonal streams	N/A	x							x	
ANU		Gunthorpes #4	**26**	N/A	Seasonal streams	N/A	x							x	
ANU		Gunthorpes #7	**67**	N/A	Seasonal streams	N/A	x							x	
ANU		Olivers Dams	**59**	N/A	Seasonal streams	N/A	x							x	
ANU		ASF Dams/Sugar Factory	**116**	N/A	Seasonal streams	N/A	x							x	
ANU		Langfords/Sugar Factory	**110**	N/A	Seasonal streams	N/A	x							x	
ANU		Gaynors/Collins	**32**	N/A	Seasonal streams	N/A	x							x	
ANU		Bendals	**23**	N/A	Seasonal streams	N/A	x							x	
GND	✓	Annandale	**5**	4.2	Beausejour River	1973		x							
GND		Concord	**4**	4.5	Black Bay River	1992		x							
GND		Les Avocat	**6**	4.8	Ballie's Bacolet River	1905		x							
GND		Mardi Gras	**7**	5	St. Louis River	1980		x							

Source: Prepared by JST based on FAO AQUASTAT (2015)

Source: FAO AQUASTAT (2015)

Figure 2-13 Water Source Location Diagram of St. Lucia (Dam and River)

2.3.2 Country scores for integrated water resource management

Integrated Water Resource Management (IWRM) is incorporated into Target 6.5, "IWRM at all levels, including appropriate cross-border co-operation by 2030," in SDGs Goal 6 (Water and Sanitation).

SDG Index 6.5.1 "Degree of IWRM" has four elements to achieve this index. The government responded to questionnaires consisting of 33 items in total: 1) Policy Environment (S1:7 items), 2) Organization/Participation (S2:11 items), 3) Control Means (S3:9 items), and 4) Funding (S4:6 items). Scoring is conducted between 0 and 100.

(1) Worldwide scores

Scores for each country as of the latest 2020 based on the above indicators are arranged in descending order of total scores as follows.

The countries covered in this report are shown in red, but they are located in the middle to lower ranks compared to the scores of countries around the world.

Table 2-7 Country Scores for Integrated Water Resource Management (1/4)

Countries	2020 reporting summary				
	Section averages				6.5.1 score
	S1	S2	S3	S4	
France	100	100	100	100	100
Singapore	100	100	100	100	100
Denmark	94	96	96	92	95
Japan	100	96	93	90	95
Kuwait	87	100	88	100	94
Monaco	98	93	88	95	94
Cyprus	97	96	89	90	93
Netherlands	94	92	87	93	92
Austria	92	95	93	84	91
Croatia	97	98	84	80	90
Germany	94	89	87	85	89
Luxembourg	84	92	90	88	89
Australia	85	89	91	88	88
Russian Federation	100	93	87	73	88
Slovenia	87	88	81	90	87
Spain	94	99	90	66	87
Greece	97	87	87	72	86
Malta	88	82	88	87	86
Sweden	81	85	87	90	86
Estonia	91	96	80	73	85
Israel	82	83	81	93	85
Belgium	83	95	88	63	82
Cuba	80	87	84	76	82
Ireland	81	80	84	78	81
Qatar	60	90	90	85	81
Switzerland	71	79	81	92	81
China	83	75	79	82	80
Czech Republic	87	83	83	67	80
Finland	88	80	82	68	80
Oman	90	81	86	60	79
United Arab Emirates	69	82	73	93	79
United Kingdom of Great Britain and Northern	86	85	76	68	79
Italy	89	78	76	63	77
Romania	92	82	82	52	77
United States of America	84	77	78	68	77
Republic of Korea	71	87	83	63	76
Hungary	80	79	77	63	75
Samoa	78	78	74	70	75
Poland	80	80	72	62	74
Liechtenstein	77	67	70	75	72
Portugal	76	68	78	67	72
Turkey	78	75	73	62	72
Morocco	78	76	66	62	71
South Africa	82	75	71	57	71
Brunei Darussalam	87	51	80	60	70
Bulgaria	77	72	70	58	69
Iceland	55	75	78	67	69

Source: IWRM Data Portal

Table 2-8 Country Scores for Integrated Water Resource Management (2/4)

Countries	2020 reporting summary				
	Section averages				6.5.1 score
	S1	S2	S3	S4	
Benin	69	78	71	52	68
Mauritius	70	67	63	73	68
Norway	64	75	66	67	68
Burkina Faso	74	84	57	50	66
Indonesia	67	66	63	68	66
Rwanda	70	73	66	53	66
San Marino	67	60	68	70	66
New Zealand	72	64	64	60	65
Jordan	70	58	72	57	64
Turkmenistan	63	48	63	80	64
Brazil	71	71	57	53	63
Democratic People's Republic of Korea	84	68	58	40	63
Malaysia	76	65	58	52	63
Zimbabwe	74	67	56	53	63
Cabo Verde	78	66	41	64	62
Lao People's Democratic Republic	64	61	66	58	62
Latvia	58	66	77	47	62
Mozambique	81	81	54	33	62
Uganda	63	63	60	63	62
Angola	69	67	64	43	61
Lithuania	68	45	62	70	61
Slovakia	64	71	62	48	61
Libya	54	67	60	60	60
Tunisia	59	62	58	60	60
Cambodia	61	64	58	52	59
Eswatini	69	57	67	43	59
Kenya	73	72	49	40	59
Bangladesh	59	60	61	50	58
Zambia	67	75	49	40	58
Azerbaijan	66	61	54	48	57
Colombia	57	70	57	42	57
Ghana	67	61	48	52	57
Saudi Arabia	42	69	71	46	57
Fiji	28	61	70	63	56
Pakistan	61	60	49	53	56
Philippines	63	62	60	38	56
Syrian Arab Republic	73	62	50	37	56
Malawi	76	57	43	43	55
Seychelles	60	70	56	35	55
Algeria	49	51	57	60	54
Belarus	50	56	66	42	54
United Republic of Tanzania	64	64	46	42	54
Bosnia and Herzegovina	60	53	56	43	53
Namibia	53	55	50	52	53
Niger	60	73	56	23	53
Thailand	60	59	41	50	53
Armenia	61	46	47	54	52

Source: IWRM Data Portal

Table 2-9 Country Scores for Integrated Water Resource Management (3/4)

Countries	2020 reporting summary				
	Section averages				6.5.1 score
	S1	S2	S3	S4	
Bolivia	60	51	51	45	52
Mali	58	60	56	35	52
Viet Nam	60	46	44	57	52
Costa Rica	49	56	52	45	51
Jamaica	52	51	68	30	50
Senegal	57	50	56	37	50
Micronesia (Federated States of)	50	59	46	42	49
Botswana	44	38	49	62	48
Uzbekistan	41	53	60	37	48
Albania	49	58	47	33	47
Burundi	50	56	48	33	47
Dominica	25	61	55	48	47
Mauritania	53	58	33	44	47
Sri Lanka	53	64	40	32	47
Barbados	38	60	63	23	46
Kazakhstan	37	51	51	43	46
Republic of Moldova	57	53	46	27	46
Tajikistan	49	43	48	42	46
India	41	39	63	37	45
Lesotho	72	46	38	23	45
Mongolia	54	45	43	37	45
Tuvalu	48	69	38	24	45
Vanuatu	53	63	49	16	45
Georgia	42	59	39	36	44
Nigeria	46	48	41	42	44
Congo	49	41	44	38	43
South Sudan	46	57	42	28	43
Egypt	47	46	49	24	42
Maldives	48	49	31	40	42
Mexico	49	47	43	28	42
Ethiopia	41	45	39	37	41
Peru	45	47	42	30	41
Cameroon	37	44	43	35	40
Côte d'Ivoire	34	46	46	33	40
Iran (Islamic Republic of)	40	39	45	36	40
Saint Lucia	40	41	45	32	40
Bahrain	28	48	41	40	39
Ukraine	35	49	40	32	39
Ecuador	40	47	52	13	38
Iraq	33	42	56	20	38
Madagascar	40	38	63	10	38
Central African Republic	53	47	24	23	37
Chad	43	44	39	20	37
Nepal	27	51	36	32	37
Andorra	23	41	43	35	36
Dominican Republic	32	50	44	16	36
Marshall Islands	37	42	50	16	36

Source: IWRM Data Portal

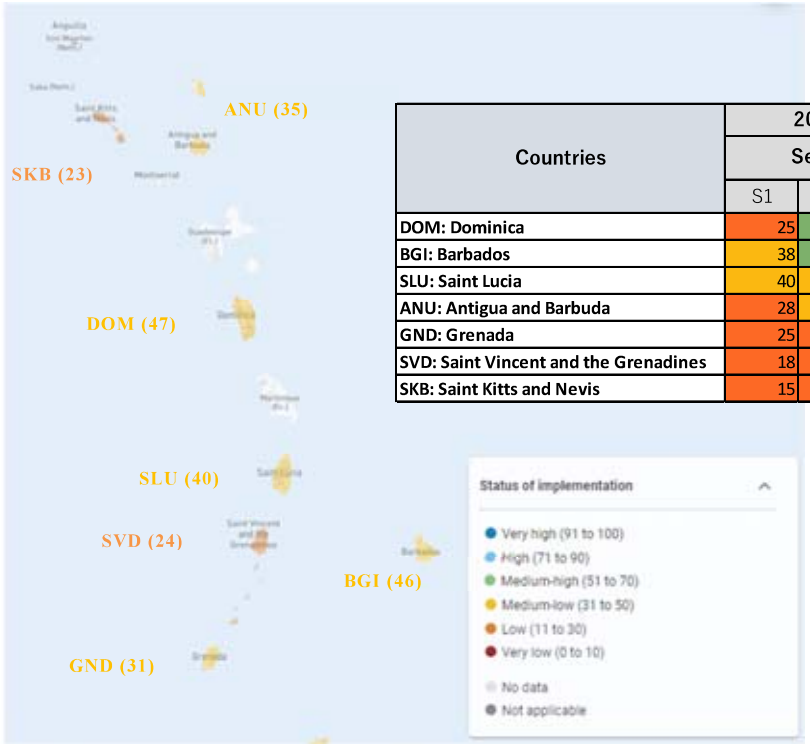
Table 2-10 Country Scores for Integrated Water Resource Management (4/4)

Countries	2020 reporting summary				
	Section averages				6.5.1 score
	S1	S2	S3	S4	
Serbia	37	42	42	23	36
Sierra Leone	44	42	32	27	36
Yemen	50	47	36	12	36
Antigua and Barbuda	28	47	45	20	35
Montenegro	54	24	38	23	35
Tonga	40	40	49	10	35
Bahamas	37	30	40	27	34
Sudan	43	35	36	23	34
Togo	50	28	32	25	34
Trinidad and Tobago	30	41	40	23	34
Uruguay	40	42	36	19	34
Bhutan	36	27	38	32	33
Myanmar	41	31	36	23	33
North Macedonia	35	26	43	28	33
Panama	40	38	30	25	33
Sao Tome and Principe	38	38	35	20	33
Chile	19	39	38	30	32
Democratic Republic of the Congo	36	40	26	27	32
Gambia	34	35	32	23	31
Grenada	25	25	34	40	31
Kyrgyzstan	27	30	43	23	31
Haiti	27	38	28	25	30
Nicaragua	39	32	31	17	30
Solomon Islands	30	30	35	24	30
Gabon	23	33	27	32	29
Paraguay	29	28	26	23	27
Guinea	19	27	27	27	25
Honduras	21	29	29	20	25
Lebanon	37	26	24	13	25
Saint Vincent and the Grenadines	18	20	48	8	24
El Salvador	26	25	23	18	23
Equatorial Guinea	40	29	0	24	23
Saint Kitts and Nevis	15	23	33	20	23
Suriname	21	24	33	15	23
Somalia	27	19	26	17	22
Belize	20	25	33	7	21
Guatemala	16	25	23	18	21
Comoros	37	26	10	7	20
Guinea-Bissau	17	25	22	13	19
Guyana	19	13	23	20	19
Papua New Guinea	17	20	30	7	19
Liberia	17	18	13	12	15
Timor-Leste	4	21	21	10	14
Afghanistan	23	13	9	2	12

Source: IWRM Data Portal

(2) Scores for target countries

Here, the St. Christopher and Nevis (total score: 23) and St. Vincent and the Grenadines (total score: 24) have particularly low scores.



Countries	2020 reporting summary				
	Section averages				6.5.1 score
	S1	S2	S3	S4	
DOM: Dominica	25	61	55	48	47
BGI: Barbados	38	60	63	23	46
SLU: Saint Lucia	40	41	45	32	40
ANU: Antigua and Barbuda	28	47	45	20	35
GND: Grenada	25	25	34	40	31
SVD: Saint Vincent and the Grenadines	18	20	48	8	24
SKB: Saint Kitts and Nevis	15	23	33	20	23

Source: IWRM Data Portal

Figure 2-14 National Scores of Integrated Water Resource Indicators as of 2020

Table 2-11 Organizations Responsible for Responses in Various Countries

Country name	Responding body	Respondent position	Response date
DOM	Dominica Water and Sewerage Company	Chief Engineer	'20-Aug-3
BGI	Barbados Water Authority	Water Quality Specialist	'20-Oct-27
SLU	Water Resource Management Agency	Water Resource Specialist	'20-Oct-1
ANU	Department of Environment, Ministry of Health and Environment	Climate Change Ambassador and DOE Director	'20-Aug-31
GND	Land Use Division, Ministry of Agriculture and Lands	Chief Land Use Officer	'20-Sep-11
SVD	Central Water and Sewerage Authority	Senior Engineer	'20-Oct-22
SKB	Ministry of Public Infrastructure	Permanent Secretary	N/A

Source: Country Survey Instrument for SDG Indicator 6.5.1 (described in descending order of scoring)

(3) Score breakdown of each subject country

The following page shows the score breakdown of S1～S4 and the questions set for calculating the scores.

For example, the policy environmental score shown in Table 2-12 shows that the national policy for St. Christopher and Nevis is underdeveloped (score: 0), indicating the immaturity of the institutional aspect of integrated water resource management.

Table 2-12 S1 Policies Environmental Scores for Each Country

Countries	1. Enabling Environment							
	1.1 National level			1.2 Other levels				Av.
	a	b	c	a	b	c	d	S1
Country name	Policy	Law	Plan	Policy	Plans	TB	Regs	
DOM: Dominica	30	30	30	n/a	10	n/a	n/a	**25**
BGI: Barbados	50	70	10	n/a	20	n/a	n/a	**38**
SLU: Saint Lucia	70	70	30	20	10	n/a	n/a	**40**
ANU: Antigua and Barbuda	40	40	20	20	20	n/a	n/a	**28**
GND: Grenada	30	30	30	n/a	10	n/a	n/a	**25**
SVD: Saint Vincent and the Grenadines	30	30	10	10	10	n/a	n/a	**18**
SKB: Saint Kitts and Nevis	0	20	20	n/a	20	n/a		**15**

No.	Question short text 2020 survey SDG indicator 6.5.1
1.1a	National water resources policy
1.1b	National water resources law(s)
1.1c	National IWRM plans
1.2a	Sub-national WR policies
1.2b	Basin/aquifer management plans
1.2c	Transboundary arrangements
1.2d	Sub-national WR regulation

Source: IWRM Data Portal

Table 2-13 Country scores for S2: Institutions and participation

Countries	2. Institutions & Participation											
	2.1 National level					2.2 Other levels						Av.
	a	b	c	d	e	a	b	c	d	e	f	S2
Country name	Orgs	Coordination	Participation	PS	Capacity	Basin orgs	Participation	Vulnerable	Gender	TB	orgs (subnat)	
DOM: Dominica	50	60	70	70	50	n/a	70	50	70	n/a	n/a	**61**
BGI: Barbados	70	80	50	60	40	n/a	n/a	n/a	n/a	n/a	n/a	**60**
SLU: Saint Lucia	50	80	30	50	40	40	40	30	30	n/a	20	**41**
ANU: Antigua and Barbuda	80	80	40	20	40	40	40	40	40	n/a	n/a	**47**
GND: Grenada	10	30	50	50	30	0	30	20	30	n/a	0	**25**
SVD: Saint Vincent and the Grenadines	50	50	10	0	60	10	0	0	0	n/a	n/a	**20**
SKB: Saint Kitts and Nevis	20	40	20	20	20	20	n/a		n/a	n/a		**23**

No.	Question short text 2020 survey SDG indicator 6.5.1
2.1a	National institutions leading IWRM
2.1b	Cross-sectoral coordination
2.1c	Public participation in WRM - national
2.1d	Private sector participation
2.1e	Developing IWRM capacity
2.2a	Basin/aquifer level organizations
2.2b	Public participation in WRM - local
2.2c	Participation of vulnerable groups
2.2d	Gender in IWRM laws/plans
2.2e	Transboundary organizational frameworks
2.2f	Sub-national authorities for IWRM

Source: IWRM Data Portal

Table 2-14 Country scores for S3: Management Instruments

Countries	3. Management Instruments									
	3.1					3.2				Av.
	a	b	c	d	e	a	b	c	d	S3
Country name	Monitoring	Sustainable	Pollution	Ecosystems	Disasters	Basin	Aquifer	Data	TB	
DOM: Dominica	50	60	50	70	60	50	20	80	n/a	**55**
BGI: Barbados	80	70	80	40	70	n/a	60	40	n/a	**63**
SLU: Saint Lucia	60	50	50	50	50	40	10	50	n/a	**45**
ANU: Antigua and Barbuda	60	40	20	40	60	40	40	60	n/a	**45**
GND: Grenada	30	40	40	40	40	10	30	40	n/a	**34**
SVD: Saint Vincent and the Grenadines	80	30	60	50	40	40	40	40	n/a	**48**
SKB: Saint Kitts and Nevis	40	40	20	40	40	20	40	20	n/a	**33**

No.	Question short text 2020 survey SDG indicator 6.5.1
3.1a	Water availability monitoring
3.1b	Sustainable and efficient use management
3.1c	Pollution control
3.1d	Water ecosystem management
3.1e	Management of water-related disasters
3.2a	Basin management instruments
3.2b	Aquifer management instruments
3.2c	Data and information sharing within country
3.2d	Transboundary data and information sharing

Source: IWRM Data Portal

Table 2-15 Country scores for S4: Financing

Countries	4. Financing						
	4.1		4.2				Av.
	a	b	a	b	c	d	S4
Country name	WR Budget	IWRM budget	WR budget	Revenues	TB	IWRM budget	
DOM: Dominica	50	60	30	50	n/a	n/a	**48**
BGI: Barbados	50	10	n/a	10	n/a	n/a	**23**
SLU: Saint Lucia	30	30	50	40	n/a	10	**32**
ANU: Antigua and Barbuda	40	20	20	20	n/a	0	**20**
GND: Grenada	30	30	n/a	60	n/a	n/a	**40**
SVD: Saint Vincent and the Grenadines	30	10	0	0	n/a	0	**8**
SKB: Saint Kitts and Nevis	20	20	n/a	n/a	n/a		**20**

No.	Question short text 2020 survey SDG indicator 6.5.1
4.1a	National budget for WR infrastructure
4.1b	National budget for IWRM elements
4.2a	Sub-national/basin budgets for WR infrastructure
4.2b	Revenues raised for IWRM elements
4.2c	Financing transboundary cooperation
4.2d	Sub-national/basin budgets for IWRM elements

Source: IWRM Data Portal

2.3.3 Indicators for water security

(1) Indicators for water security

UNU-INWEH lists the 10 items in the table below as factors related to water security. The indices for each item are evaluated with a maximum of 10 points and a total of 100 points. From the viewpoint of water security, the evaluation categories are "safety" at 75 or more points, "relatively safe" at 65 to 74 points, "unsafe" at 41 to 64 points, and "extremely unsafe" at 40 or less points.

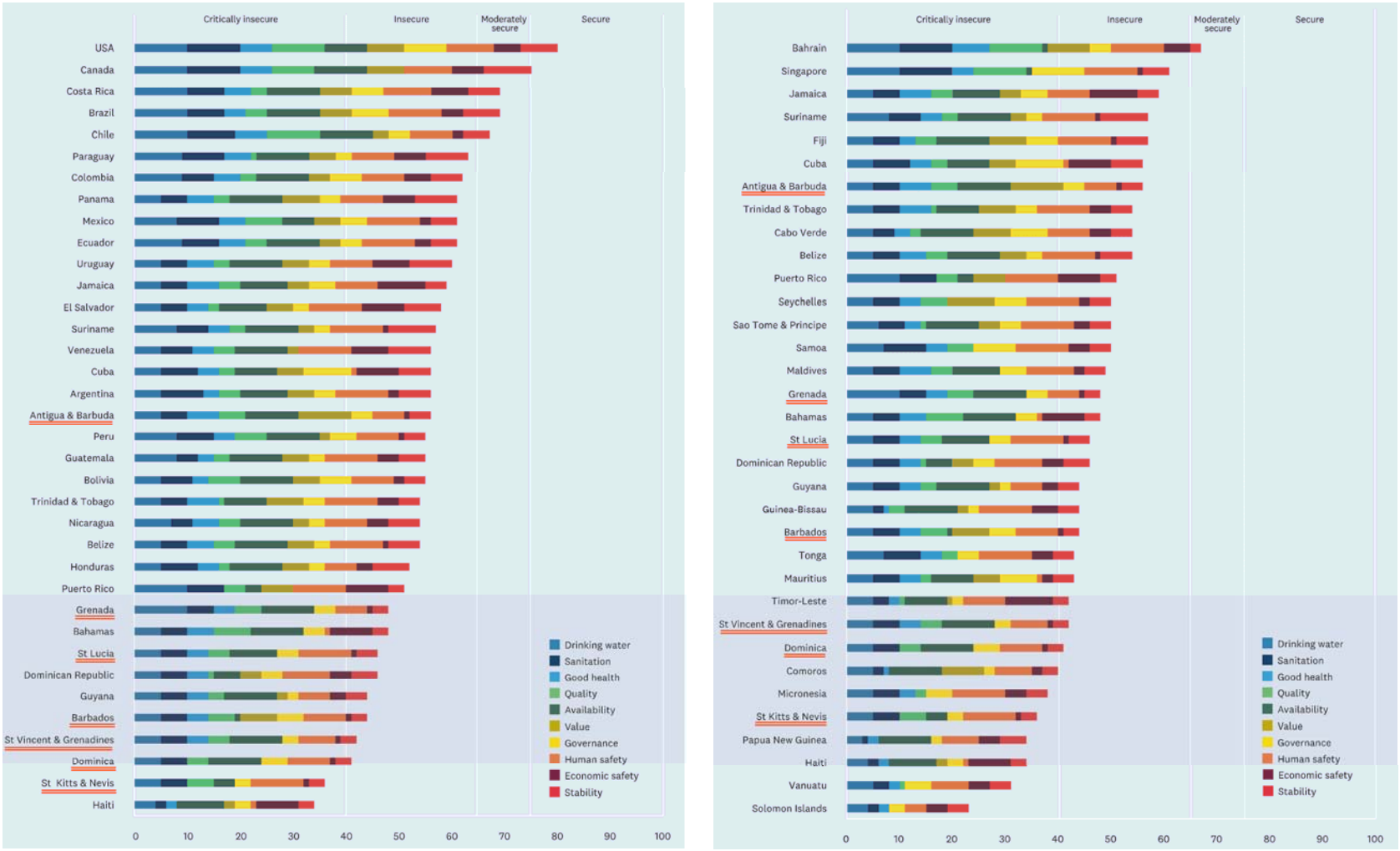
Table 2-16 Indicators for water security

	Water Security Component	Indicator(s) Used in this Assessment	Associated SDG Indicator(s)	Data Sources
1	**Drinking water**	Proportion of the population using basic to safely managed drinking water (%)	6.1.1: Proportion of the population using safely managed drinking water services	JMP (WHO and UNCICEF)
2	**Sanitation**	Proportion of the population using basic to safely managed sanitation (%)	6.1.2a: Proportion of the population using safely managed sanitation services	JMP (WHO and UNCICEF)
3	**Good health**	Mortality rate attributed to exposure to unsafe Water Sanitation and Hygiene (WASH) (deaths per 100,000 population)	3.9.2: Mortality rate attributed to unsafe water, unsafe sanitation, and lack of hygiene (exposure to unsafe Water, Sanitation, and Hygiene for All (WASH) services)	WHO
4	**Water quality**	Proportion of household wastewater treatment (%)	6.3.1: Proportion of domestic and industrial wastewater flows safely treated	WHO; Jones et al., 2021
5	**Water availability**	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (%)	6.4.2: Level of water stress: freshwater withdrawal as a proportion of available freshwater resources	FAO AQUASTAT
6	**Water value**	Water Use Efficiency (USD/m^3)	6.4.1 Change in Water Use Efficiency over time	FAO AQUASTAT
7	**Water governance**	Degree of Integrated Water Resource Management (%)	6.5.1 Degree of Integrated Water Resource Management (%)	IWRM data portal UNEP / DHI
8	**Human safety**	Mortality due to water-disasters (deaths per 100,000 population)	1.5.1, 11.5.1, 13.1.1 Number of deaths, missing persons, and directly affected persons attributed to disasters per 100,000 population	EM-DAT IHME
9	**Economic safety**	Modelled economic impact of floods (% of national GDP) Modelled drought risk (non-dimensional integer)	1.5.2, 11.5.2: Direct economic losses attributed to disasters in relation to global gross domestic product (GDP)	WRI Aqueduct
10	**Water resource stability**	Interannual variability (non-dimensional integer) Large dam storage /capita (m^3/capita)	None None	WRI Aqueduct ICOLD WRD

Source: UNU INWEH (2023) Global Water Security 2023 Assessment

(2) Water security score for the target countries

Figure 2-15 shows the scores for each country, including the target countries for this survey. With the exception of Antigua and Barbuda, all countries rank low within the US region and mid-to-low among SIDS. However, due to missing data for some indicators, which are evaluated as zero, there is a possibility of underestimation. Therefore, this document should be viewed as a reference material from a broader perspective. Meanwhile, the evaluation indicator items mentioned above will be used as reference elements in the subsequent discussion on water security.



Source: UNU INWEH (2023) Global Water Security 2023 Assessment

Figure 2-15 Water security scoring results (left: US region, right: SIDS)

2.4 Overview of the water supply situation

Based on the information obtained from this survey, the following is a summary of water supply services in the target countries. For details on each country, see the chapters below.

2.4.1 General situation of water supply

Table 2-18 summarizes the general situation of water supply in the target countries.

(1) Water utilities in the target countries

The table below shows the abbreviations and official names of water utilities in each country. With the exception of SKWSD in St. Christopher and Nevis, which is a water services department under the umbrella of the central government, all the utilities are public enterprises and operate under corporate accounting principles.

Table 2-17 Names of water utilities in the target countries

Country name	Water utilities	
	Abbreviation	Official name
St. Lucia (SLU)	WASCO	Water and Sewerage Company Inc.
Antigua and Barbuda (ANU)	APUA	Antigua Public Utilities Authority
Commonwealth of Dominica (DOM)	DOWASCO	Dominica Water and Sewerage Company Ltd.
St. Christopher and Nevis (SKB)	SKWSD	St. Kitts Water Services Department
St. Vincent and the Grenadines (SVD)	CWSA	Central Water and Sewerage Authority
Grenada (GND)	NAWASA	National Water and Sewerage Authority

(2) Water supply coverage

All countries have a high water supply coverage of more than 90%, indicating that the development of water supply facilities has almost been completed. The lowest coverage is 90% in ANU, with the remaining 10% relying on water trucks or rainwater harvesting.

(3) Scale of water supply business

In order of number of connections, SLU > GND > SVD > ANU > DOM > SKB, with SLU having the largest number of 73,914, which is about 3.9 times of 18,000 in SKB. On the other hand, in terms of water supply capacity, 73,300m^3/day in SLU and 31,900 m^3/day in SKB, the difference is about 2.3 times.

(4) Service level of water supply

The time of water supply depends on the availability (quantity), distribution (location) and rainfall (season) of water sources, and only DOM with abundant surface water sources have achieved 24-hour water supply throughout the year. In SKB and SVD, water is supplied 24 hours a day, 7 days a week only during the rainy season, and the water supply situation during the dry season varies from region to region. SLU, ANU, and GND have water rationing in both the rainy and dry seasons. Especially in SLU, there are areas

where the water supply frequency is once every two to three days. Therefore, there are many complaints about the water supply time.

All water utilities in the target countries have their own laboratories for water quality testing. The water utility laboratories in ANU and SKB are positioned as internal checks because the laboratories are not accredited by the government, and the ministries have separate laboratories for water quality testing.

Table 2-18 Overview of Water Supply Situation in the Target Countries

Item		SLU	ANU	DOM	SKB	SVD	GND
Water utility		WASCO	APUA	DOWASCO	SKWSD	CWSA	NAWASA
Water supply coverage		98 %	90 %	98 %	99 %	98 %	96 %
Number of connections		73,914	27,759	24,000	18,000	40,470	42,719
Water supply capacity ※1		73,300 m^3/day	32,000 m^3/day	32,500 m^3/day	31,800 m^3/day	32,390 m^3/day	33,000 m^3/day
Water supply frequency and average hours	Rainy season	24 hours/day (approx. 75%)	20 to 24 hours/day	24 hours/day	24 hours/day	24 hours/day	20 hours/day
	Dry season	24 hours/day (approx. 60%)	18 to 24 hours/day	24 hours/day	15 to 24 hours/day	8 to 24 hours/day	12 hours/day
Water quality testing※2		Testing in own lab. inspections	Testing in own lab. inspections	Testing in own lab. inspections	Testing in own lab. inspections	Testing in own lab. inspections	Testing in own lab. inspections

※1 Since the water supply capacities in SVD and GND are unknown, the average daily water supply in FY2022 is applied.

※2 The laboratories of ANU and SKB are unaccredited and therefore positioned for checking water quality internally.

2.4.2 Performance of water utilities

Based on the information obtained in this survey, the performance of water utilities in the subject countries is summarized below as well as Table 2-20. In terms of ANU for which a financial report was not obtained and SKB for which corporate accounting is not applied[7], the report shall be stated to the extent possible. Here, figures are quoted from the most recent financial reports according to the performance of external audits in each country. For SLU, fiscal year 2020, fiscal year 2021 for GND, and fiscal year 2022 for DOM and SVD. In SLU in fiscal year 2020, the aftermath of COVID-19 should also be considered.

(1) Accounting system

In SKB, the Ministry of Finance is responsible for the financial management of water works as part of services provided by a central government's department, where basic financial and accounting data are not available. On the other hand, in the other water utilities, corporate accounting is applied in accordance with the International Financial Reporting Standards (IFRS), which is a global standard for accounting, and financial reports are prepared for which external audits are conducted by auditing firms. Although ANU was asked to provide a financial report on several occasions, it was not finally received by the time of this survey.

(2) Business profitability

(a) **Water and toll collection rates**

The water rates per 20 m^3 of domestic water use are in the order of ANU > SLU > GND > DOM > SVD > SKB. The highest price is 104.95 XCD in ANU, whose water sources rely heavily on seawater desalination (70-90%), and the lowest price is 33.67 XCD in SKB. The difference is about 3.1 times. The target countries have not been able to raise water rates for more than 10 years, except for GND where water rates were raised in 2020. The SKB, in particular, has not been able to raise its water rates since 2001, and its water rates are among the lowest in the Caribbean countries.

The tariff collection rates are over 100% and good in all target countries, except for SKB (72%). The reason for the rate of 100% or more is that the year of tariff collection does not coincide with the year of billing. As described above, in SKB both the level of water rates and the collection rate are low.

(b) **Non-revenue water rate**

All countries have exceeded 30% of the non-revenue water (NRW) rate, which is a guideline for sound water utilities, and reducing NRW is a common issue for the Eastern Caribbean countries. NRW rates exceed 50% in SLU, ANU, DOM, and SKB. Especially in ANU, where high-cost desalination is the main source of water supply, the water supply

[7] Water works are run by a department of a central government ministry rather than by an independent water utility (described later in the chapter of SKB).

business is regularly in the red, mainly due to the large amount of NRW that does not generate revenue. In addition, SKB plans to introduce desalination plants in the near future, making the reduction of non-revenue water an urgent issue.

(3) Profitability (* Not evaluable for ANU and SKB)

SLU > GND > SVD > DOM in descending order of sales, which agrees with the trend of the number of connected houses. The difference between SLU and DOM is about 2.4 times. On the other hand, net income is highest in GND > SLU > SVD > DOM, with the ranking being reversed in SLU and GNU compared to sales, and also with a deficit of about 3.5 million XCD in DOM, where the depreciation burden of fixed assets is large.

The ratio of ordinary profit to sales[8] in GND is 20.9%, which indicates the most efficient management, while in SLU, which has the highest sales, and SVD it is low-single-digit percent. In both countries, it is necessary to confirm whether there are any factors that are structurally squeezing profitability in terms of costs, particularly in SLU with high sales levels. Negative figures are shown for DOM with large depreciation burdens. The operating ratio[9], another indicator of profitability, shows a similar characteristic.

As for EBITDA margins[10], according to a five-stage assessment proposed by the Global Water Security & Sanitation Partnership (GWSP), one of the World Bank group entities, GND and DOM are evaluated as Well-Performing, SVD and SLU as Good, and ANU as Elementary.

Table 2-19 EBITDA margins 5-stage assessment

Negative	0～5%	5～18%	18～30%	Greater than 30%
Elementary	Basic	Good	Well-Performing	World-Class

Source: GWSP (2018) Water Utility Turnaround Framework, A Guide for Improving Performance

(4) Stability (*Not evaluable for ANU and SKB)

The equity ratio[11] exceeds 90% in SVD, showing an extremely high figure. This is a reflection of the small amount of external debt, indicating financial stability. In DOM, on the other hand, it is low at 32.9%, and external borrowing accounts for more than two-thirds of the funding required to maintain business activities. The information from

[8] Calculated as ordinary profit ÷ sales. The larger the ratio shows, the better financial efficiency would be, indicating the capacity of water charges to cover the overall service cost, and this is a positive factor for profitability.

[9] Calculated as operating revenue ÷ operating cost. The ratio indicates the extent to which water and sewerage charges cover the direct cost for operation and maintenance of water equipment and water service operation, and can be construed that the larger the ratio shows, the better financial efficiency would be and that if the ratio is under 100% the water charges are not able to cover the direct cost.

[10] EBITDA ÷ sales (where EBITDA is an indicator of a company's or entity's valuation and refers to earnings calculated by adding interest expense and depreciation to income before income taxes). The larger the ratio shows, the higher the capacity of water revenue would be to earn cash associated with operating activities, which is interpreted as a positive factor for profitability.

[11] Calculated as net assets ÷ total assets. The higher the ratio shows, the smaller the external borrowing burdens would be, which means a positive factor for financial stability.

financial officials indicated that they had been continuously borrowing a substantial amount from major domestic commercial banks and other institutions, corroborating that financial stability was unsatisfactory.

The ratio of fixed assets to long-term capital[12] is 107.4 percent in DOM, which can be interpreted as a situation in which a portion of fixed assets must be covered by funds that need to be repaid in the short term. As mentioned above, this high ratio backs up the heavy reliance on borrowing from financial institutions.

(5) Liquidity (*Not evaluable for ANU and SKB)

As a supplementary analysis of cash flow management of each water utility, the account receivable collection period[13] has been calculated from the figures on financial statement. In SLU, although calculated as 11.8 months in covered fiscal year 2020, it is recorded around 6 to 7 months in other fiscal years (refer to the chapter of SLU); this might show a temporal stagnation of collection of water charges due to COVID-19. It is preferable to monitor the indicator of the subsequent fiscal years.

[12] Calculated as fixed assets ÷ (equity + fixed liabilities). This is an indicator of whether fixed assets can be covered by stable funds. The lower the ratio shows, the more stable the company's financial condition would be.

[13] Calculated as accounts receivable ÷ (sales ÷ 12). Sales are expressed as the number of months of water charge, that is, the number of months required to recover water charges. The larger the amount, the longer it takes to convert accounts receivable into cash, which is a negative factor for funding liquidity.

Table 2-20 Performance of water utilities in each country

Item		SLU	ANU	DOM	SKB	SVD	GND
Water utility		WASCO	APUA	DOWASCO	SKWSD	CWSA	NAWASA
Accounting system		Corporate accounting	Corporate accounting	Corporate accounting	Corporate accounting not applied	Corporate accounting	Corporate accounting
Water rate (XCD/20 m^3 of domestic water use)		71.99	104.95	56.02	33.67	55.49	64.45
Collection rate		110%	NA	NA	72%	115%	100%
Non-revenue water (NRW) rate ※2		55 %	50 %	58 %	50 %	30～40 %	40 %
Water meter installation rate		100 %	100 %	93 %	89 %	100 %	100 %
Net sales	(XCD)	50,724,449	NA	21,175,964	NA	30,343,718	42,641,013
	(Million yen)	2,844	NA	1,187	NA	1,701	2,391
Net income	(XCD)	731,837	NA	△3,522,486	NA	375,019	8,920,366
	(Million yen)	2,844	NA	1,187	NA	1,701	2,391
EBITDA	(XCD)	6,586,673	NA	4,700,353	NA	4,589,791	9,789,358
	(Million yen)	2,844	NA	1,187	NA	1,701	2,391
EBITDA margins		13%	NA	22%	NA	15%	23%
Ratio of operating profit to total assets		-2.0 %	NA	-0.6%	NA	0.6 %	6.2 %
Ratio of ordinary profit to net sales		2.5 %	NA	-16.6 %	NA	1.2 %	20.9 %
Operating ratio		94.6%	NA	90.0%	NA	98.8%	120.8%
Equity ratio		61.4 %	NA	32.9 %	NA	92.4 %	61.7 %
Fixed assets to long-term capital		64.8 %	NA	107.4 %	NA	78.5 %	65.3 %
Account receivable collection period (Month)		11.8	NA	3.3	NA	6.1	1.4

※1 Figures were quoted from the latest financial reports available in each country. FY2020 for SLU, FY2021 for GND, and FY2022 for DOM and SVD.
※2 The NRW rate of DOM is referred from Water Audit, but note that the other countries are interview-based figures and may be less accurate.

2.4.3 Development status of desalination plants

(1) Desalination plants in each country

Table 2-23 summarizes the existing desalination plants in the target countries, with the exception of Barbados, based on DesalData provided by Global Water Intelligence. The Commonwealth of Dominica and St. Christopher and Nevis do not currently have desalination plants, and it can be seen that Antigua and Barbuda has the largest number of plants among the countries.

The order of the year when the desalination plants started to be in service is shown in the table. Since around 1980, the development of desalination plants has progressed in both the public and private sectors, particularly in Grenada and Antigua and Barbuda. Although on a smaller scale, three plants are also in operation in St. Lucia.

Left: APUA, 2,850 m^3/d, Fryes Beach, Antigua
Right: Le Sport Resort, 250 m^3/d, Cap Estate, St. Lucia
Source: Caribbean Water Treatment Ltd. (https://www.cwtltd.net/projects)

Figure 2-16 Desalination facilities in Antigua and St. Lucia

Table 2-21 Dissemination of desalination plants in the target countries

Online date	Country	Type	Plant owner	Cap. (m^3/d)	Technology	Consultant	Procurement	EPC price	EPC contractor (desal)	Membrane supplier
1978	GND	Gov	National Water & Sewerage Corporation	4,000	RO		EPC		American Engineering Services	
1979	ANU	Pvt	Maryna Hotel	120	RO		EPC		Veolia OTV	
1987	ANU	Gov	Public Utility	9,000	MED		EPC	20,850,000 USD	Veolia Sidem	
1993	ANU	Pvt	-	2,725	RO		EPC	6,690,000 USD	Culligan International Company	DuPont
1995	ANU	Pvt	K-Club Hotel	246	RO		EPC	660,000 USD	Culligan International Company	
1995	ANU	Gov	-	1,820	RO		EPC	4,610,000 USD	MECO	DuPont
1995	ANU	Gov	Government	4,542	RO		EPC	11,330,000 USD	Enerserve (Cascal)	DuPont
1996	GND	Gov	-	300	RO		EPC	800,000 USD	Culligan International Company	
1997	GND	Gov	St. George's University	228	RO		EPC		American Engineering Services	
1998	ANU	Gov	Government	4,500	RO		EPC	11,230,000 USD	Enerserve (Cascal)	
1998	SVD	Pvt	-	550	RO		EPC		ITT Aquious	
1998	SVD	Pvt	-	1,136	RO		EPC		ITT Aquious	
1998	SVD	Gov	-	1,700	RO		EPC		ITT Aquious	
2001	GND	Gov	-	500	RO		EPC		American Engineering Services	
2001	GND	Gov	-	600	RO		EPC		American Engineering Services	
2002	ANU	Pvt	-	379	RO		EPC	1,010,000 USD	Ionics, Inc.	
2003	ANU	Pvt	Carlisle Bay Antigua	150	RO		EPC	400,000 USD	Enerserve (Cascal)	
2003	ANU	Pvt	St. James Club	200	RO		EPC	540,000 USD	Enerserve (Cascal)	
2003	ANU	Pvt	-	1,511	RO		EPC		ITT Aquious	
2003	SLU	Pvt	Sandals Lucia	500	RO		EPC	1,330,000 USD	Enerserve (Cascal)	
2006	ANU	Gov	Apua	17,275	RO		BOOT		Enerserve (Cascal)	
2006	SLU	Gov	Enerserve (Cascal)	500	RO		EPC		Veolia Iberica	
2010	SVD	Pvt	-	132	RO		EPC		ITT Water Equipment Technologies	
2010	SVD	Pvt	-	2,271	RO		EPC		TSG Water Resources	Toray Industries, Inc.
2011	ANU	Pvt	-	250	RO		EPC		ITT Water Equipment Technologies	
2011	ANU	Gov	-	380	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	ANU	Gov	APUA Barbuda	545	RO		EPC		ITT Water Equipment Technologies	
2011	ANU	Gov	Antigua Public Utilities Authority	2,850	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	GND	Gov	Government of Grenada	140	RO	Caribbean Water Treatment Ltd.	EPC		Xylem Inc.	Hydranautics
2011	GND	Gov	Sandals Lucia	300	RO	Caribbean Water Treatment Ltd.	EPC		Xylem Inc.	Hydranautics
2011	GND	Gov	Government of Grenada	300	RO	Caribbean Water Treatment Ltd.	EPC		Xylem Inc.	Hydranautics
2011	GND	Gov	St. George University	492	RO		EPC		ITT Water Equipment Technologies	
2011	GND	Gov	St. George's University	500	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	SLU	Pvt	Cap Estate Golf Club	250	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	SVD	Gov	-	140	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	SVD	Gov	Mustique Company Limited	950	RO	Caribbean Water Treatment Ltd.	EPC		ITT Water Equipment Technologies	Hydranautics
2011	SVD	Pvt	Mustique Company Limited	1,000	RO		EPC		ITT Water Equipment Technologies	
2017	ANU	Pvt	-	133	MMF+RO	Caribbean Water Treatment Ltd.	EPC		Xylem Inc.	Hydranautics
2017	ANU	Pvt	-	189	MMF+RO	Caribbean Water Treatment Ltd.	EPC		Xylem Inc.	Hydranautics
2019	ANU	Pvt	-	1,000	RO					
2021	ANU	Gov	-	400	Sand Filtration+RO				Ace Water Treatment Co. Ltd	
2024	ANU	Gov	Antigua Public Utilities Authority	14,534	RO					

Source: DesalData

Notes: Gov indicates government agencies including the Waterworks Public Corporation, and Pvt indicates private businesses such as accommodation facilities and factory facilities (classification is judged based on DesalData data).

(2) Trends in private companies related to seawater desalination facilities

(a) Consultant company

According to the company's website, a case in which solar panels were introduced into seawater desalination facilities with the aid of a loan from CCIC (Caribbean Climate Innovation Center) has also been introduced.[14]

(b) EPC contractors

Facilities are basically constructed as EPC (Engineering, Procurement and Construction) projects, and the only facility with the largest desalination capacity in the Antigua and Barbuda adopts the Bulk Operation Post-Contract Transfer Method (BOOT: Build-Operate-Own-Transfer).

The U.S.-based ITT Water Equipment Technologies, described as a recent EPC operator, was a member company of ITT Corporation at that time, but it was spun off as Xylem Inc. in 2011, and since then has been involved in seawater desalination projects within the Caribbean region. Therefore, in the target country, the status of the company's participation as an EPC operator in most desalination projects in recent years can be read.

Ace Water Treatment Co. Ltd, described as an EPC operator in 2021, is the water treatment Ace Co., Ltd., a Japanese company, and is a facility provided as a grant aid under the Japan's Economic and Social Development Program (contrary to the table, the facility actually began operations at 1,500 m^3/day in February 2022, and the facility was installed next to the 2,850 m^3/day facility that began operations in 2011).[15]

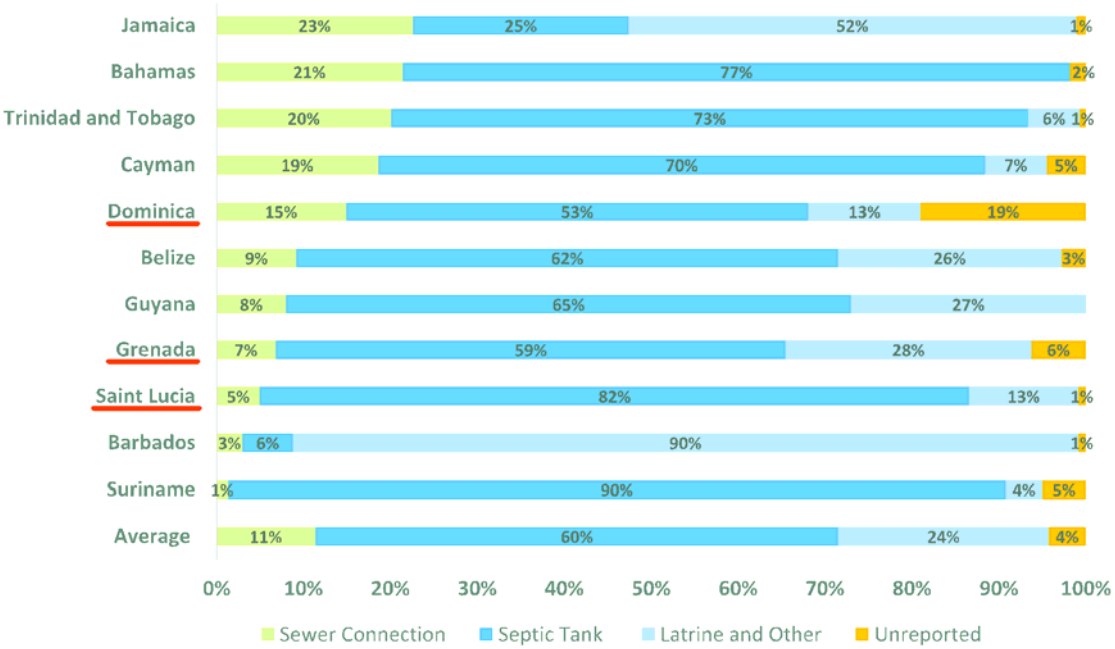
(c) Suppliers of membrane products

Although there are many columns not included in DesalData data, one is provided by Toray Industries, Inc (Toray Industries, Inc.) in 2010, and Hydranautics (a joint subsidiary of Nitto Denko Corporation) from 2011 onwards is a supplier of membrane products. This indicates that Japanese companies have a strong presence in membrane products.

[14] Source: Caribbean Water Treatment Ltd. (https://www.cwtltd.net/solar-systems)
[15] Source: HP of the Japanese Observatory of Trinidad Tobago (https://www.tt.embjapan.go.jp/files/100325939.pdf)

2.4.4 Dissemination of sewerage facilities

The sewerage connection ratio is lowest in Dominica, 15%, 7% in Grenada and 5% in St. Lucia. Of the target countries, only St. Lucia and Commonwealth of Dominica have sewage treatment plants. Although some areas in St. Lucia, St. Vincent, and Grenada have separated sewerage systems, the areas have a situation of untreated discharge into the ocean, and some coastal areas suffer from water pollution problems. Septic tanks are becoming popular in areas where sewerage systems are not in place, followed by basic sanitation facilities such as a pit latrine.



Source: IDB (2021) Caribbean Water Study

Figure 2-17 Sewage treatment methods in Caribbean countries

2.5 Risks to water security

2.5.1 Natural disaster risk

(1) Natural disasters in the target area

(a) Overview of natural disaster risks

The Caribbean is considered one of the world's most natural disaster-prone regions. Since it is a volcanic region, there are many seismic activities, and especially there is a high risk of hurricanes over a wide area. Hurricanes are accompanied by landslides on steep slopes, floods on flat land and near rivers, and storm surges in coastal areas. It was emphasized that hurricane damage was the greatest threat even in the results of the study in each country this time. Drought is also occurring frequently because the national land is limited, and the amount of water resources is not abundant.

Table 2-22 Natural disaster risks in the Caribbean countries

Jurisdiction	CRI*	Hurricane	Windstorm	Earthquake	Volcanic Eruption	Drought	Landslide	Flooding	Tidal Waves
Anguilla		✓	✓	✓	✓			✓	✓
Antigua & Barbuda	47	✓	✓	✓	✓	✓		✓	
Aruba		✓	✓	✓	✓			✓	✓
Bahamas	86	✓	✓				✓	✓	✓
Barbados	151	✓	✓	✓	✓	✓	✓	✓	✓
Belize	32	✓	✓	✓				✓	✓
Bermuda		✓	✓	✓		✓	✓	✓	✓
Bonaire			✓	✓		✓	✓	✓	
British Virgin Islands		✓	✓	✓		✓	✓	✓	
Cayman Islands		✓	✓	✓	✓	✓		✓	✓
Cuba		✓	✓	✓		✓	✓	✓	✓
Curacao		✓	✓	✓		✓	✓	✓	
Dominica	10	✓	✓	✓	✓		✓	✓	✓
Dominican Republic	50	✓	✓	✓				✓	✓
Grenada	21	✓		✓	✓		✓		✓
Guadeloupe		✓	✓	✓	✓	✓	✓	✓	✓
Guyana	1205		✓	✓		✓		✓	✓
Haiti	3	✓	✓	✓		✓	✓	✓	✓
Jamaica	57	✓	✓	✓		✓	✓	✓	✓
Martinique		✓	✓	✓	✓	✓	✓	✓	✓
Montserrat		✓	✓	✓	✓		✓	✓	✓
Puerto Rico	1	✓	✓	✓	✓		✓	✓	✓
Saint Barthelémy		✓	✓	✓	✓			✓	
Saint Kitts & Nevis	127	✓	✓	✓	✓	✓		✓	✓
Saint Lucia	51	✓	✓	✓	✓		✓	✓	✓
Saint Martin		✓	✓	✓	✓	✓	✓	✓	
Saint Vincent & the Grenadines	52	✓	✓	✓	✓	✓	✓	✓	✓
Suriname	173	✓	✓			✓		✓	✓
Trinidad & Tobago	161	✓	✓	✓	✓			✓	✓
Turks & Caicos		✓	✓	✓	✓	✓		✓	
United States Virgin Islands		✓	✓	✓	✓	✓	✓	✓	✓

Source: IDB (2021) Caribbean Water Study
Note: For IDB material excerpts, CRI in the tables indicate CRI for 1999-2018.

(b) National vulnerability to natural disasters

A German environmental NGO, German Watch, has published the Global Climate Risk Index (GCRI), which analyzes natural hazard risks of various countries due to the effects of climate change. Since this index is calculated from historical data (the number of fatalities and economic losses associated with extreme weather disasters during the period in question), it does not directly indicate the risk of future climate change. However, in order to be prepared for more frequent or more severe weather disasters in the future, this CRI score needs to be captured as a warning because it represents the vulnerability to abnormal weather disasters in the past.

Table 2-23 summarizes the latest and worldwide rankings of the Climate Risk Indexes in the countries covered. The lower CRI score (the higher the ranking), the greater the impact of abnormal weather hazards in the last 20 years. From these data, it can be said that the fragility of the Commonwealth of Dominica and then Grenada is remarkable.

Table 2-23 Global Climate Risk Indexes for the target countries (2000-2019)

Country name	Ranking	CRI
Commonwealth of Dominica	11th	33.00
Grenada	24th	39.67
St. Vincent and the Grenadines	48th	59.17
St. Lucia	51st	60.33
Antigua and Barbuda	56th	64.50
St. Christopher and Nevis	130th	116.00
Barbados	148th	135.33

Source: German Watch, Global Climate Risk Index 2021

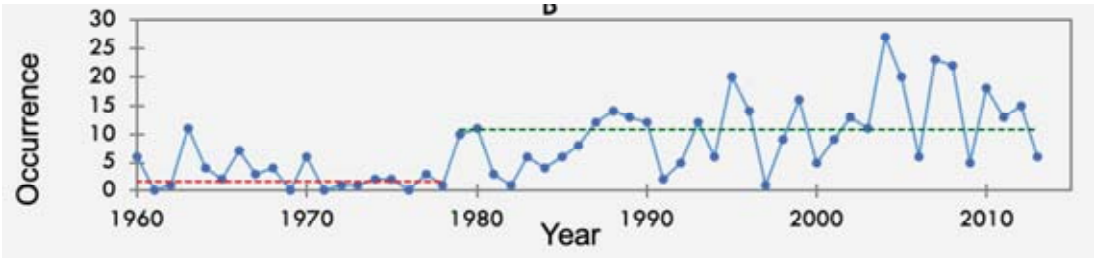
For example, Hurricane Katrina, the largest hurricane in U.S. history in 2005, lost only 1 percent of U.S. GDP despite causing up to $100 billion in damage. In contrast, Hurricane Ivan in 2004 lost more than 200 percent of its GDP in the Cayman Islands and Grenada.

SIDS do not have sufficient resources to recover from natural disasters, which can have a serious impact on the economy and people's lives in the affected areas. In addition, by dividing national funding resources into restoration costs each time a natural disaster occurs, existing development plans are delayed, and there is a vicious circle that adds debt to compensate for the financial gap.[16]

[16] Source: IDB (2021) Caribbean Water Study

(c) Outline of natural disaster history

Figure 2-18 shows the trend of weather-related disasters in the Caribbean region. Before 1980, it was 1.7 cases per year on average, but since 1980, it has been increased to 10.8 cases per year on average, and it can be said that the threat of natural disasters has heightened.



Source: CDB (2020) The State of the Caribbean Climate
Note: Weather-related disasters occurring in 22 independent national and foreign territories in the Caribbean region

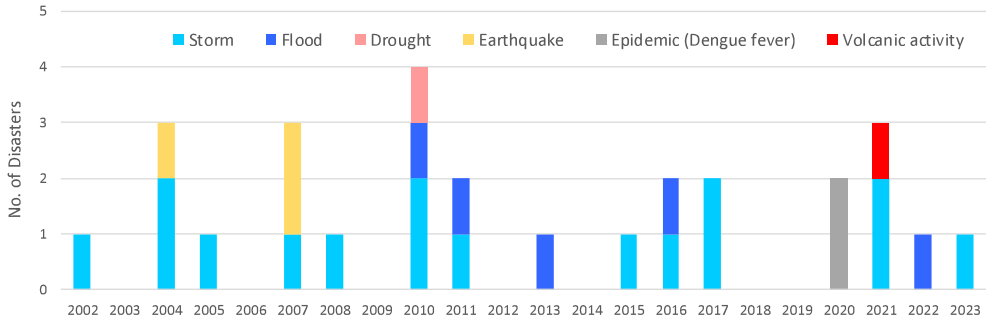
Figure 2-18 Trends in the number of climate-related disasters in the Caribbean region (1960-2013)

In Table 2-24, the number of natural disasters in the target region (with the exception of Barbados) since the 2000 are shown annually. While earthquake damage is observed due to being in a volcanic activity area, the damage caused by hurricanes, which are prone to widespread disasters, stands out in terms of frequency and number of victims. Furthermore, Table 2-25 shows the number of occurrences and victims of disasters by type in each country (the left side of the table indicates regions located at higher latitudes, i.e., closer to the north).

Table 2-24 Number of natural disasters in the target area

No. of Disasters

Type of Disaster	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Storm	1	-	2	1	-	1	1	-	2	1	-	-	-	1	1	2	-	-	-	2	-	1
Flood	-	-	-	-	-	-	-	-	1	1	-	1	-	-	1	-	-	-	-	-	1	-
Drought	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Earthquake	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Epidemic (Dengue fever)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Volcanic activity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Total	1	0	3	1	0	3	1	0	4	2	0	1	0	1	2	2	0	0	2	3	1	1



Source: EM-Dat: Disasters for the period 2000-2023

Note: 1 count of hurricanes and droughts, which are wide-area disasters, are duplicated in counts per country.

Table 2-25 Number of natural disasters and number of victims in each country

No. of Disasters ←North South→

Type of Disaster	SKB	ANU	DOM	SLU	SVD	GND	Total
Storm	2	3	4	5	7	2	23
Flood	-	-	-	3	3	-	6
Drought	-	-	-	1	1	1	3
Earthquake	-	-	1	1	-	-	2
Epidemic	-	-	-	1	1	-	2
Volcanic activity	-	-	-	-	1	-	1
Total	2	3	5	11	13	3	37

Affected population ←North South→

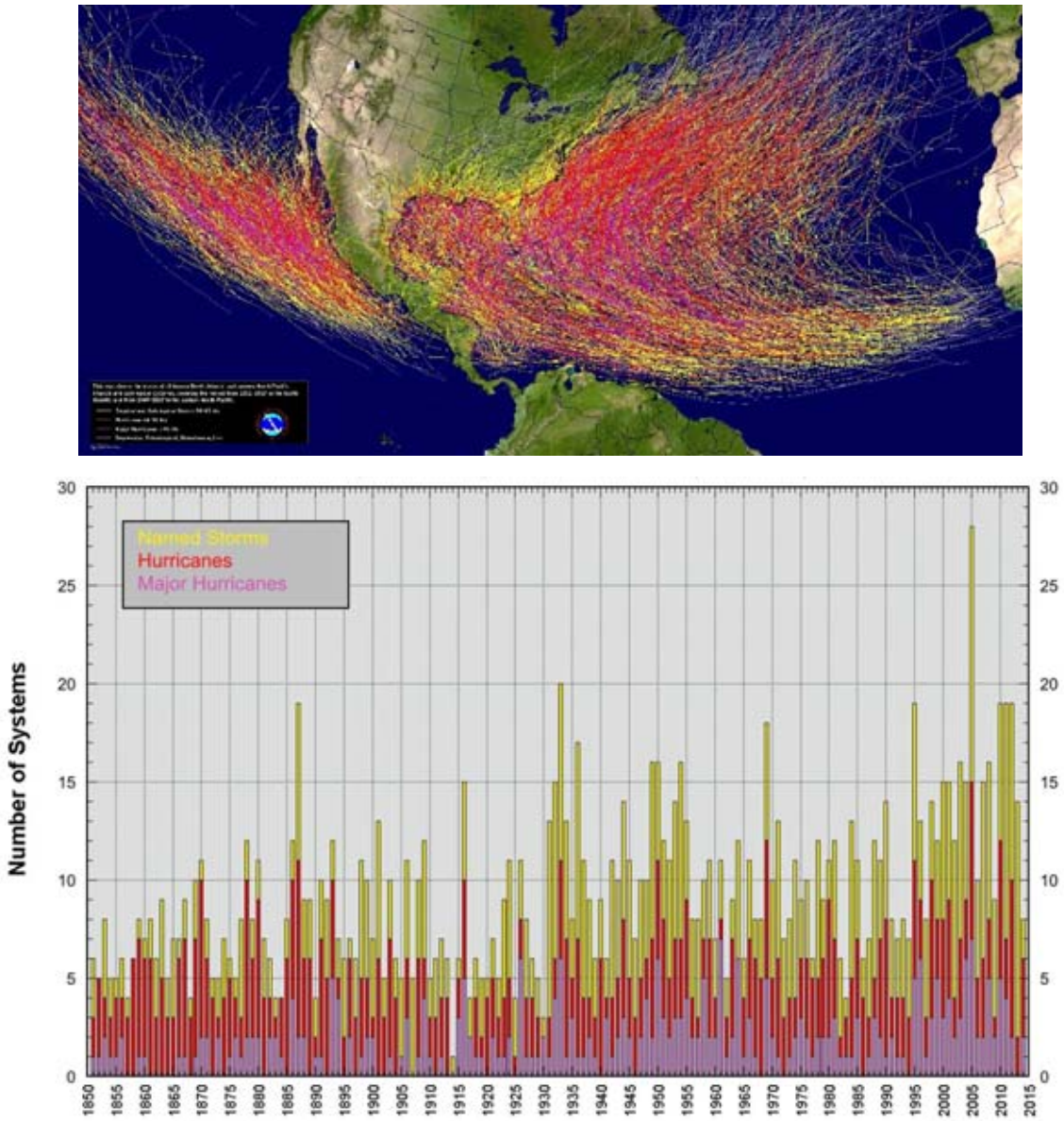
Type of Disaster	SKB	ANU	DOM	SLU	SVD	GND	Total
Storm	500	32,600	107,757	206,000	7,913	60,075	414,845
Flood	0	0	0	27,484	42,697	0	70,181
Drought	0	0	0	0	0	0	0
Earthquake	0	0	100	0	0	0	100
Epidemic	0	0	0	1,318	1,760	0	3,078
Volcanic activity	0	0	0	0	13,300	0	13,300
Total	500	32,600	107,857	234,802	65,670	60,075	501,504

Source: EM-Dat: Disasters for the period 2000 – 2023

(2) Hurricanes

(a) Occurrence of hurricanes in the Atlantic

The warm waters stretching from the North African coast to Central American coast, including the Caribbean region, are called hurricane arrays, and many hurricanes occur in these waters every year, expanding their power and approaching the Americas. In recent years, there has been a trend of an increased frequency in the occurrence of large hurricanes categorized as Category 3 or higher, as well as named storms.[17]



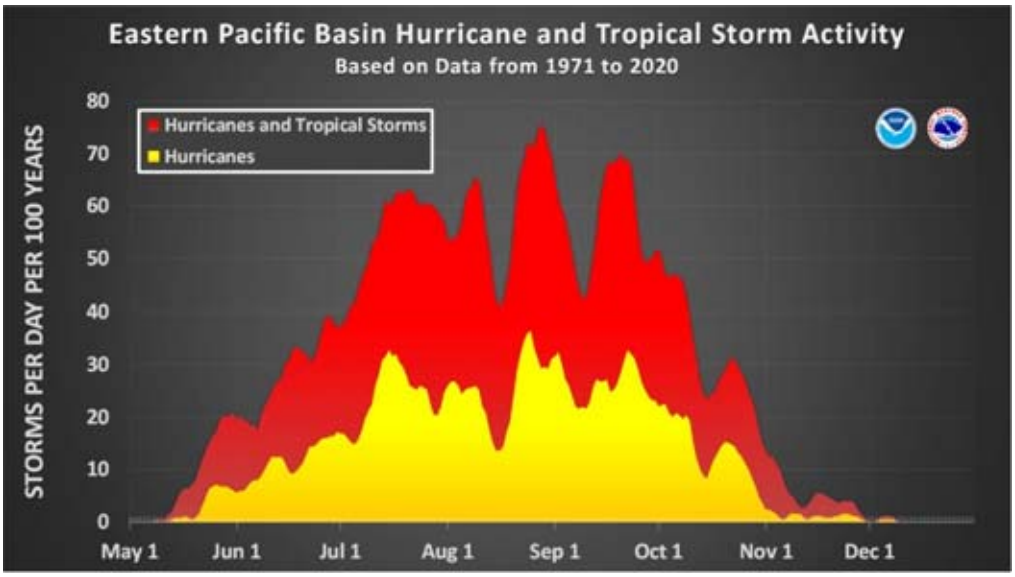
Source: NOAA (https://www.nhc.noaa.gov/climo/)
Note: Yellow (storm), Red (Hurricane Categories 1-2), Purple (Hurricane Categories 3-5)

Figure 2-19 Occurrence of hurricanes in the Atlantic Ocean (1851-2015)

[17] Intensity discrimination on the Simpson scale: It is classified as Category 3 for 50m/s or higher and Category 4 for 59m/s or higher and Category 5 for 70m/s or higher at the largest wind speed averaged for one minute.

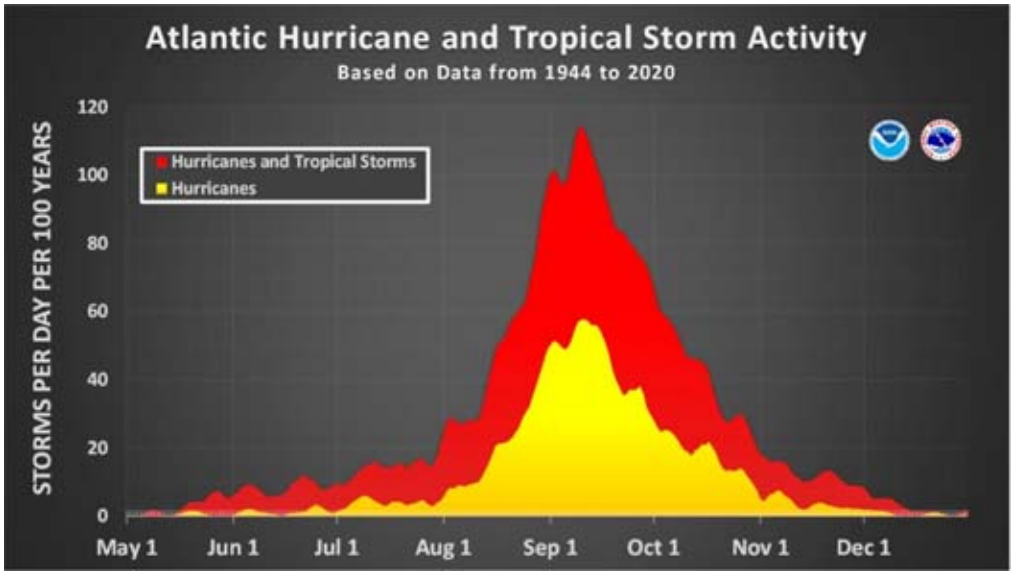
(b) Season of hurricane occurrence

The hurricane season in the eastern Pacific (near the west coast of Mexico) lasts from May to November with a gradual peak. On the other hand, the Atlantic hurricane season tends to be intense from June to November, especially in September, and the peak frequency of occurrence can be said to be higher than that of the eastern Pacific.



Source: NOAA (https://www.nhc.noaa.gov/climo/)
Note: Normalized in 100-year units based on data from 1971 to 2020. The vertical axis is the number of occurrences.

Figure 2-20 Monthly frequency of hurricanes in the eastern Pacific (Reference)

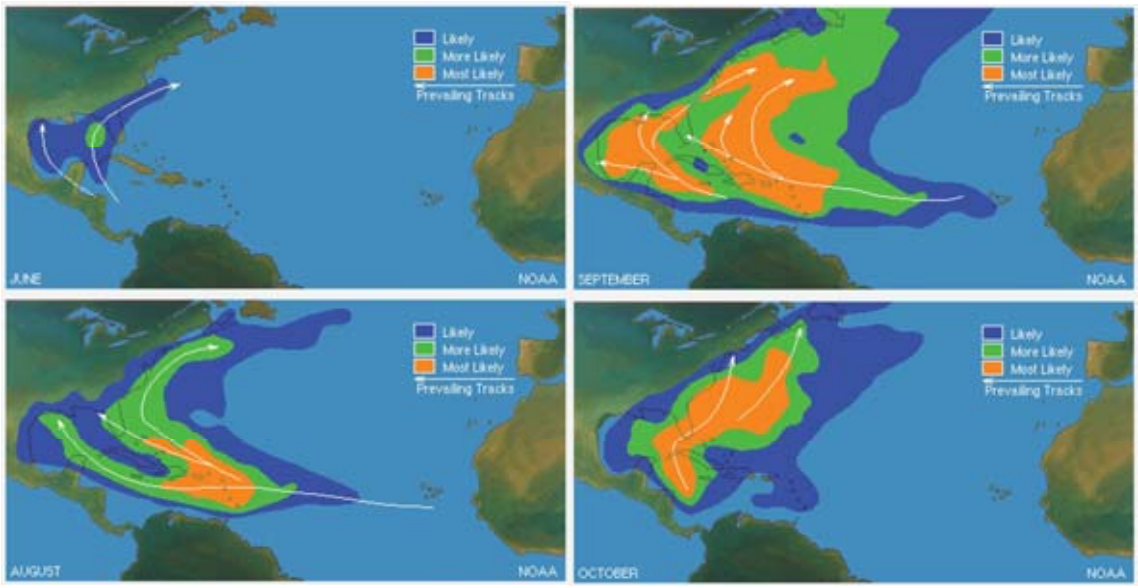


Source: NOAA (https://www.nhc.noaa.gov/climo/)
Note: Normalized to 100-year units based on data from 1944 to 2020. The vertical axis indicates the number of occurrences.

Figure 2-21 Monthly frequency of hurricanes in the Atlantic

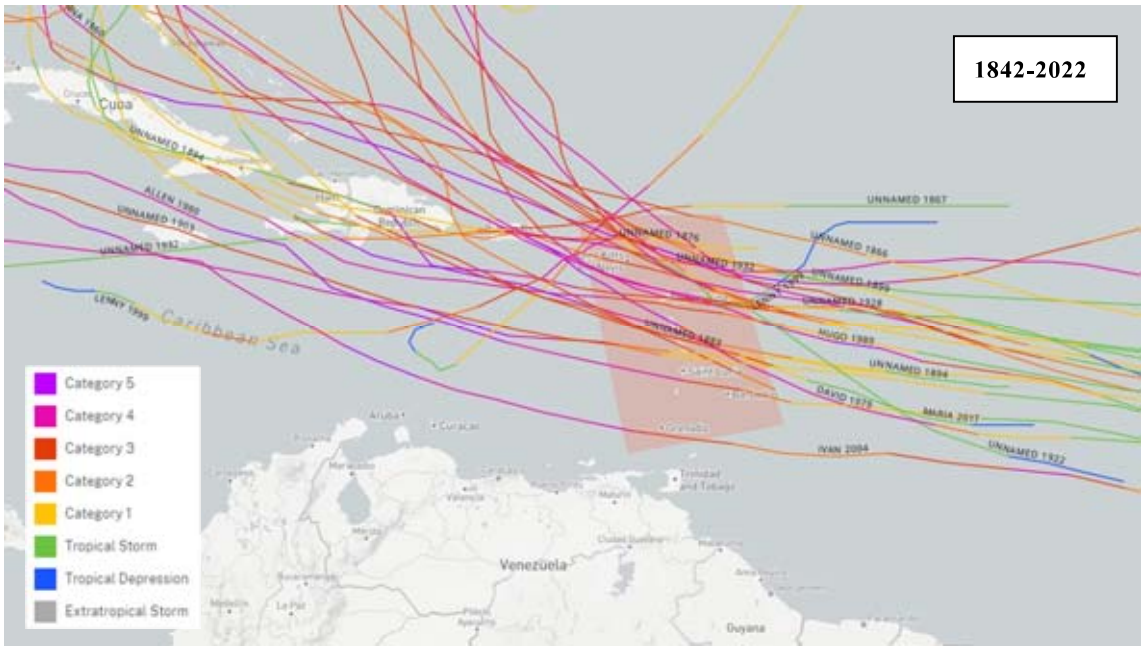
(c) Hurricane tracks

Figure 2-22 shows the monthly trends in hurricane tracks, and Figure 2-23 shows the tracks of Category 3 or higher of hurricanes that occurred after 1842 that passed the East Caribbean region. The hurricane tracks tend to be larger in the northern part of the East Caribbean region, and the risk of hurricane damage tends to be higher.



Source: CDB (2020) The State of the Caribbean Climate

Figure 2-22 Hurricane tracks in the Atlantic by month (July-October)



Source: NOAA HISTORICAL HURRICANE TRACKS
Annotation: Illustrates hurricanes that were Category 3 or higher when they passed through the red colored area.

Figure 2-23 Hurricane tracks in the East Caribbean region

(d) Damage history of hurricane-induced water supply facilities

The hurricane damage as listed in the table below has occurred at water utilities in each country.

Table 2-26 History of disasters by water supply industry in each country

Year	Natural disaster/country	Details of the damage	Loss million USD
2004	Hurricane Ivan (Grenada)	Widespread water supply restrictions and about a month of restoration have struck major industries such as agriculture and tourism.	3
2010	Hurricane Thomas (St. Lucia)	The pipeline in the northern part of the island was damaged, and damage occurred at all intake facilities in the island. In addition, landslides into the dam caused damage to the pump facilities and loss of power, which resulted in a water cut-off.	20
2015 2017	Tropical Cyclone Erica, Hurricane Maria (Dominica)	The number of fatalities due to floods and landslides was about 50. Damage to water supply systems and sources was catastrophic, and disaster recovery operations were delayed by difficulties in accessing intake facilities, shortages of earth-moving vehicles and equipment, and shortage of DOWASCO staff.	24
2017	Hurricane Irma, Hurricane Maria (Puerto Rico)	Two weeks after the Category 5 Irma, the Category 4 Maria in will strike. Damage to the water supply system throughout the island occurred, and it took nine months for one-third of the water-supply population to recover from normal operation.	700-800
2019	Hurricane Dorian (Bahamas)	Category 5 with hundreds of fatalities. It particularly affected pump facilities, water storage tanks, water distribution systems, well facilities, buildings, pipes, and other electrical equipment, and caused serious damage to water supply and sewerage systems, particularly in some parts of the northern region.	54

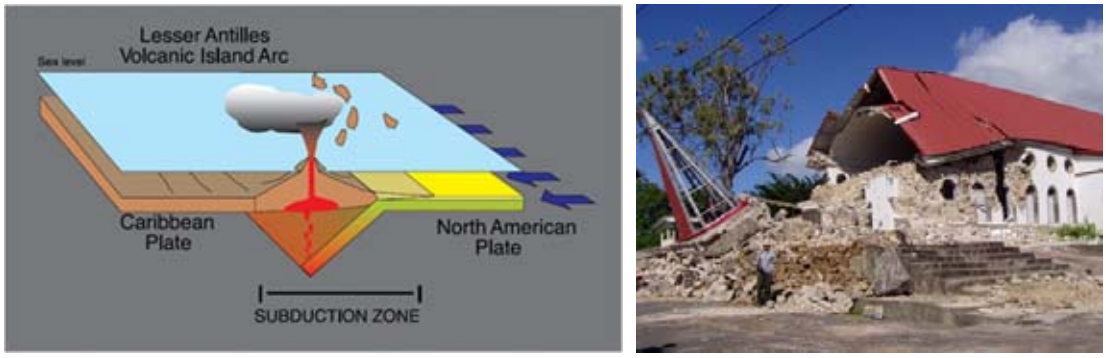
Source: Added based on IDB (2021) Caribbean Water Study

(3) Earthquake and volcanic activity

(a) Occurrence of earthquakes

The Eastern Caribbean region is located at the eastern end of the Caribbean plate. The effect of the North American plate subducting beneath the Caribbean plate creates an arcuate volcanic zone, which forms volcanic arcs such as the Leeward Islands and the Windward Islands to which each country belongs. Therefore, plate boundary type

earthquakes and volcanic earthquakes are active. In the Eastern Caribbean region, earthquakes occur frequently, especially in the region north of St. Lucia.



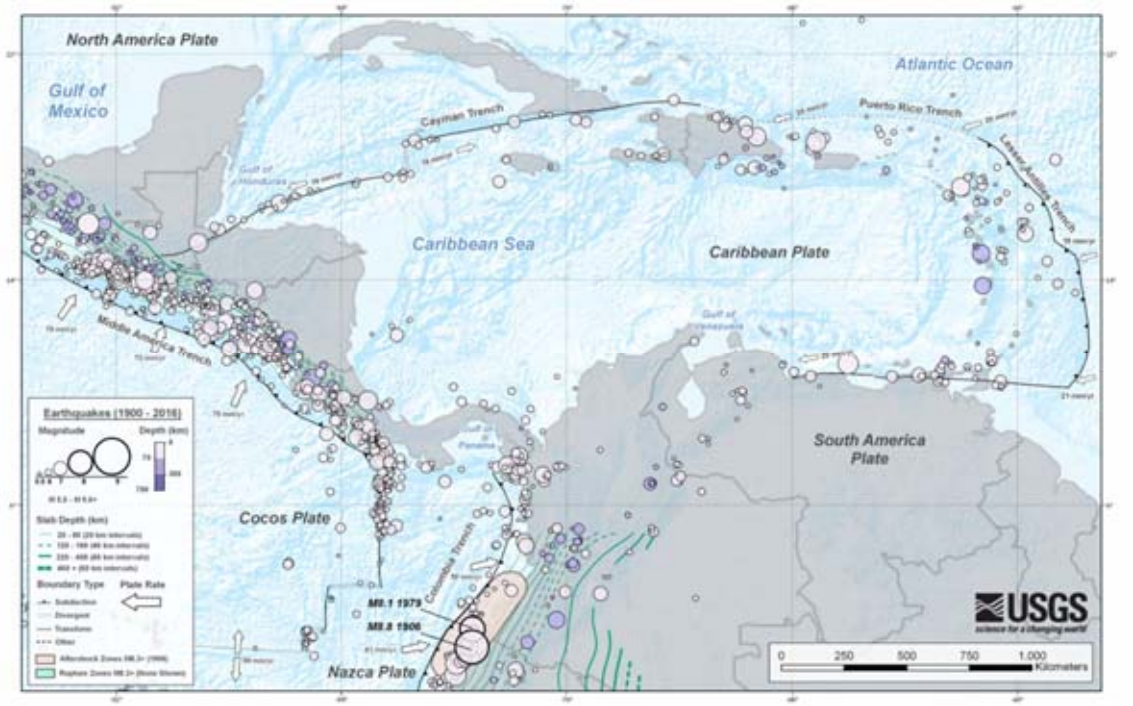
Source: The University of the West Indies Seismic Research Centre
Note: (Left) Volcanic Formation Mechanism; (Right) Damage Caused by M6.3 Earthquake Occurring in the Dominican Country in 2004

Figure 2-24 Volcano Formation Mechanism and Examples of Earthquake Damage in the Eastern Caribbean Region

Table 2-27 Records of major earthquake disasters since 1900

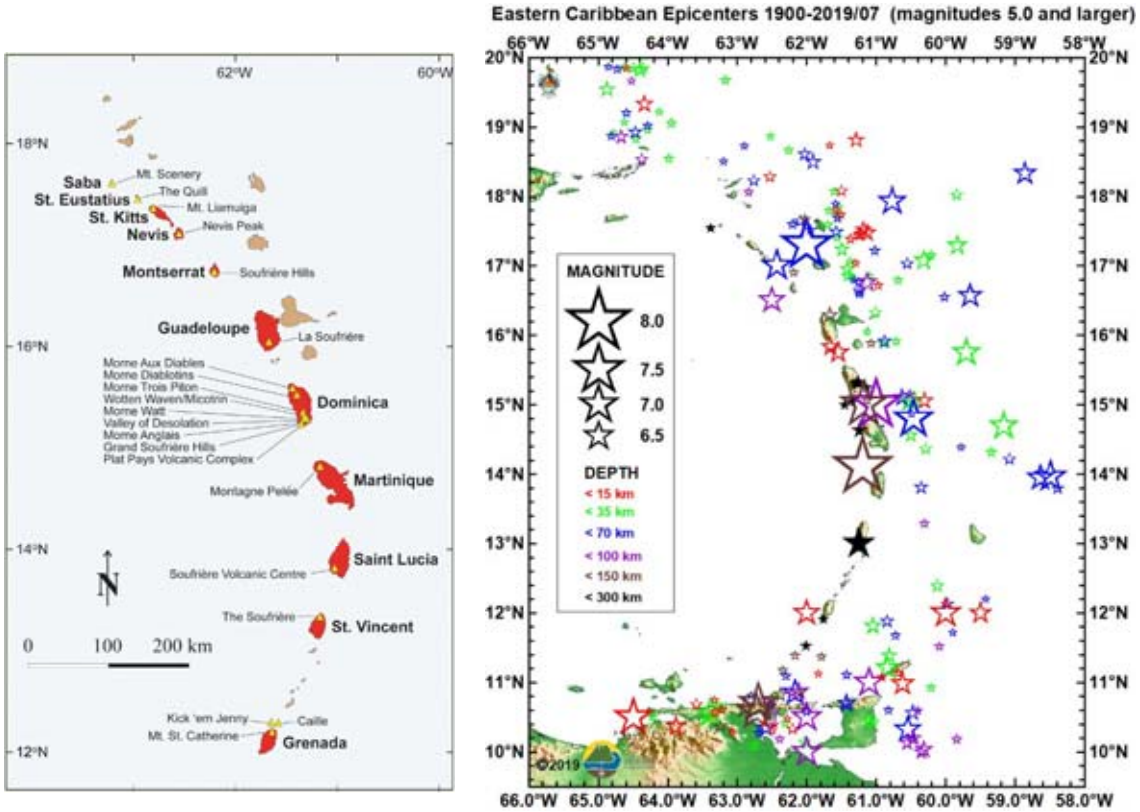
Year	Magnitude and hypocenter	Damage scale
1906	More than M7.0 St. Lucia Northwest	Severe damage and no deaths in St. Lucia and Martinique
1918	M6.5 Northwest Trinidad	Many masonry buildings were destroyed in Port of Spain.
1953	M7.8 Northeast of St. Lucia	There was damage in St. Lucia, Barbados, and St. Vincent, but little serious damage because there were few large buildings then.
1954	M6.5 Northern Trinidad	Many stone buildings were destroyed in Port of Spain (and buildings built after the last earthquake in 1918 were also damaged).
1974	M unknown Northwest Antigua	Damage occurred on neighboring islands.
2004	M6.3 Dominica Northeast	Damage to buildings in Dominica (Figure 2-24), one person was killed.
2007	M7.3 Northern Martinique	In the south, there were widespread effects in Guiana, western Colombia, and in the north as far as Anguilla, but the direct effects were limited. In Martinique, one person died of a heart attack, one building collapsed, and minor damage was reported to hospitals, schools, etc.
2018	M6.9 Western Trinidad	The north and south affected a wide range up to Suriname. In Trinidad, the damage of large-scale landslides and lateral slip faults occurred.

Source: The University of the West Indies Seismic Research Centre



Source: U.S. Geological Survey

Figure 2-25 Plate boundary and earthquake history in the Caribbean (1900-2016)



Source: The University of the West Indies Seismic Research Centre

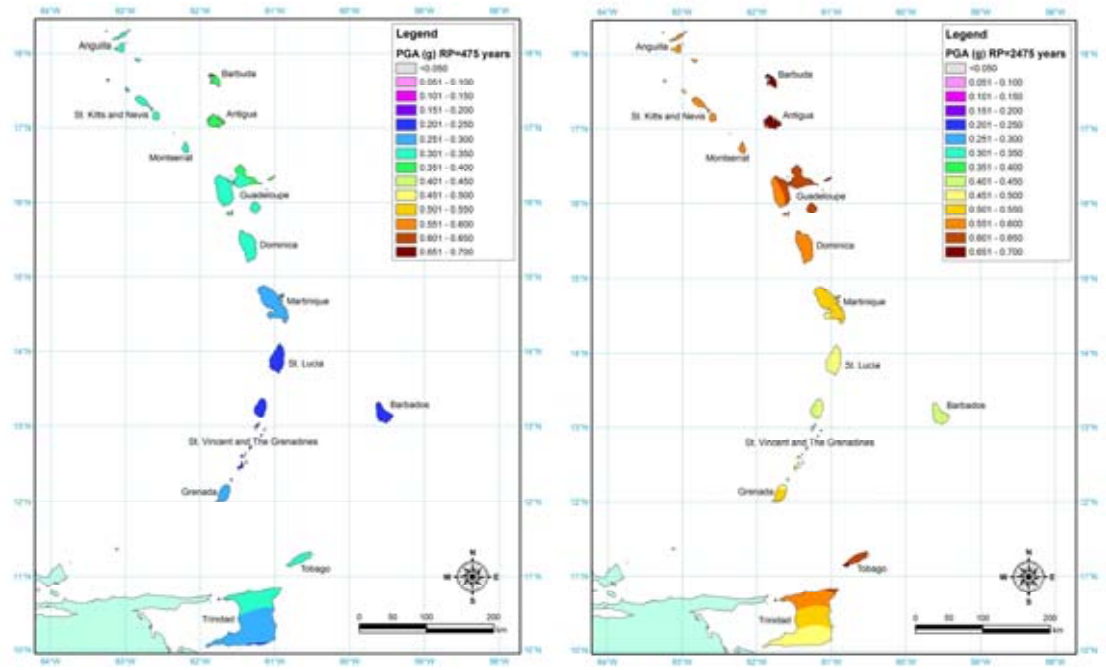
Note: (Left) Active volcanic location, (Right) History of earthquakes with more than M5.0

Figure 2-26 Volcano Location Map and Earthquake History in the East Caribbean Region

(b) Seismic hazard assessment

A probabilistic seismic hazard analysis has been conducted by the University of the West Indies Seismic Research Centre based on the seismic history of the target area. The estimated map of the surface-maximum accelerations is shown below.

Among the color categories in the figure, the closer to brown, the higher the surface maximum acceleration caused by earthquake ground motion is indicated. It can be said that the more the area located north and south around St. Vicent, the higher the seismic hazard tends to be.



Source: The University of the West Indies Seismic Research Centre
Note: (Left) Earthquake ground motion with a 475-year reproduction period = 50-year occurrence probability of 10%
(Right) Earthquake ground motion with a 2475-year reproduction period = 50-year occurrence probability of 2%

Figure 2-27 Seismic hazard map in the east Caribbean region

(c) Records of volcanic eruptions

Table 2-28 summarizes the records of major volcanic eruptions. Among the target countries, regular eruptions are observed on the island of St. Vincent.

As for the most recent eruptive activity, in La Soufrière Volcano, located in the northern part of St. Vincent, after an effluent eruption accompanied by a lava outflow occurred from December 2020 to April 2021, more than 30 explosive eruptions occurred in April of the same year (explosive eruptions have occurred for the first time in 40 years since 1979).

This eruption has had a wide impact on ash fall, mainly in the northern part of St. Vincent, to the southern part of St. Lucia and Barbados, and volcanic mudflow has also

occurred in some areas of the island of St. Vincent due to heavy rainfall that occurred in late April. This volcanic mudflow destroyed three intake facilities in the northern region and partly damaged pipeline facilities, affecting about 2,700 people, with about three months of continuous water cuts in the region. It is also said that other water sources caused turbidity due to the effect of precipitation, resulting in a decrease in tap water quality.[18]

Table 2-28 Records of Major Volcanic Eruptions

Year	Volcano name (national name)	Damage scale
1718	La Soufrière (St. Vincent)	A large-scale explosive eruption occurred, and the number of fatalities was unknown.
1812	La Soufrière (St. Vincent)	A large-scale explosive eruption occurred and about 80 people died. There was considerable damage to the sugar industry, and the economic loss was unknown.
1902	La Soufrière (St. Vincent)	A large-scale explosive eruption occurred, killing about 1,600 people. There was considerable damage to the sugar industry, and the economic loss was estimated at US$200 million.
1902	Mount Pelée (Martinique)	Large-scale explosive and spouting eruptions occurred and over 30,000 people died. Destruction of the city of Saint-Pierre. There was a lot of damage to agriculture, etc. and the economic cost was about US$1 billion.
1976	La Soufrière (Guadeloupe)	Small-scale steam eruptions occurred and there was no death. However, the economic loss was estimated to be US$1 billion.
1979	La Soufrière (St. Vincent)	A medium-scale explosive eruption occurred and there was no death. However, the economic loss was estimated to be US$100 million.
1995	Soufrière Hills (Montserrat)	Medium-scale explosive and spouting eruptions occurred, killing about 20 people. Destruction of the capital of Plymouth. The economic loss was estimated to be more than US$500 million.
2021	La Soufrière (St. Vincent)	Large explosive and spouting eruptions occurred. The northern part of the island was damaged, but no one was killed. About 18,000 people took refuge.

Source: The University of the West Indies Seismic Research Centre

Source: The University of the West Indies Seismic Research Centre
Annotation: Ash fall conditions in Sandy Bay in the northwestern part of La Soufrière volcano (Left) erupting and (Right)

Figure 2-28 Volcanic Eruption in St. Vincent (2021)

[18] Source: UNDP (2021) La Soufrière Volcanic Eruption Sector Reports

(4) Drought

(a) The latest drought record

In Trinidad and Tobago, located south of the Eastern Caribbean countries, the dry season of 2024 saw the worst drought in history due to a lack of rainfall[19]. The distribution map of the Standardized Precipitation Index as of February 2024, shown in Figure 2-29, indicates a particularly high risk of drought around the country. Reviewing data throughout the dry season (Figure 2-30), the drought situation on the mainland of South America was more severe, with wildfires in Guyana affecting local communities[20]. As an aftermath in the Eastern Caribbean region, especially south of St. Lucia, droughts due to insufficient rainfall also occurred. The precipitation data for each country, arranged in order of latitude in Figure 2-31, show notably low rainfall in February for St. Lucia, St. Vincent and the Grenadines, and Grenada. Although the situation was most severe in mid-May, the onset of the rainy season at the end of May brought about some improvement. The responses of each country to this event, based on official notifications and news articles, are described below.

(b) Response to water shortages in St. Lucia

In St. Lucia, the water sources in the southern and northern regions saw up to an 80% reduction in water volume. After consultations with key stakeholders, WASCO declared a water shortage emergency across the island on May 14, 2024. This was the fourth emergency declaration in the past decade, following the previous one in 2020. The declaration banned the use of tap water for non-potable purposes and urged residents to cease activities that could lead to water contamination. Violators faced fines of over $3,000, imprisonment for more than six months, or both, with additional fines of over $50 for each day of continued violation[21,22]. WASCO implemented planned water outages across the island, including the capital, Castries, and provided water by tankers to some areas[23]. The Ministry of Health issued guidelines for preventing and dealing with waterborne diseases and heatstroke due to the water shortage[24].

[19] Source: NEWSDAY “WASA: Worst drought ever – New water restrictions from March 1 - June 30” March 5 2024, https://newsday.co.tt/2024/03/05/updated-wasa-worst-drought-ever-new-water-restrictions-from-march-1-june-30/

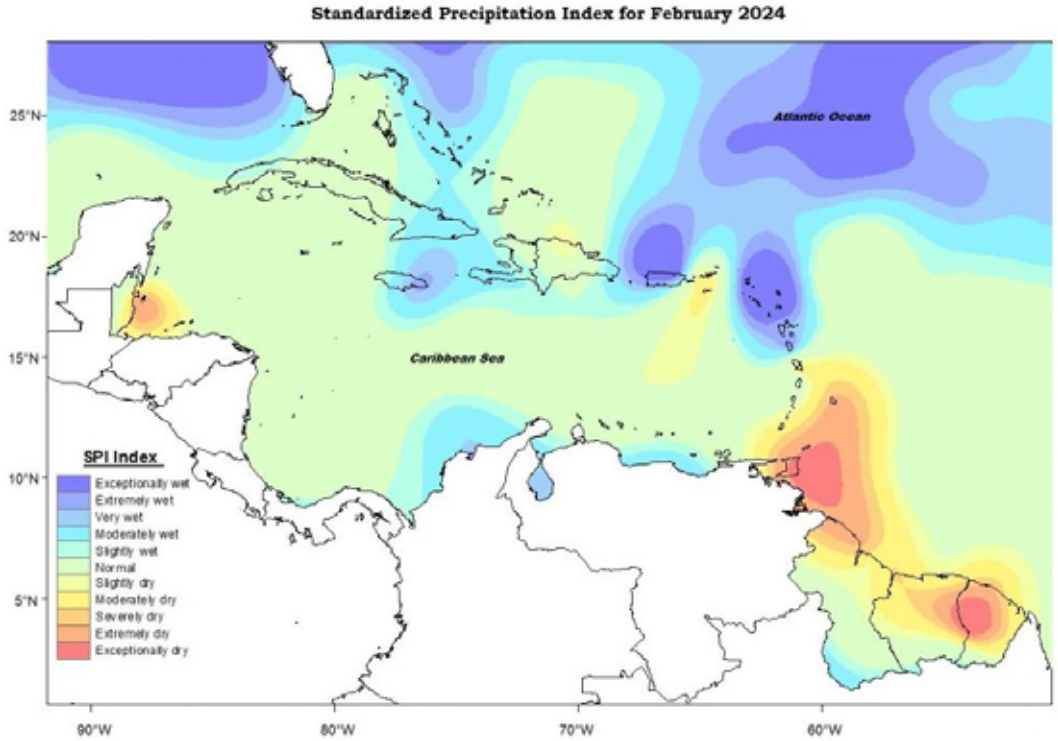
[20] Source: GUYANA NEWS “Drought, fires affecting the livelihoods of some communities – Jagdeo” April 6, 2024, https://www.stabroeknews.com/2024/04/06/news/guyana/drought-fires-affecting-the-livelihoods-of-some-communities-jagdeo/

[21] Source: ST. LUCIA TIMES ”Cabinet Approves Declaration Of Water-Related Emergency” May 14, 2024, https://stluciatimes.com/163511/2024/05/cabinet-approves-declaration-of-water-related-emergency/

[22] Source: 284 Media “Saint Lucia declares water emergency amid critical shortage” May 15, 2024, https://www.284media.com/regional/2024/05/15/saint-lucia-declares-water-emergency-amid-critical-shortage/

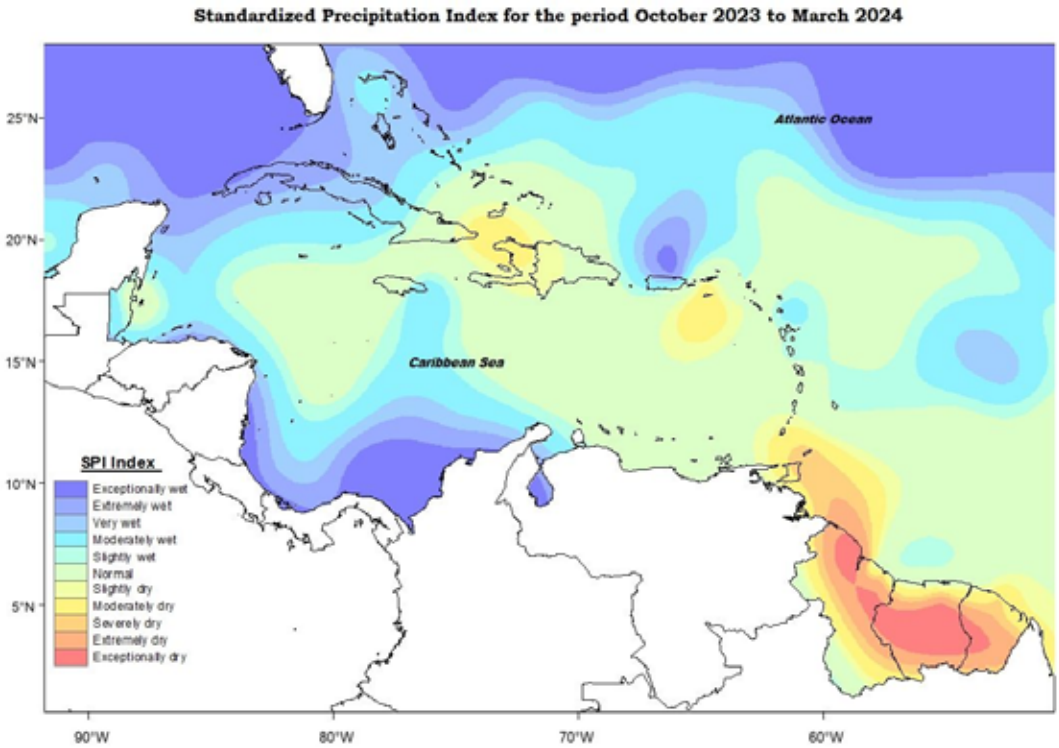
[23] Source: WASCO “UPDATE ON DRY SEASON NORTHERN VALVING INITIATIVE” 19 May, 2024 https://www.wascosaintlucia.com/news/alerts/update-on-dry-season-northern-valving-initiative

[24] Source: Ministry of Health ” Water Related Emergency: Health Risks, Impacts, and Safety Tips” May 22, 2024, https://www.govt.lc/news/water-related-emergency-health-risks-impacts-and-safety-tips



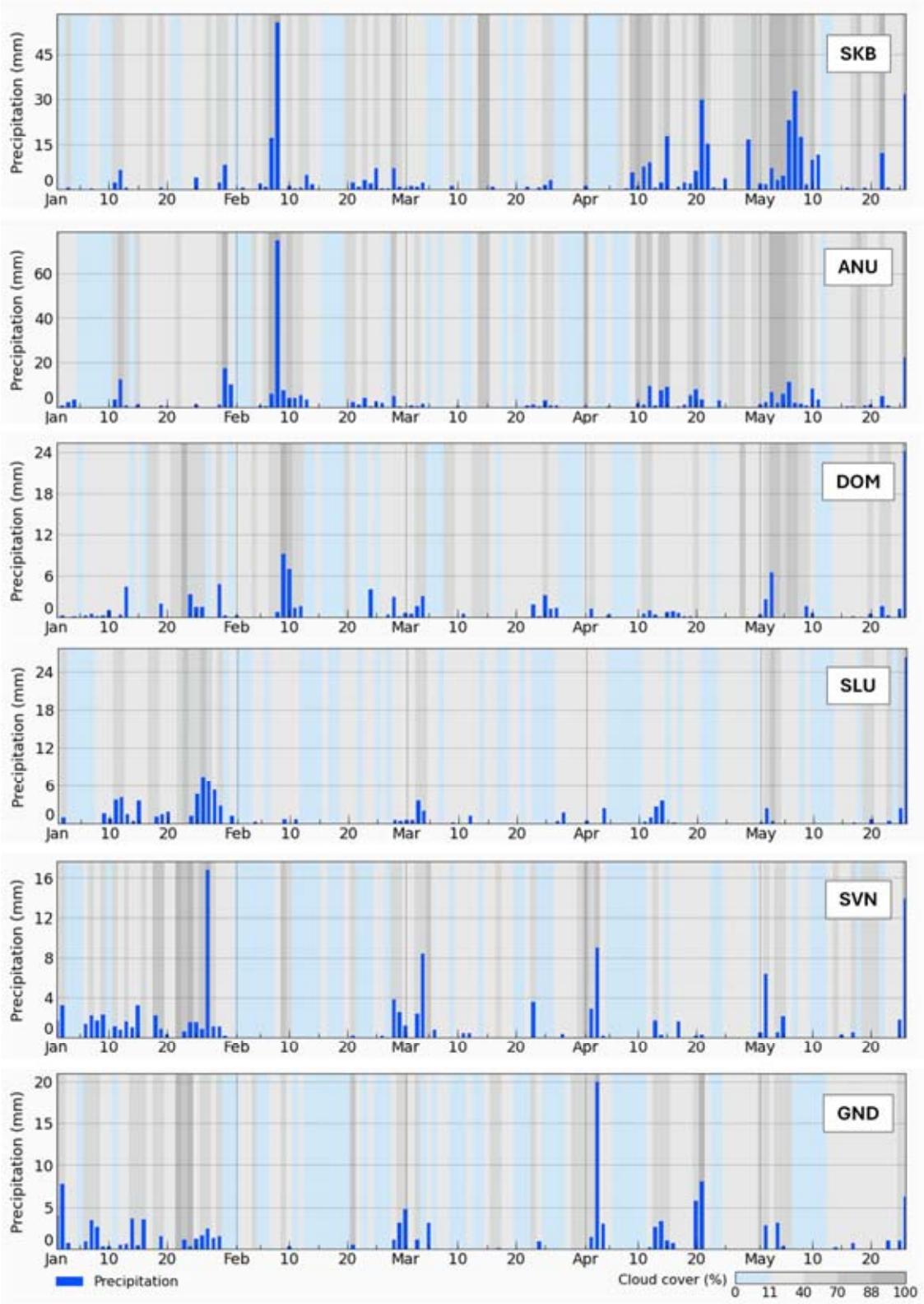
Source: Caribbean Regional Climate Centre (https://rcc.cimh.edu.bb/spi-monitor-february-2024/)

Figure 2-29 Distribution of standardized precipitation index (February 2024)



Source: Caribbean Regional Climate Centre (https://rcc.cimh.edu.bb/spi-monitor-march-2024/)

Figure 2-30 Distribution of standardized precipitation index (October 2023 - March 2024)



Source: Prepared by JST based on Weather Archive (meteoblue) https://content.meteoblue.com/en
Note: The scale of the precipitation graphs is not unified across the countries

Figure 2-31 Precipitation data for each country (January 2024 - May 2024)

(c) Response to water shortages in St. Vincent and the Grenadines

In the Dalaway water supply system, which serves the capital Kingstown, the river flow, which is the primary water source, decreased by about 30% from February to April due to insufficient rainfall. Despite the dry season's water shortage, residents increased water usage for washing cars, cleaning homes, and watering gardens, which CWSA believes exacerbated the water resource strain. CWSA had distributed water from each supply system and maintained efforts to ensure 24-hour water supply, but the situation became critical by May 11 due to reduced river flow. According to the Water Management Alert System on CWSA's website, planned water outages were implemented in the densely populated southern part of St. Vincent[25]. Households without water storage tanks were advised to use drums or buckets, and residents were urged to conserve water[26].

(d) Response to water shortages in Grenada

Grenada experienced its most severe drought in 14 years, prompting the National Emergency Advisory Council (NEAC) to convene and declare a water shortage emergency on May 10[27]. Following this declaration, the use of tap water for non-potable purposes was banned from May 12, with police patrolling the areas to enforce the restrictions. Violators faced fines of up to 500 EC dollars or up to one month of imprisonment. NAWASA conducted planned water outages, focusing primarily on early morning and nighttime use, especially in the southern and eastern parts of the island. Water tankers were prioritized for terminal areas of the distribution network, schools, and particularly medical facilities[28].

[25] Source: https://www.cwsasvg.com/
[26] Source: loop “St Vincent hopes for rainfall as dry conditions affect water supply” May 15, 2024, https://caribbean.loopnews.com/content/st-vincent-hopes-rainfall-dry-conditions-affect-water-supply
[27] Source: IFRC “Grenada: Drought DREF Operation” May 25, 2024, https://reliefweb.int/report/grenada/grenada-drought-dref-operation-mdrgd001
[28] Source: NOW GRENADA “Nawasa declares drought emergency” May 11, 2024, https://nowgrenada.com/2024/05/nawasa-declares-drought-emergency/

(5) Vulnerability of facilities to natural disasters

Based on the previous sections, hurricanes and windstorms are the main threats in the Eastern Caribbean region, particularly in terms of frequency and magnitude of the occurrence. For reference, the vulnerability of water and sanitation facilities to various natural hazards in the Caribbean region, as prepared by the IDB, is attached below. Hurricanes cause direct damage to terrestrial structures from their strong wind damage, and the accompanying landslides and floods have wide-ranging effects on underground buried facilities, such as pipelines, in addition to above-ground facilities. Although the table indicates that earthquake disasters can cause significant damage to above-ground and underground assets, considering the low frequency of large-scale earthquakes, hurricanes and other severe storm disasters can be regarded as higher-risk external forces.

In addition, since the land is narrow, natural disasters are likely to affect the entire island, and the disaster-supporting sides tend to suffer from disasters and delay their relief actions.

Table 2-29 Natural disaster risks of water supply and sewerage facilities in the Caribbean region

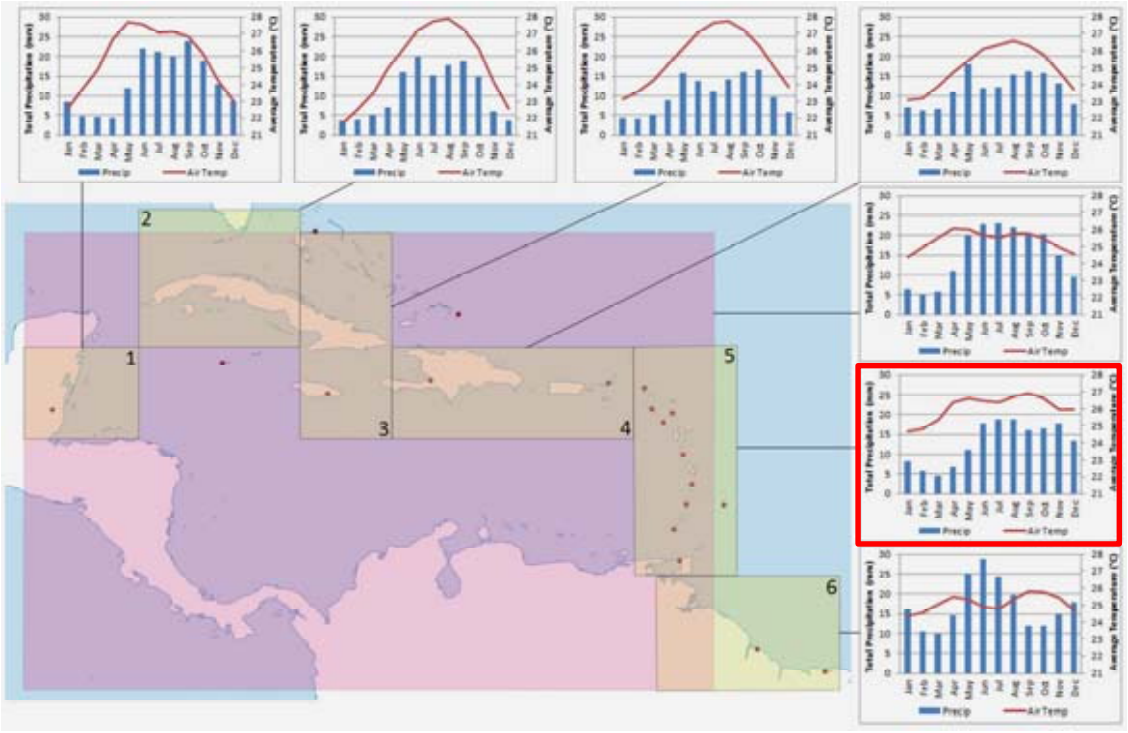
Jurisdiction	Hurricane	Windstorm	Earthquake	Volcanic Eruption	Wildfire	Drought	Landslide	Flooding	Tidal Waves
Above ground assets									
Conventional WTP	High	High	High	Low	Low	Low	Low	Medium	Medium
Desalination plants	High	High	High	Low	Low	Low	Low	Medium	High
WWTP	High	High	High	Low	Low	Low	Low	Medium	Medium
Pumping stations	High	High	High	Low	Low	Low	Low	Medium	Medium
Water tanks	High	High	High	Low	Low	Low	Low	Medium	Medium
Dams/Reservoirs	Medium	Medium	High	Low	Low	Medium	Medium	Medium	Medium
Intakes	High	High	High	Low	Low	Low	Medium	High	Medium
Underground assets									
Water mains and Sewage collector	Low	Low	High	Low	Low	Low	High	Medium	Low
Water distribution and wastewater networks	Low	Low	High	Low	Low	Low	High	Medium	Low
Water source (submersible pumps)	Low	Low	High	Low	Low	Low	High	Medium	Low

Source: IDB (2021) Caribbean Water Study

2.5.2 Risks of climate change

(1) Climate change trends

The Caribbean region is divided into six climate categories from the pattern of annual variability in temperature and precipitation (Figure 2-32). The Eastern Caribbean region will be Zone 5.



Source: CDB (2020) The State of the Caribbean Climate

Figure 2-32 Climate categories in the Caribbean region (monthly average temperature and precipitation)

The changes in monthly average temperature and rainfall over the period 1900-2014 (25 years) are shown on the next page as climate change trends to date.

Temperature rising: There is a clear upward trend in zones other than Zone 2.

Precipitation variability: Zones 1 to 4 show a slight decrease in trend, while in Zones 5 and 6, there is no significant trend observed, and the precipitation levels generally remain at the same level.

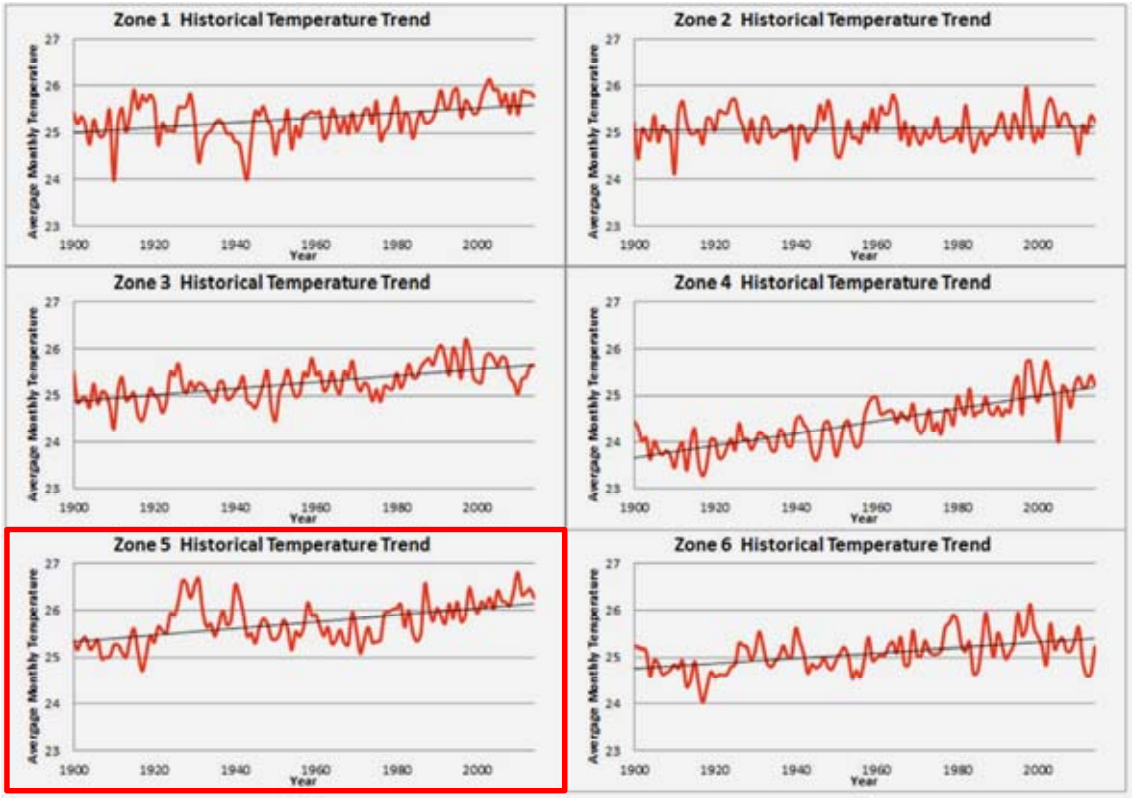
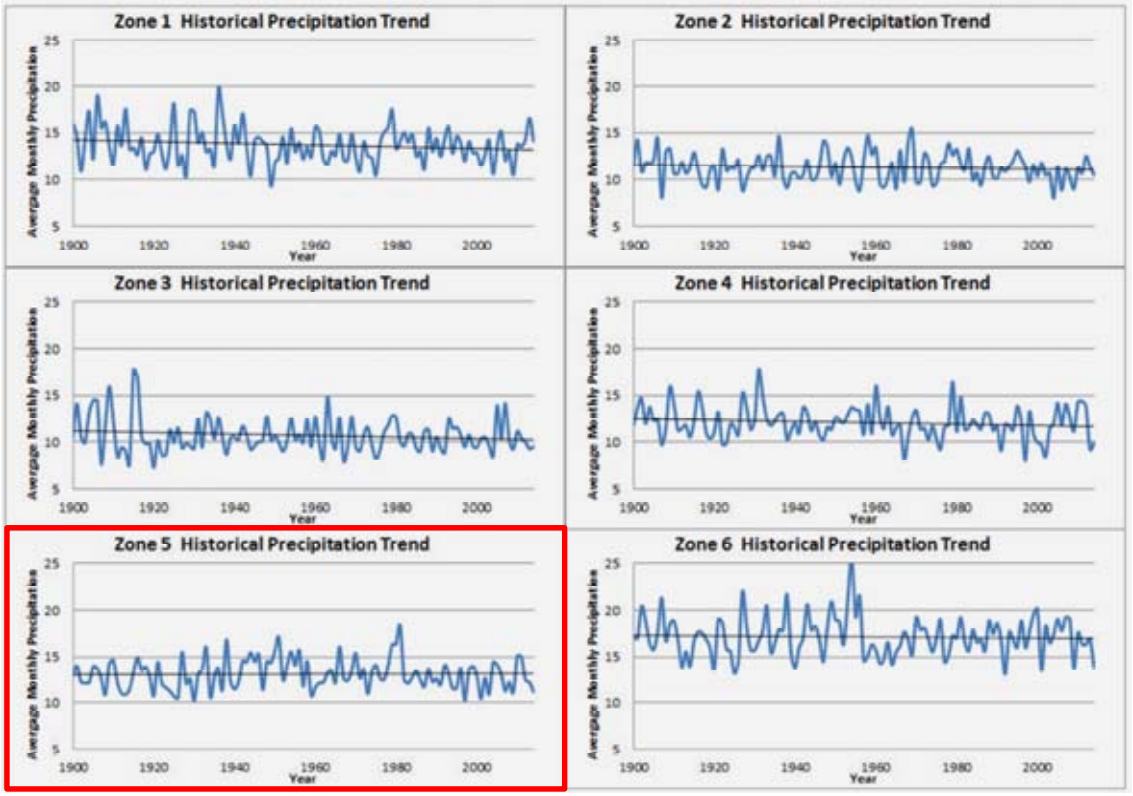


Figure 2-33 Historical trends in average temperature in each zone (1900-2014)

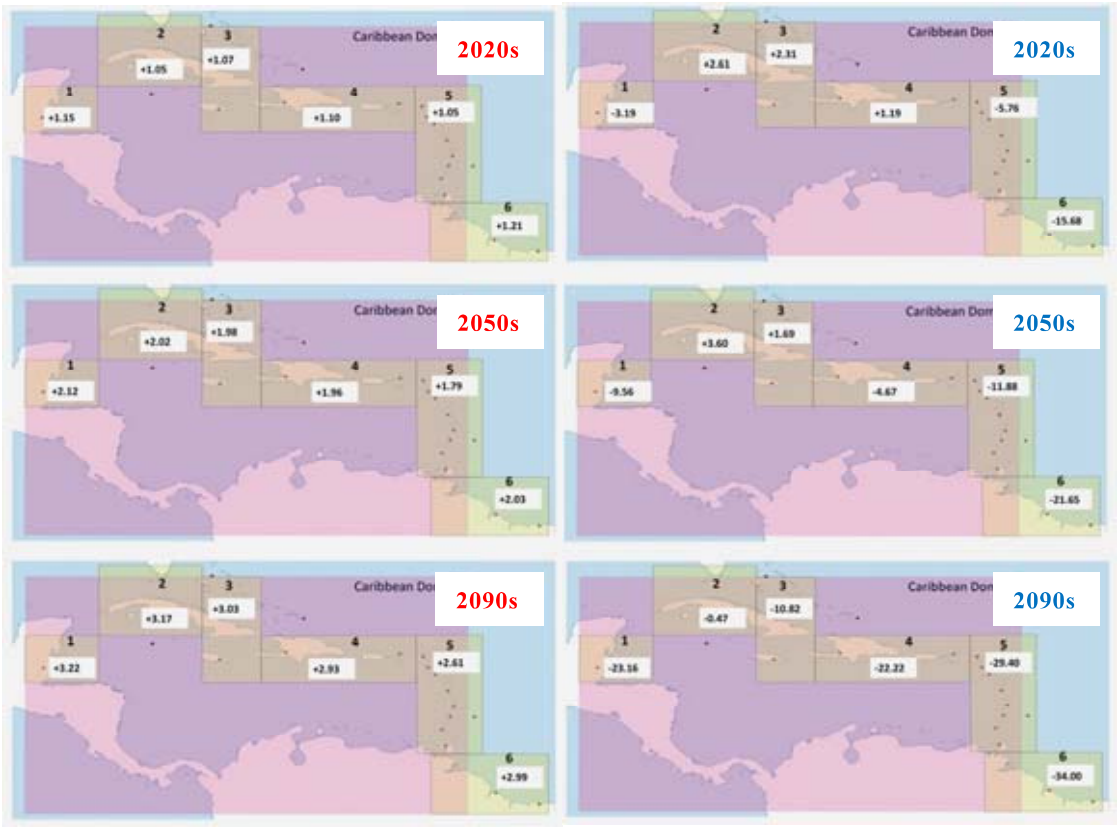


Source: CDB (2020) The State of the Caribbean Climate

Figure 2-34 Historical trends in precipitation in each zone (1900-2014)

(2) Climate change projections

Climate change projections in the Caribbean region show a long-term trend toward decreased precipitation in all zones as temperatures rise, as shown in the figure below. Although there has been no significant change in precipitation as shown in Figure 2-34 so far, there is a possibility that it will decrease in the future, increasing the risk of water resource shortages.



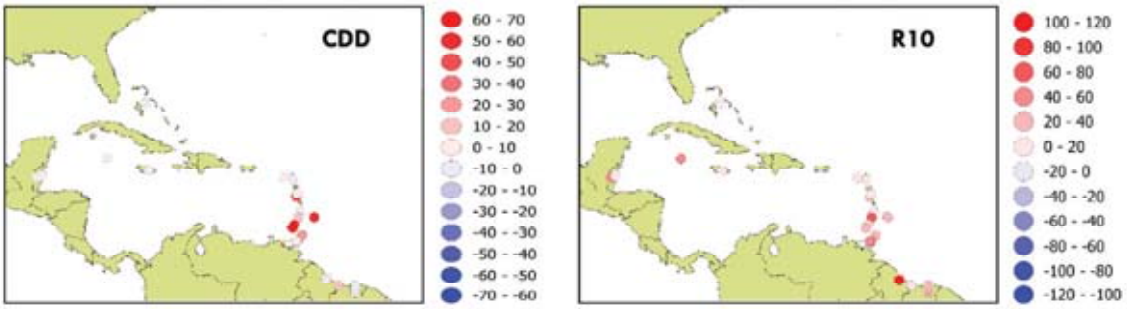
Source: CDB (2020) The State of the Caribbean Climate
Note: (Left) Average Temperature Change °C; (Right) Precipitation Change, %; A1B based on 1962-1989

Figure 2-35 Projected climate change in each zone (temperature and precipitation)

(3) Potential impacts of climate change

(a) Extremes in precipitation patterns

As shown in Figure 2-36, it is predicted that in the future, there will be an increase in both the number of dry days and rainy days. This means that precipitation patterns for each season will become more extreme, leading to an increase in drought frequency during dry periods. This trend is particularly pronounced in the southern regions of the Eastern Caribbean.



CDD: Max. consecutive no-rainfall days (number of consecutive days when daily rainfall is below 1mm)
R10: the number of days during which precipitation above the precipitation 10mm occurs
Source: CDB (2020) The state of the Caribbean climate
Note: Projections for the 2090s using 2006-2016 as the base year

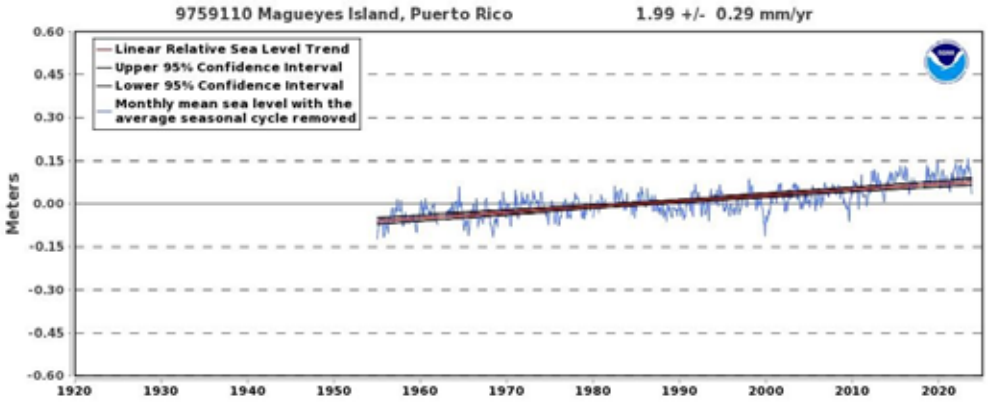
Figure 2-36 Future projections of no precipitation and number of days of precipitation in the Caribbean region

(b) Severity of hurricane disasters

The frequency of hurricanes and storms occurring in the Atlantic is projected to decrease by 28% by the end of the 21st century. On the other hand, the occurrence frequency of Categories 4 and 5 is predicted to increase by 80%, and it is feared that hurricane disasters will become severe due to the extreme intensity.

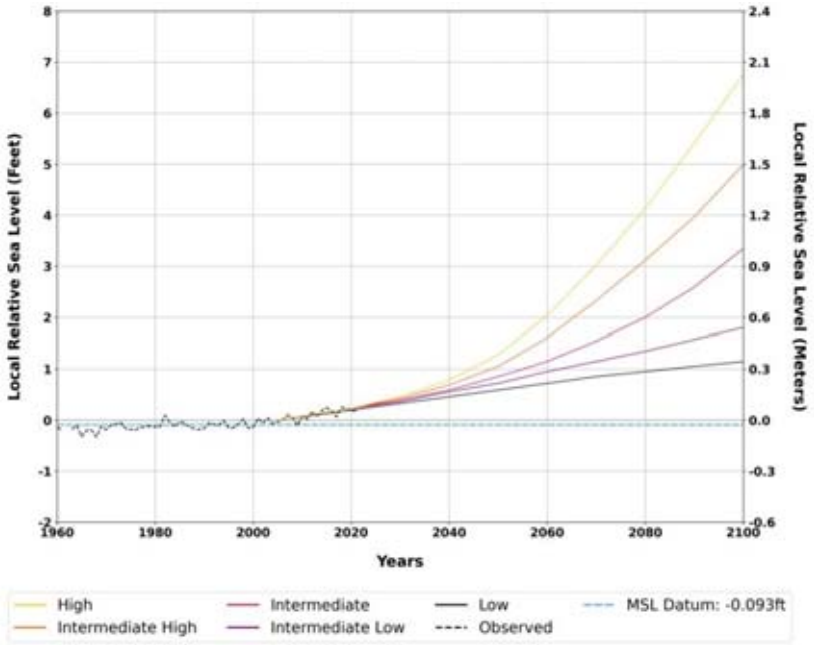
(c) Sea-level rise

As many sea level records in the Eastern Caribbean region have a short period of time, the changes in sea level in Puerto Rico, which is located in the same Caribbean Sea and has been recorded since the 1950s, are shown in Figure 2-37 for reference. The sea level has been rising at a pace of about 2 mm/year as a trend over the past half a century, and is projected to rise to about 30cm～2m by 2100 (Figure 2-38). Progress in sea-level rise could lead to saltwater runs into rivers and salinization of groundwater, leading to further shortages of freshwater resources.



Source: NOAA TIDES & CURRENTS (https://tidesandcurrents.noaa.gov/sltrends/sltrends.html)

Figure 2-37 Sea level rise trend in Puerto Rico



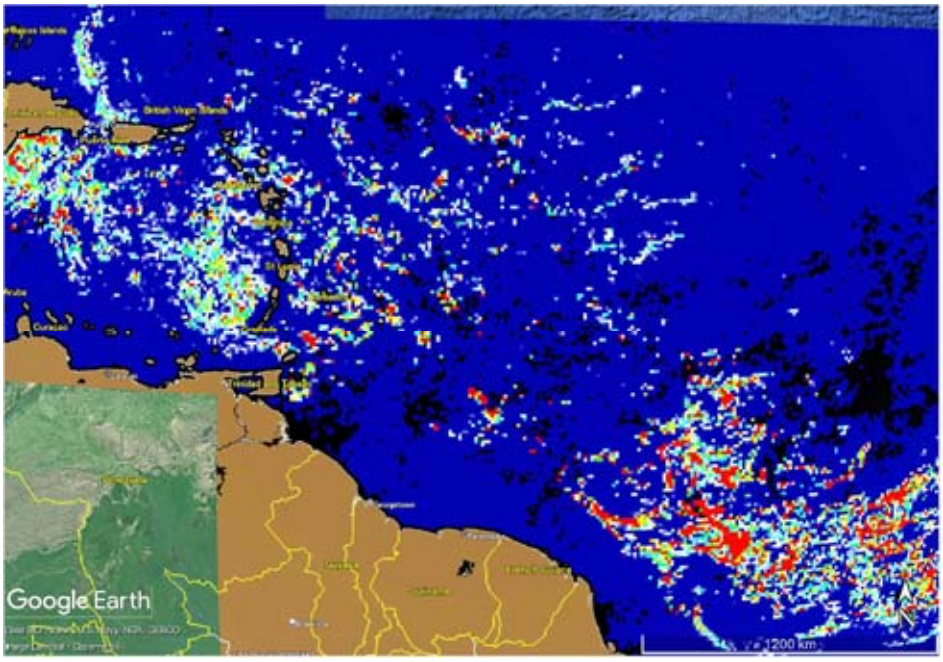
Source: NOAA TIDES & CURRENTS (https://tidesandcurrents.noaa.gov/sltrends/sltrends.html)

Figure 2-38 Projections of sea level rise in Puerto Rico

(d) Effect of Sargassum seaweed

Since 2011, a large amount of floating seaweed called sargassum has drifted over a wide area from West Africa to the coast of the Caribbean Sea, becoming a common environmental problem within the region, not only affecting tourism and fishing, but also causing concerns about foul odors and health hazards from hydrogen sulfide produced by the decaying seaweed. It has been pointed out that this abnormal occurrence is caused by global warming.

This seaweed clogs the intake filters of seawater desalination facilities (a direct intake system is presumed) and affects freshwater output in the Virgin Islands and the Antigua and Barbuda.[29,30]



Source: University of South Florida, Satellite-based Sargassum Watch System (SaWS) based on

Figure 2-39 Distribution of Sargassum seaweed (May 2023)

Source: Government of St. Lucia Website

Figure 2-40 Situation of Sargassum seaweed at the coasts in St. Lucia

[29] Source: https://bvi.gov.vg/media-centre/sargassum-seaweed-causes-water-interruption-virgin-gorda
[30] Source: JICA (2019) Fact-finding Survey Regarding the Influx and Impacts of Sargassum Seaweed in the Caribbean Region

(4) Initiatives for Climate Change and Natural Disaster Risks

In many cases, water utilities cannot obtain sufficient resources necessary for recovery when hurricane damage has occurred. For this reason, the Caribbean Water Utility Insurance Collective (CWUIC) was launched in September 2023, under the leadership of the IDB Group. It offers parametric insurance to water utilities in the Caribbean countries to help them recover from natural disasters. Parametric insurance is, different from ordinary casualty insurance in which insurance claims are paid in principle in the amount corresponding to the actual loss of the insured, an insurance in which a predetermined amount of insurance claims is paid in the event the index (parameter) that is causally related to the loss satisfies a set of conditions at the time of the contract. Generally, it has the advantage of not requiring or minimizing the assessment of damage status, allowing prompt payment of insurance claims.

CWUIC is the sixth segregated portfolio within the Caribbean Catastrophe Risk Insurance Facility Segregated Portfolio Company (CCRIF SPC)[31], an insurance scheme created with a total grant of USD 8,450,000[32], with support over the preceding two years in terms of IDB technical and financial structure and CCRIF insurance modeling[33]. In this survey, we collected data from an official in charge of CWUIC. He mentioned that currently only hurricanes and heavy rainfalls were covered, but in the future they would like to develop an insurance scheme for droughts and earthquakes. In addition, he said that the policy conditions were being reviewed annually.

2.5.3 Risks of water source pollution

Among the target countries, sewer systems are in place in St. Lucia, Dominica, St. Vincent, and Grenada, but these systems are limited to certain areas primarily around the capital or nearby regions. Except for Dominica, the collected sewage is discharged untreated into harbors or offshore. In other areas, septic tanks are used for individual household treatment, and the treated water and untreated greywater are discharged into roadside ditches or allowed to seep into the soil.

[31] A segregated portfolio company established by the ownership, operation, and registration of Caribbean countries for the purpose of reducing the financial damage of the Caribbean and Central America countries due to severe disasters such as hurricanes, earthquakes, and heavy rains, which can provide the member states with insurance rates that are more advantageous than individually subscribing to insurance and reinsurance for disasters. In the past, five parametric insurance schemes in preparation for tropical cyclones, heavy precipitation, and earthquakes have been formed as segregated portfolios for the fisheries and power transmission and distribution sectors. A segregated portfolio company is a corporate form that is permitted in certain countries and regions in the Americas, enabling the establishment of multiple segregated portfolios within a single legal entity to legally separate assets and liabilities by portfolio. This allows the entity to have an effect similar to that of holding multiple independent funds internally.

[32] The breakdown is USD 7.8 million from IDB (including USD 5.6 million from the UK government. Please refer to the project list shown below) and USD 650,000 from CDB.

[33] Source: CCRIF (2023) Caribbean Water Utilities to Access Parametric Insurance Coverage Against Extreme Weather Events

Meanwhile, water intake facilities for rivers used as water sources are located upstream, and seawater intake points for desalination are located far from the sewage discharge points. Groundwater is also sourced from deep wells, which means there is no direct impact from water source pollution. Therefore, the degree of risk of water source pollution due to the lack of sewer systems can be evaluated as relatively low. On the other hand, in St. Lucia and Antigua, untreated sewage is discharged in the harbor areas of tourist districts, causing odor complaints. While there is a need for sewage treatment facilities, these areas are not directly related to swimming areas, and there is no significant impact on tourism. Furthermore, future population growth is expected to be slow or declining, indicating that the issue is not recognized as an urgent problem.

2.5.4 Risk regarding securing human resources

One common challenge identified through this survey across all countries is the securing of human resources, including the turnover of staff and the recruitment of new personnel. This issue will be discussed in detail in Chapter 10.

2.5.5 International trends for water security

The 4th International Conference on Small Island Developing States (SIDS4), to be held in Antigua and Barbuda from May 27 to 30, 2024. *The Antigua and Barbuda Agenda for SIDS (ABAS)*, adopted at the conference, addresses the security concerns of SIDS due to climate change[34]. It includes the content related to water sector, as shown below, and calls for support from the international community for SIDS in the areas of food and energy as well. Considering these circumstances, it can be said that there is increasing interest in the international community's efforts towards "water security."

B. A secure future

ii. Develop integrated water resources management by: (p.12)

a. Developing policies, legislative frameworks, institutional and human capacities for the effective, inclusive, sustainable and integrated water resources management and facilitate the expansion of wastewater treatment, recycling and reuse; Agreed ad ref

b. Significantly reducing the impact of climate change on water scarcity through enhancing climate resilience to water-related hazards and supporting a climate and disaster resilient water supply and sanitation, and access to safe and affordable potable water and sanitation, and hygiene for all; and Agreed ad ref

[34] Source: https://sdgs.un.org/documents/outcome-document-antigua-and-barbuda-agenda-sids-abas-renewed-declaration-resilient

c. Providing appropriate gender-sensitive and disability-inclusive facilities and infrastructure for safe drinking water, sanitation, and hygiene, and waste management systems. Agreed ad ref

iii. Enhance food security by: (p.12)

a. Developing and implementing adaptation and mitigation strategies that take into account the linkages between food, water and energy, such as integrating climate-resilient infrastructure and promoting sustainable agricultural practices and the deployment of agricultural technologies that are resilient to the adverse impacts of climate change; Agreed ad ref

b. Increasing sustainable agriculture and fisheries, food security and nutrition and livelihoods in SIDS in a manner that helps with climate adaptation, mitigates emissions and promotes sustainable use of biodiversity, including through incubation, diversification, local value addition, climate-resilient best practices, and promoting, scaling up and replicating locally grown ideas, to accelerate the achievement of sustainable agriculture and fisheries, food security, and good and improved nutrition, as well as improved overall health and wellbeing; and Agreed ad ref

c. Developing sustainable food and agricultural production, that is resilient to the impacts of climate change, address water availability, and efficiently uses water resources, improving supply and distribution of food, including the reduction of food loss and waste, and enhancing resilience to potential excessive food price volatility and food crises. Agreed ad ref

iv. Build resilient infrastructure by: (p.13)

a. Scaling up planning, development and management of quality, reliable, sustainable and resilient infrastructure and energy efficient land, marine and air transportation systems; and Agreed ad ref

b. Applying the Principles for Resilient Infrastructure in SIDS to create risk-informed policy, investment decisions and systems in sectors including transportation, energy, communications, water, health and education, with a view to nurturing a culture of maintenance for resilient societies. Agreed ad ref

C. Environmental Protection and Planetary sustainability

iv. Mainstream Disaster Risk Reduction by: (p.16)

e. Reducing disaster risks, including by building protective infrastructure and enhancing resilience of freshwater and other water systems, and using the recovery, rehabilitation and reconstruction phases after a disaster to increase resilience, and developing systems for managing evacuations and the distribution of basic relief support. Agreed ad ref

2.6 Existing JICA surveys and projects

2.6.1 Existing survey in the target area

Table 2-32 summarizes the status of the implementation of past JICA surveys in the Caribbean countries covered. Table 2-31 and subsequent sections provide an overview of the Case and the relevant results of the previous survey along with information that can be used.

For example, in addition to referring to the results of previous surveys in the field of water supply and sewage, if it is a past investigation of fishery projects, it contributes to the confirmation of basic information, such as fishing port and fishing ground information, in assessing the effects of the desalination facility installation on the aquatic industry.

Table 2-30 Past JICA surveys for the target countries

Reported year	Field	Project	Outline
2013	Fishery	A survey to develop detailed plans for fishery management projects jointly by fishermen and administration in the Caribbean region	-
2014	Fishery	Preparatory Survey on the Project for Improvement of Fisheries-Related Equipment in the Caribbean Region	-
2014	Fishery	Caribbean marine product distribution information collection and confirmation survey	-
2014	Disaster prevention	Information gathering and confirmation surveys in the areas of disaster prevention in Jamaica and St. Lucia in North and Latin America	Table 2-33
2015	Disaster prevention	Information gathering and confirmation survey related to the disaster prevention field in CARICOM countries	Table 2-34
2015	Energy	Information gathering and confirmation survey in the fields of renewable energy and energy conservation in the CARICOM countries	-
2016	Energy	Information gathering and confirmation survey on geothermal development in Grenada	-
2017	Disaster prevention	Preparatory Survey on the Project for Bridge Replacement in the Cul-De-Sac Basin, St. Lucia	-
2017	Water supply and sewage	Information-gathering and confirmation surveys for JICA-IDB collaboration on the water and sanitary sector in the North and Latin America region and the Central America region	Table 2-31
2019	Water supply	Information gathering and confirmation survey on the project to strengthen water supply in the Caribbean region in North and Latin America	Table 2-32
2019	Fishery	Preparatory Survey on the Project for Improvement of Fisheries Buildings and Equipment in Roseau and Marigot, Dominica	-
2020	Waste	North America and Latin America (wide-area) Caribbean Marine Plastic Waste Problem Information Collection and Check Survey	-
2022	Multiple	Information-gathering and confirmation surveys on the ideal way of developing co-operation in the Central American and Caribbean regional With/Post COVID-19 communities	Table 2-37Table 2-37 Outline of past JICA
2022	DX	Information-gathering and confirmation surveys for remote implementation of JICA projects using DX techniques and ICT environmental improvement in Latin America and the Caribbean region	-
2022	Other	Information gathering and confirmation survey related to the cooperation of start-up companies in the Caribbean region, Latin America	-
2022	Fishery	Preparatory Survey on the Project for Improvement of Choiseul Fishing Port in St. Lucia	Table 2-36
2023	Energy	Energy Conservation Promotion Project in North and Latin America	Table 2-35

2023	Multiple	Information gathering and confirmation surveys on the development of human resources and infrastructures for the creation of a strong society in the event of a With/Post COVID-19 in North and Latin America (wide area)	Table 2-37Table 2-37 Outline of past JICA

Source: Prepared by JST based on JICA HP

Table 2-31 Outline of past JICA surveys on the water sector (1/2)

Project name	Information-gathering and confirmation surveys for JICA-IDB collaboration on the water and sanitary sector in the North and Latin America region and the Central America region (April 2017)
Country Name	Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, and the Dominican Republic
Survey outline	For the above eight countries, mainly in the Central American region, the possibility of a loan aid is being investigated and examined with the aim of promoting the utilization of Japanese technologies in the water supply and sewage sector. In 2012, JICA signed a Memorandum of Understanding with IDB on Cofinancing Arrangements for Renewable Energy and Energy Conservation (CORE), and in 2016 signed a Memorandum of Understanding and a Memorandum of Understanding for Expanding Cofinancing for both sides (covering the areas of Renewable Energy Development and Energy Conservation, as well as the transport, water, and sanitation sectors that contribute to energy efficiency). For this reason, this study gathers and analyzes information and prepares a list of candidates that contribute to the formulation of cofinancing projects with a view to utilizing CORE schemes and collaborating with IDB.
Use of knowledge	✓ Information on co-financing with IDB

Source: JICA report

Table 2-32 Outline of past JICA surveys on the water sector (2/2)

Project name	Information Gathering and Confirmation Survey on Water Supply Enhancement Project in the Caribbean Region in North America and Latin America (June 2019)
Country Name	Guyana, Grenada, Jamaica, St. Christopher and Nevis, St. Vincent and the Grenadines, the Bahamas, Belize
Survey outline	Taking the above seven countries in the Caribbean region as an object, various information such as existing water resource reserves, the current state of water supply, the state of introduction of desalination facilities, etc. are collected and arranged, and the possibility of support contributing to non-revenue water countermeasures, seawater desalination projects, water demand in the same region, etc. is being examined. In the first phase of the study, literature reviews were conducted, and from the seven countries included in the study, three were selected for the second phase of the study from the viewpoints of 1) the necessity of introducing a seawater desalination system, 2) the situation of non-revenue water countermeasures and the possibility of water supply project improvement through implementation, and 3) the possibility of support by our country. At the country level, field surveys and information gathering are carried out with the view to the formation of projects in mind, and proposals for cooperation are made to each country.
Use of knowledge	✓ Basic information for each country ✓ Proposal policy for cooperation plan

Source: JICA report

Table 2-33 Outline of past JICA survey on disaster prevention sector (1/2)

Project name	Information gathering and confirmation survey in the area of disaster prevention in Jamaica and St. Lucia in North and Latin America (April 2014)
Country Name	Jamaica, St. Lucia
Survey outline	Considering measures for floods, storms, storm surges, sediment-related disasters, and earthquakes in the target countries, information on the current state of disasters, the government's policies, systems, and response conditions related to disaster prevention are gathered, and proposals for cooperation in the fields of disaster prevention and disaster recovery are being made.
Use of knowledge	✓ Basic information on St. Lucia and information on disaster and disaster prevention

Source: JICA report

Table 2-34 Outline of past JICA survey on disaster prevention sector (2/2)

Project name	Information gathering and confirmation survey related to the disaster prevention field in CARICOM countries (September 2015)
Country Name	Antigua and Barbuda, Guyana, Grenada, Jamaica, Suriname, St. Christopher and Nevis, St. Vincent and the Grenadines, St. Lucia, Commonwealth of Dominica, Trinidad Tobago, Barbados, Belize
Survey outline	The present state and problems of policy and technological aspects in the field of disaster prevention in the surveyed country in the CARICOM region are extracted and analyzed, and information collection and analysis for examining the direction of cooperation are carried out. Considering measures for floods, storms, storm surges, sediment-related disasters, and earthquakes in the target countries, information on the current state of disasters, the government's policies, systems, and response conditions related to disaster prevention are gathered, and proposals for cooperation in the fields of disaster prevention and disaster recovery are being made.
Use of knowledge	✓ Basic information on St. Lucia and information on disaster and disaster prevention

Source: JICA report

Table 2-35 Outline of past JICA survey on Energy sector

Project name	CARICOM Energy Conservation Promotion Project in North America and Latin America (June 2023)
Country Name	Jamaica, Barbados, St. Christopher and Nevis
Survey outline	Many of the CARICOM countries strongly rely on imported fuels for their main sources of electric power energy, and the reduction of dependence on imported fuels and the reduction of power generation costs are issues, such as being affected by soaring oil prices. Although the CARICOM countries have formulated policies to promote the introduction and conservation of renewable energy, and have also established numerical targets, efforts such as the preparation of a roadmap for the realization of policies for each country and the introduction of a fixed purchase system for electric power are not sufficient, and business entry by private enterprises is not sufficiently advanced. The JICA project was implemented for the purpose of human resource development, organizational capacity enhancement, and technological transfer after conducting a baseline study in the target country.
Use of knowledge	✓ Status of Energy Resources and Electricity Infrastructure in the CARICOM region

Source: JICA report

Table 2-36 Outline of past JICA survey on Fisheries sector

Project name	Preparatory Survey on the Project for Improvement of Choiseul Fishing Port in St. Lucia (August 2022)
Country Name	St. Lucia
Survey outline	This is a preliminary survey of a project aimed at reducing fisherman labor, increasing fishing machines, and increasing fish catch, while ensuring the accessibility and safety of fishing vessels in the route and port mouth by implementing sediment reduction measures in Choiseul fishing located in the southwestern part of the country.
Use of knowledge	✓ Information on fishing ports and fishing grounds when considering the introduction of seawater desalination facilities

Source: JICA report

Table 2-37 Outline of past JICA surveys on other sectors

Project name	1) February 2022: Collection and Confirmation Survey on Development-Cooperation in Central America and the Caribbean Regional With/Post COVID-19 Community 2) Collecting and Confirming Human Resources and Infrastructure-Developing Surveys for Strong Social Co-creation in North and Latin America (Wide Area) With/Post COVID-19 Disasters (March 2023)
Country Name	Key countries: Mexico, Honduras, Guatemala, Nicaragua, Panama, El Salvador, Belize, Costa Rica, Cuba, the Dominican Republic, Haiti, St. Lucia, Jamaica, Guiana Countries covered by the research: Antigua and Barbuda, the Bahamas, Barbados, Dominica, Grenada, Suriname, St. Christopher and Nevis, St. Vincent and the Grenadines, Trinidad and Tobago
Survey outline	According to the survey in ①, the impacts of COVID-19 problems on various sectors in the target area and the need for collaboration are analyzed and information-gathered. Pilot projects are also carried out, and the direction of future development is summarized. Through this survey, the following survey in ② presented the analyses and recommendations regarding the development of human resources and infrastructures for the creation of a strong society in the event of COVID-19 problems contributing to the establishment of basic social services in priority sectors of each country, in addition to the analyzed immigrant issues that must be addressed preferentially, the development of private sectors and VC including new industries, the transition to green economies, and the creation of local communities and local fertilization.
Use of knowledge	✓ St. Lucia: Information and Communications and Electricity, Transportation and Transportation (Bridge and Road Traffic Control), Education, Health Care, Sargassum (Seaweed Migration Problem), Regional Economy and Social Development ✓ Sectorial and cross-sectorial development policies

Source: JICA report

2.6.2 Existing JICA projects in the target area

Most of the existing projects are free of charge or technical cooperation in the field of fisheries. Of these, in 2013 and 2020 (up to September 2024), St. Lucia (with the exception of Barbados) is the central base for wide-area projects. This is considered to be a reference for the implementation system in forming technical cooperation projects.

Table 2-38 Implemented JICA Projects for the target countries

Year	Field	Country	Project	Aided amount
1998	Fishery	SLU	Beaufort Fisheries Complex Construction Project	1 billion yen
2001	Fishery	SLU	Coastal fishery promotion plan	1.31 billion yen
2001	Fishery	DOM	Coastal Fisheries Development Expansion Project	1.11 billion yen
2002	Fishery	GND	The Project for Improvement of Glenville Fisheries Product Distribution	1.4 billion yen
2002	Fishery	DOM	The Project for Improvement of Marigot Fishing Port	1.66 billion yen
2003	Fishery	SVD	Kingstown Fish Market Rehabilitation Project	750 million yen
2004	Fishery	ANU	Fisheries Center Construction Project	910 million yen
2005	Fishery	SKB	Micro Fisheries Promotion Project	610 million yen
2006	Fishery	SVD	Our Fisheries Center Development Project	1.43 billion yen
2008	Fishery	SLU	The Project for Improvement of Anse La Raye Fisheries Facility	530 million yen
2009	Fishery	ANU	The Project for Improvement of Small Fisheries Facilities in Barbuda Island	1.32 billion yen
2009	Fishery	GND	Gouyave Traditional Fishing Area Base Improvement Project	1.17 billion yen
2009	Fishery	DOM	The Project for Improvement of the Portsmouth Fisheries Center	740 million yen
2013	Fishery	Multiple countries	A joint fisheries management project between fishermen and administration in the Caribbean region	-
2014	Fishery	SLU	The Project for Improvement of Fisheries-Related Equipment	560 million yen
2014	Fishery	GND	The Project for Improvement of Fisheries-Related Equipment	480 million yen
2014	Fishery	SVD	The Project for Improvement of Fisheries-Related Equipment	480 million yen
2015	Fishery	DOM	The Project for Improvement of Fisheries-Related Equipment	160 million yen
2015	Fishery	SKB	The Project for Improvement of Fisheries-Related Equipment	180 million yen
2015	Fishery	ANU	The Project for Improvement of Fisheries-Related Equipment	580 million yen
2017	Fishery	SLU	Cul-De-Sac Basin Bridge Replacement Plan	1.53 billion yen
2019	Fishery	DOM	The Project for Improvement of Buildings and Equipment for Fisheries in Roseau and Marigot	1.07 billion yen
2019	Resources Energy	Multiple countries	CARICOM Energy Conservation Promotion Project (wide area)	-
2020	Fishery	Multiple countries	Project for Improving Conservation Management of Coastal Fisheries Resources in Cooperation with Fisheries Persons and Administration	-
2022	Fishery	SLU	Choiseul Fishing Port Improvement Project	1.26 billion yen

Source: Prepared by JST based on JICA HP

2.7 Activity of return trainees in the water field and possibility of cooperation

JICA has invited trainees in the water sector from Eastern Caribbean countries and has conducted training in Japan. In this investigation, interviews were carried out with attendants on the present activity situation and the possibility of future cooperation in order to tackle the problems of water security.

(1) Returning trainees who were subject to the interview

The table below shows the appointment of five returning trainees and the timing of their training as interviews. A total of seven trainees were listed, and two of them were retired from service (as of March 2024).

Table 2-39 Familiarization of return trainers and names of training courses

No.	Country name	Your organization	Training course	Training year
1	SLU	WRMA	Practical IWRM for Solving Water Problems	2023
2	SLU	WRMA	Sewerage and Urban Drainage Management	2023
3	ANU	APUA	Conservation and Management of the Water Environment in Island Countries	2018
4	DOM	DOWASCO		2017
5	GND	Ministry of EPTICAFC		2018

Source: JST prepared based on interviews

(2) Activity status after training

The table below lists 1) sharing of knowledge and experience after the training of trainees in each country, 2) incorporation into the current business, and 3) problems in the implementation of training within the department.

Table 2-40 Shared status of knowledge and experience obtained during training

Country name	Contents
SLU	In order to share the knowledge acquired, all training materials are stored in an on-site database so that staff can view them. Presentations are given to staff in PowerPoint on the action plan created in the training and incorporated into IWRM work. In addition, the training materials were shared with the relevant organizations (WASCO, Environmental Sanitation Department).
ANU	The report of the whole training course was submitted to APUA and training department, and then the manager, engineers, and supervisors of the water division were invited to present the training results. However, training materials are not shared.

DOM	There are no opportunities within the organization to present the results of training, but ministries and schools invite them to workshops to share their knowledge and experience. The training materials are stored in the server of the Engineering Department to which they belong and are shared within the Department. Since this server is not accessible from other departments, the Engineering Department has a public folder as needed to provide materials to other departments.
GND	A training result report and training materials (softcopy) were submitted to the head of the department.

Source: JST prepared based on interviews

Table 2-41 Current uptake status

Country name	Contents
SLU	Since WRMA is responsible for protecting and managing water-resources, there are several stakeholders. Then, the contents learned in the training are utilized for the exchange with the stakeholder. Knowledge gained from training is helping to investigate water pollution and to raise staff awareness and technology about water quality.
ANU	Though the training mastered the water source management of the surface water, it does not utilize the knowledge directly, because it is engaged in the operation and maintenance of the seawater desalination facility at present. However, it feeds back the experience obtained in the training, and theoretically shares the information in the workplace, though it is verbal.
DOM	A checklist is prepared to avoid implementation, design, and mistakes, and schedule management, strategic planning, and confirmation of the project scope are being conducted. However, the budget for renewal of equipment and systems, etc. is not enough to perform the present job.
GND	Though they belonged to the environmental division during the training, they could not directly utilize the knowledge learned in the training, because they were transferred to the agricultural division by the Ministry reorganization at present.

Source: JST prepared based on interviews

Table 2-42 Problems in the implementation of training

Country name	Contents
SLU	In WRMA, a) limited human resources (minimum required personnel and number of staff), b) insufficient knowledge of water resources, and c) high costs of training (including purchasing equipment). For effective training, the feasible scenarios are taken into account. For example, it is important for staff to understand the purpose and subject of training how to analyze the situation when there are large restrictions on available data.
ANU	Since most of the training is classroom (text-based), it requires practical exercises. Since staff members work under the shift system, they are required to set and implement the training date and time that they can participate in. APUA Training Department manages and implements training, but it is difficult to train all APUA staff due to the aging of equipment

	and materials, lack of staff and budget, etc. Learning management system (e-learning) is introduced as a complement.
DOM	a) Even if there is a shortage of staff or training opportunities, there are cases where staff are too busy to participate. In particular, engineers involved in the early stages of a project cannot leave the field. b) In the event of a budget shortage (transportation expenses, daily allowance, etc.) or overseas training, the budget for travel expenses may be insufficient.
GND	The department is currently facing several challenges, including the implementation of effective training programs, the assurance of necessary financial support, and access to resources in the field of expertise. However, it is possible to overcome these challenges and achieve the expected results through aggressive activities and cooperation with stakeholders.

Source: JST prepared based on interviews

(3) Possibility of future collaboration

In order to address the issue of water security through returning trainees, interviews were conducted on 1) future collaboration between returning trainees (between other countries) and 2) possibility of collaboration with other entities in the country. The results are shown in the table below.

Table 2-43 Cooperation between return trainers (between other countries)

Country name	Contents
SLU	No contact meetings are held among trainees, but it is better to have an opportunity for contact meetings. We think that the opportunity to deepen exchange between trainees and provide mental support and advice is necessary. The liaison conference should not be a formality, but should be a place where free discussion can be held. At present, it can be contacted by a mobile phone.
ANU	No contact meeting is held among trainees. Based on the knowledge obtained in the training, it is desirable to discuss the direction and action plan to overcome the weak points of the water supply system by focusing on the weak points (tap water source, non-reclaimed water, etc.). This is the issue of how to collaborate with the training departments within the organization so that more staff can use the available information.
DOM	A liaison meeting among trainees is desired, but at present, no liaison meeting has been held because water supply systems such as tap water sources are different. What we expect at liaison meetings is to facilitate communication between the parties involved and to promote conversations and information exchange. Through consultations with the respective experts, each subject and field can be intensively touched on. Furthermore, because they have experienced similar disasters in natural disasters, they can cooperate with each other in these disaster countermeasures.
GND	It is desirable to hold the liaison meetings, but it is not. I would like to obtain a place where trainees share the knowledge and experience of each country.

Source: JST prepared based on interviews

A liaison meeting is not held among the return trainees, although they want a place to exchange opinions and information. The Liaison Conference expects to share its knowledge and experience on how each country is addressing problems and issues.

It is realistic to set up a chairman for each country to hold a liaison conference, and to start with an on-line conference. At the same time, each of the trainees has their own contact information. Creating and forming a network of contact information is the first step toward holding the contact conference.

Table 2-44 Collaboration with other local areas in the country

Country name	Contents
SLU	Since the targeted fields are related to other entities, WRMA action plan created in the training was communicated to those in charge of other entities to share the results of the training in order to understand them. In addition, when problems related to water resources and the environment occur, experience and knowledge are shared among each organization and department.
ANU	As they depended on the training department within APUA, they did not particularly encourage cooperation. However, it is necessary to cooperate on sharing of knowledge, companion consciousness, sharing of good examples, preparation of action plan, and realization of the plan.
DOM	In order to construct a robust water supply sector after hurricane damage, a strategic development plan for the water supply sector was formulated by utilizing the knowledge obtained in the training. Though the communication conference with other departments has not been established, it can be expected that the awareness improvement of the staff, productivity improvement, equalization of the work quantity, introduction of the evaluation system by the information sharing, reduction of the burden of the supervision, etc. by the improvement in the sense of responsibility, etc..
GND	No liaison meetings are established with other departments, but by holding these meetings, everyone concerned can always obtain the most up-to-date information on important progress and changes. It can also be an effective way to promote cooperative relationships among stakeholders through liaison meetings.

Source: JST prepared based on interviews

In collaboration with other local organizations, the action plan prepared in the Japanese training is shared, and it is used to promote understanding and implement the plan. In addition, the knowledge acquired in the training is incorporated into the development plan and other results of the training are being produced. In this way, cooperation with related departments will be strengthened, which will provide a foothold for the holding of liaison meetings.

2.8 Public relations for the Japan-CARICOM Friendship Year 2024

In 2024, 30 years have passed since Japan and CARICOM began working-level consultations, and this is the 60th anniversary of the establishment of diplomatic relations between Japan and Jamaica. To commemorate the Japan-CARICOM Friendship Year 2024, various commemorative projects are planned in various parts of Japan and other parts of the Caribbean.

In the list of businesses published by the Japanese Ministry of Foreign Affairs[35], only Barbados plans to carry out the project in the target country. Therefore, even though the degree of awareness at the time of interviews with the organizations in each country was not high in January and February 2024, each country had a big interest in the project. Using this opportunity, the project will be shaped through this survey and the public relations efforts of the JICA St. Lucia office will contribute to the smooth implementation of cooperative projects in Caribbean island nations, which, like Japan, are frequently affected by typhoons and earthquakes.

[35] Source: https://www.mofa.go.jp/mofaj/area/latinamerica/kikan/caricom/pagew_000001_00030.html

Chapter 3 Saint Lucia

3.1 Basic information

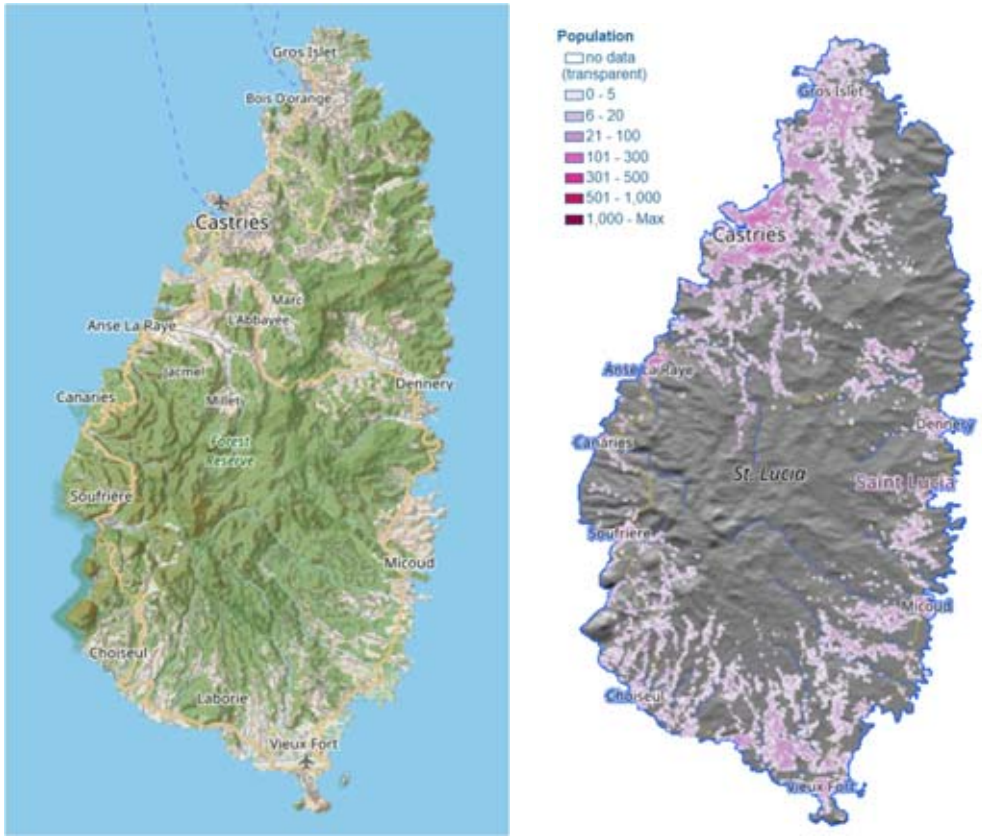
3.1.1 Outline of the country

Saint Lucia is located near 14 degrees north and 61 degrees west, the central part of the Windward Islands, and its total area is approximately 610km^2. The capital is Castries in the northwestern region, with a population composition of African (85.3%), mixed race of African and European (10.9%) and Indian (2.2%). The official language is English, but the influence of France, which dominated the country from the 17th century to the mid-18th centuries, remains strong, and the French colloquial patois is still widely used nowadays.[1]

3.1.2 Socioeconomic conditions

(1) Population dynamics

As shown in Table 3-1, the population is 183,630 (2020) with a growth rate of 0.4%. Fifty-five percent of the population is concentrated in the northern capital, Castries, and Gros Islet.



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

Figure 3-1 Population distribution map of St. Lucia (2020)

[1] Source: Overview of Saint Lucia (2022) by the Embassy of Japan in Trinidad and Tobago

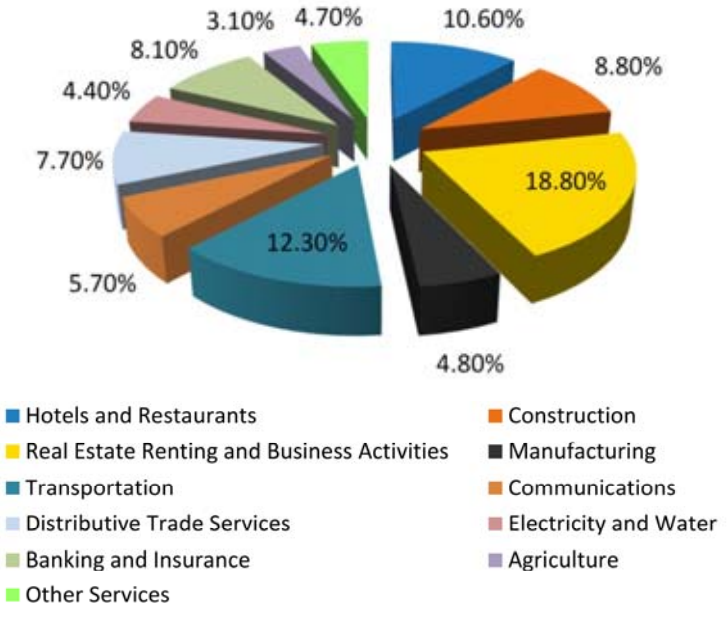
(2) Macroeconomics

The economy of St. Lucia was originally centered on agriculture, but since the 1990s, banana production, which was the primary industry, has begun to decline. In recent years, like many Caribbean countries, the tourism industry has become the mainstay. As shown in Table 3-1, the composition of GDP includes 2% from agriculture, 9% from manufacturing, and 86% from services, including tourism. The sub-sectors related to the main tourism industry are structured as illustrated in Figure 3-2. However, the tourism industry is influenced by fluctuations in the number of tourists from Europe and the United States, as well as natural disasters such as hurricanes that are specific to the region. In addition, the economy is heavily dependent on fossil fuel imports, making the domestic economy vulnerable to external factors.[1]

Table 3-1 Demographic and Economic Status of St. Lucia

	Items	Unit	2010	2015	2020
Basic info.	Total population	inhab	174,090	179,130	183,630
	Urban population	inhab	31,840	32,810	34,140
	Rural population	inhab	140,740	144,400	147,060
	Population density	inhab/km2	281	289	296
Economics	Gross Domestic Product (GDP)	current US$	1,486,637,037	1,809,977,778	1,616,774,074
	Agriculture	value added to GDP	X	40,130,000	39,084,444
	Industry	value added to GDP	X	135,464,074	144,777,778
	Services	value added to GDP	X	1,140,279,258	1,391,212,221
	GDP per capita	current US$/inhab	8,540	10,105	8,805

Source: FAO AQUASTAT



Source: CCCCC (2015)

Figure 3-2 Sub-sectors of tourism industry in St. Lucia

Figure 3-3 shows the monthly tourist population in St. Lucia. September, when hurricanes are the most frequent annual trend, is the off-season, but the warm climate has led to stable demand for tourism throughout the year (approximately 60% of the tourists visited by cruise ships). It had been increasing year by year from 2011 to 2020, but it dropped sharply due to the corona virus, and it gave a big blow to the country's tourism industry.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	26,993	26,142	29,536	29,122	24,786	22,404	32,835	28,429	16,844	22,431	22,536	30,346	**312,404**
2012	25,605	28,947	30,885	27,399	24,257	21,151	29,416	27,866	16,687	22,248	23,709	28,631	**306,801**
2013	25,899	27,853	33,842	27,772	26,679	24,071	28,428	27,536	18,391	22,385	25,167	30,603	**318,626**
2014	27,643	30,135	34,538	30,757	27,676	25,268	32,100	28,646	18,247	22,805	26,933	33,410	**338,158**
2015	31,541	32,083	34,595	31,200	29,658	26,347	32,481	27,822	17,468	23,745	25,821	32,147	**344,908**
2016	30,661	31,637	35,069	30,104	29,813	25,855	33,381	29,991	18,169	24,251	25,254	33,687	**347,872**
2017	31,649	33,402	35,427	34,322	31,436	31,312	38,291	33,400	20,249	27,967	29,962	38,910	**386,327**
2018	32,755	35,536	41,741	32,555	32,277	31,318	37,844	34,168	18,745	25,991	30,422	41,428	**394,780**
2019	34,546	38,166	41,674	36,828	34,354	34,040	42,778	36,342	21,608	26,923	32,913	43,569	**423,741**
2020	33,675	39,638	18,086	0	0	0	1,955	3,261	4,122	7,808	7,766	14,384	**130,695**

Source: Prepared by JST based on https://stats.gov.lc/subjects/economy/tourism/

Figure 3-3 Monthly Tourism in St. Lucia (2011-2020)

As shown in Table 3-2, the GNI per capita in 2022 is USD 12,400, and SLU is still one of the DAC listed countries. The year 2022 was marked by the headwinds of the external environment, such as the malfunctioning of the international supply chain mainly due to Russia's invasion of Ukraine and COVID-19 lockdown in China, and the sluggish growth of consumer activity in response to the high inflation and stagnation of the stock markets in the U.S. and European countries accompanied by the high interest rate policy.

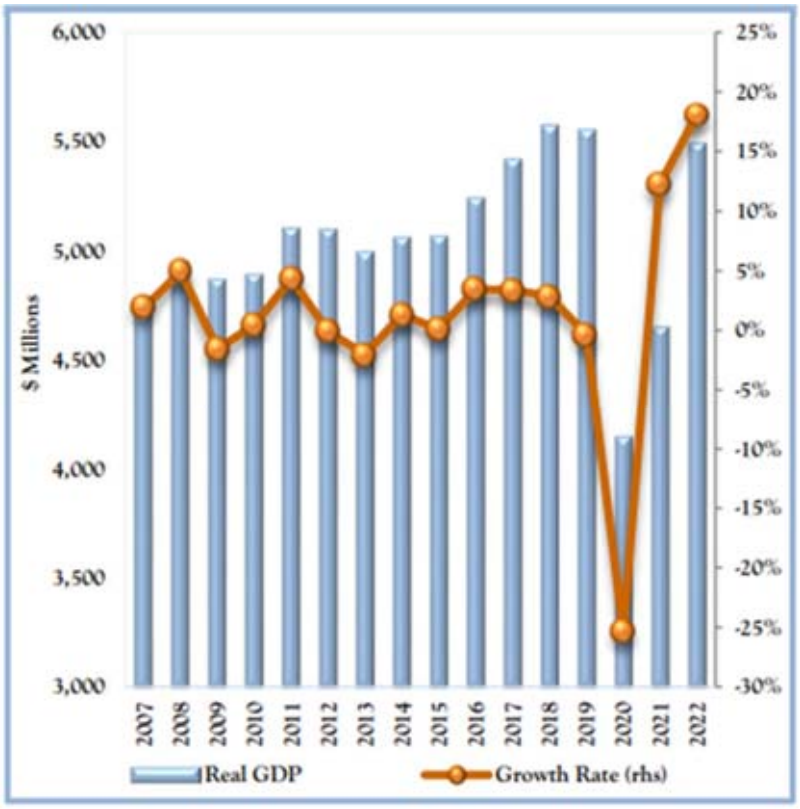
However, in St. Lucia, particularly in the tourism industry, the recovery trend in post-COVID economic and social activities has been remarkable with the momentum of these backwinds, and other industries have been favorably impacted. In 2022, the GDP per

capita recorded USD 13,031 and grew at an annual rate of 15.7%[2]. Assuming that this growth rate has continued for five years, the GDP per capita in 2027 would be USD 27,017.[3]

Table 3-2 Key Economic Indicators of St. Lucia

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)
2,241	12,400	No data	No data	6.4	-655.4
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)**
2,344	13,031	15.9	15.7	17.4	508.4

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



Source: Saint Lucia (prepared by a survey team from 2023) ECONOMIC AND SOCIAL REVIEW 2022

Figure 3-4 Historical Changes of Actual GDP in St. Lucia

[2] Hereinafter, unless otherwise specified, in terms of the World Bank database, GNI per capita in Atlas method (current USD), GDP per capita (current USD) and GDP per capita growth (annual %) are applied.

[3] The US dollar conversion rate is assumed to be constant. The same applies to the description regarding GDP forecasts.

(3) Financial Position

The central government's current account balance had revenues of USD 416 million in FY 2022, but its expenditures reached USD 523 million, a deficit of approximately 107 million USD. In FY 2023, however, revenues are projected to increase by 20.7% to USD 502 million, while expenditures will increase by only 3.0% to USD 538 million, with the deficit expected to be just under USD 36 million. Reflecting the strong growth in GDP mentioned above, the ratio of public debt to GDP was improved from 85.9% in FY 2021 to 69.8% in FY 2022.

Table 3-3 Current Accounts and Public Debt in St. Lucia

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 First half results	FY'22 Actual	FY'23 Forecast
416	502	523	538	1,628	1,743	69.8	No data
Of which, grant aid				Of which, external debt		Of which, external debt	
31	39			874	No data	37.5	No data

Source: Saint Lucia (2022) ECONOMIC AND SOCIAL REVIEW, ECCB (2023) ECONOMIC AND FINANCIAL REVIEW JUNE 2023

(4) Business environment

The Ease of Doing Business Index[4] is 63.7 (2020). This ranks 93rd out of 190 countries and is at a mid-range internationally, but exceeds 59.1 in Latin America and the Caribbean region, which is highest in the six surveyed countries. On the other hand, the Corruption Perceptions Index[5] is 55 (2023), which ranks 45th out of 180 countries covered in the world and next to St. Vincent and the Grenadines and Dominica in countries covered in this survey.[6]

(5) National Development Plans

Based on external factors such as socio-economic changes after the COVID-19 pandemic and the global high prices caused by the Russian invasion of Ukraine, the Department of Economic Development in the Ministry of Finance, Economic Development and the Youth Economy is developing the Medium Term Development Strategy 2021-2026 by updating the Medium-Term Development Strategy for FY2020 to FY2023.

[4] For the index, source: World Bank (2020) Doing Business 2020
[5] For the index, source: the website of Transparency International
[6] Excluding Antigua Barbuda and Saint Christopher Navis, which are not covered by the index

(6) Outline of electric power business operation

LUCELEC (Saint Lucia Electricity Services Limited) is responsible for the electric power business in the country. The company was privatized in 1994. Currently, three companies, i.e. EMERA (the parent company of the power companies of Barbados and Bahamas), First Citizen Bank, and National Insurance Corporation, hold 20% of the shares, Castries City Counsil (CCC) holds 15.5% and the government-owned shares are only about 10%[7].

In recent years, fuel costs have soared, but the company has maintained profitable operations through the use of swap contracts and increase in fuel surcharges. On the other hand, the electricity tariff is 1.024 XCD per kWh (approx. 59.5 JPY; high-voltage electricity for industrial use, in May 2024) and is similarly high as the other Eastern Caribbean countries[8].

(7) Power infrastructure development status

With regard to the supply-demand balancing in SLU, the peak demand is 61.9 MW while the firm capacity is 68.0 MW. The redundancy rate of approximately 9% is secured[9].

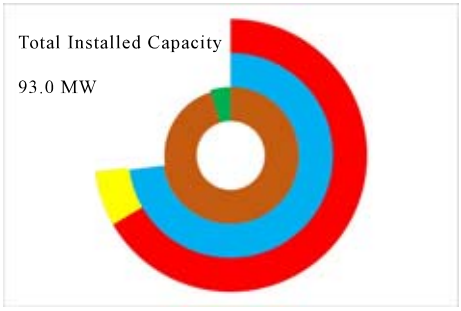
The total annual blackout time in 2022 was 8.43 hours, but the causes of the severe blackouts were system shutdowns (1.43 hours), which were presumed to have occurred accidentally and blackouts (0.63 hours) due to substation flooding. The company's annual total outage time exceeds the company's 2022 target (6.65 hours), but they managed to recover in the short-term. For example, they performed maintenance on three engines and one generator in accordance with the recommendations of the generator manufacturers in 2022, while ensuring the high availability of thermal power plants. We can conclude that the power infrastructure of the country is reliable.

In 2021, power generation on the island consists of thermal power generation (capacity 88.4 MW) and solar power generation (capacity 4.55 MW, including private sectors) as shown in Figure 3-5 Outline of Electricity Situation in St. Lucia. They rely solely on imported fuel for their thermal power generation.

[7] Adapting Annual Report 2022; LUCELEC, 2023. Common shareholders hold the remaining shares about 15%.

[8] https://www.lucelec.com/content/rates-service-standards, 2024.5. An average electricity tariff of targeted countries (including fuel surcharge) is 1.051XCD. (Excluding ANU where the fuel surcharge is not publicized.)

[9] Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022 Adapting Annual Report 2022; LUCELEC, 2023



	Peak Demand	61.9 MW
	Available Cap.	6.1 MW
	Firm Cap.	68 MW
	Fossil-fuel Gen.	88.4 MW
	RE Gen.	4.55 MW

Source: Prepared by JST

Figure 3-5 Outline of Electricity Situation in St. Lucia

Major renewable energy programs currently underway include: 1) 10 MW solar; 2) 7.5 MW storage facilities; and 3) 30 MW geothermal power. However, for 2) storage battery facilities program, the tender in 2022 was unsuccessful due to the impact of the corona crisis on the global supply chain and the soaring lithium price, they are currently studying the scope of the project.

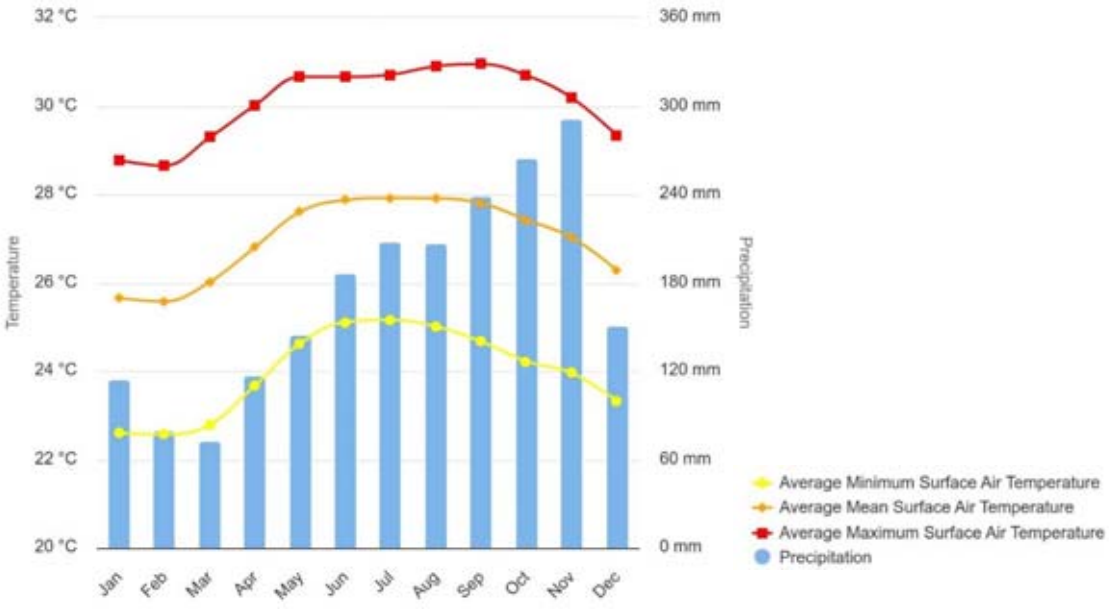
The country has set a target of 50% renewable energy by 2030, but the current rate is still less than 5%. While there is no imminent risk, such as a short supply of electric power and rising operating costs that would affect the profitability, replacing existing fossil fuels with renewable energy is a challenge for the country's energy policy.

3.1.3 Natural conditions

(1) Weather conditions

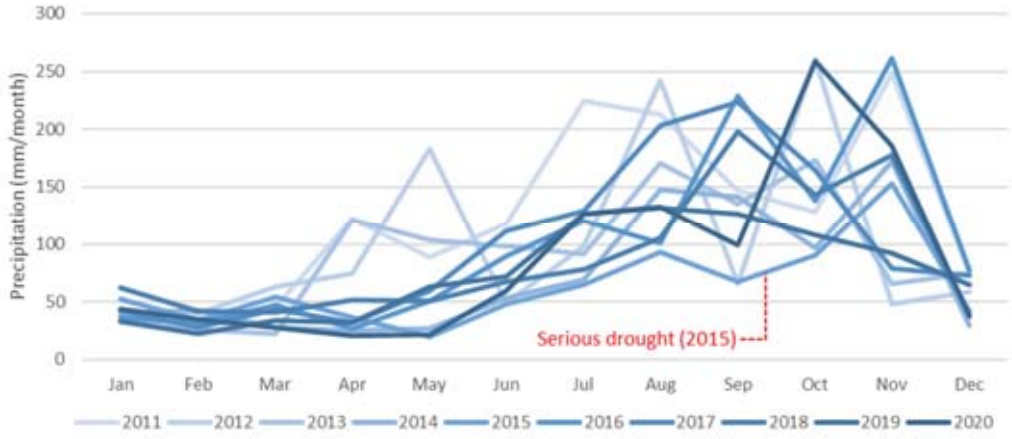
St. Lucia has tropical climate, with average temperatures around 26-28℃, dry season from December to May, rainy seasons from June to November, and hurricane seasons from June to October. Figure 3-7 shows the monthly rainfall for 10 years. In the dry season, rainfall is less than 50 mm from January to March. Precipitation in the rainy season was different in each year, and serious drought occurred in 2015 because of less rainfall in the rainy season than in the previous year.

[10] 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



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

Figure 3-6 Average temperature and precipitation in St. Lucia



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

Figure 3-7 Monthly Precipitation in St. Lucia

Table 3-4 Monthly Precipitation in St. Lucia

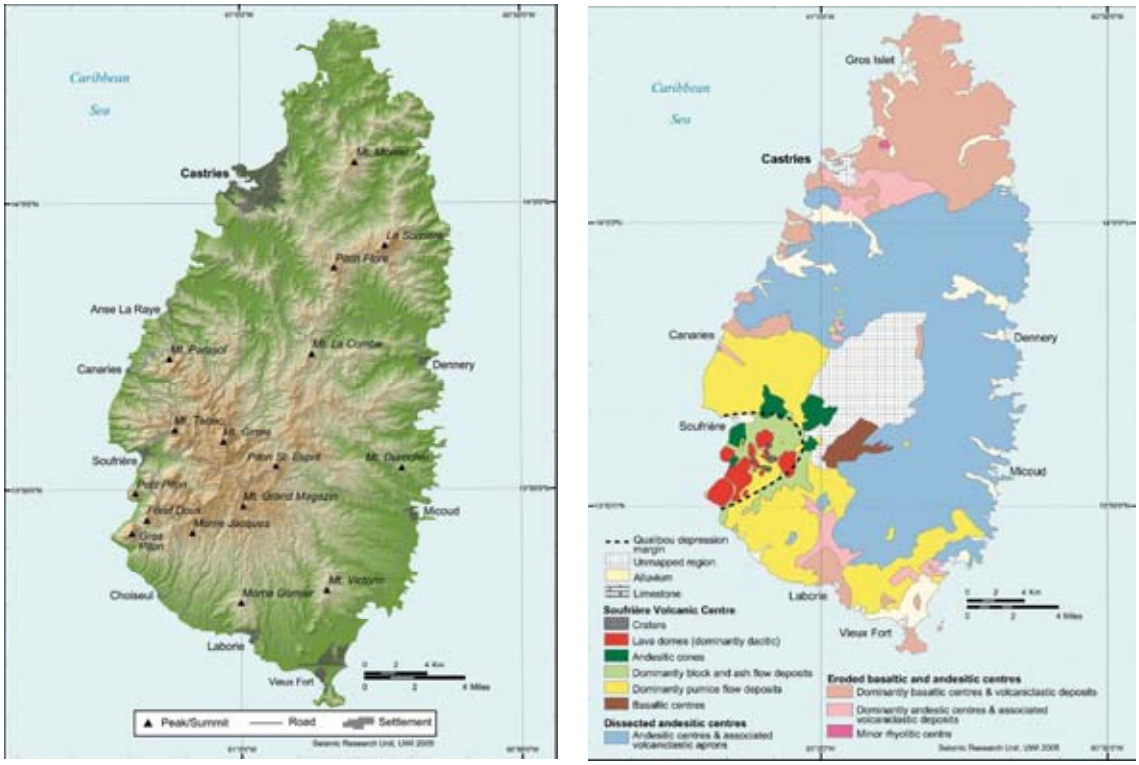
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	52	35	45	122	88	118	224	213	147	128	248	75	**1,496**
2012	42	40	63	75	183	49	99	242	66	261	48	59	**1,226**
2013	33	26	22	122	104	99	91	170	135	173	66	74	**1,115**
2014	40	42	28	25	27	53	69	148	142	96	172	29	**872**
2015	52	34	54	36	19	48	64	93	67	90	153	42	**753**
2016	36	31	47	26	51	90	120	101	229	138	261	77	**1,208**
2017	42	28	44	32	60	111	130	203	224	165	79	73	**1,190**
2018	62	42	41	51	50	68	78	105	198	144	178	38	**1,054**
2019	33	22	34	32	63	72	127	132	127	108	92	65	**905**
2020	44	35	28	20	21	59	127	133	99	259	186	38	**1,049**

Source: Prepared by JST based on World Bank Climate Change Knowledge Portal
Note: mm/month

(2) Topographical and geological conditions

In St. Lucia, relatively flat topography spreads over the northern and southeastern parts including the capital city Castries, and steep mountains are occupied mainly in the southwestern part. The island's highest altitude is 958m Mt. Gimmy (Mt. Gimie). Mount Petit Pitong (Petit Piton) and Mount Gros Pitong (Gros Piton), the twin mountains facing the southwest coast, have become World Heritage-known tourist destinations and are used in the country's flag design.

The country is mostly composed of volcanic basalts, andesites, and ripples, whose geological ages are oldest in the northern part and newer in the southwestern part with active volcanoes.

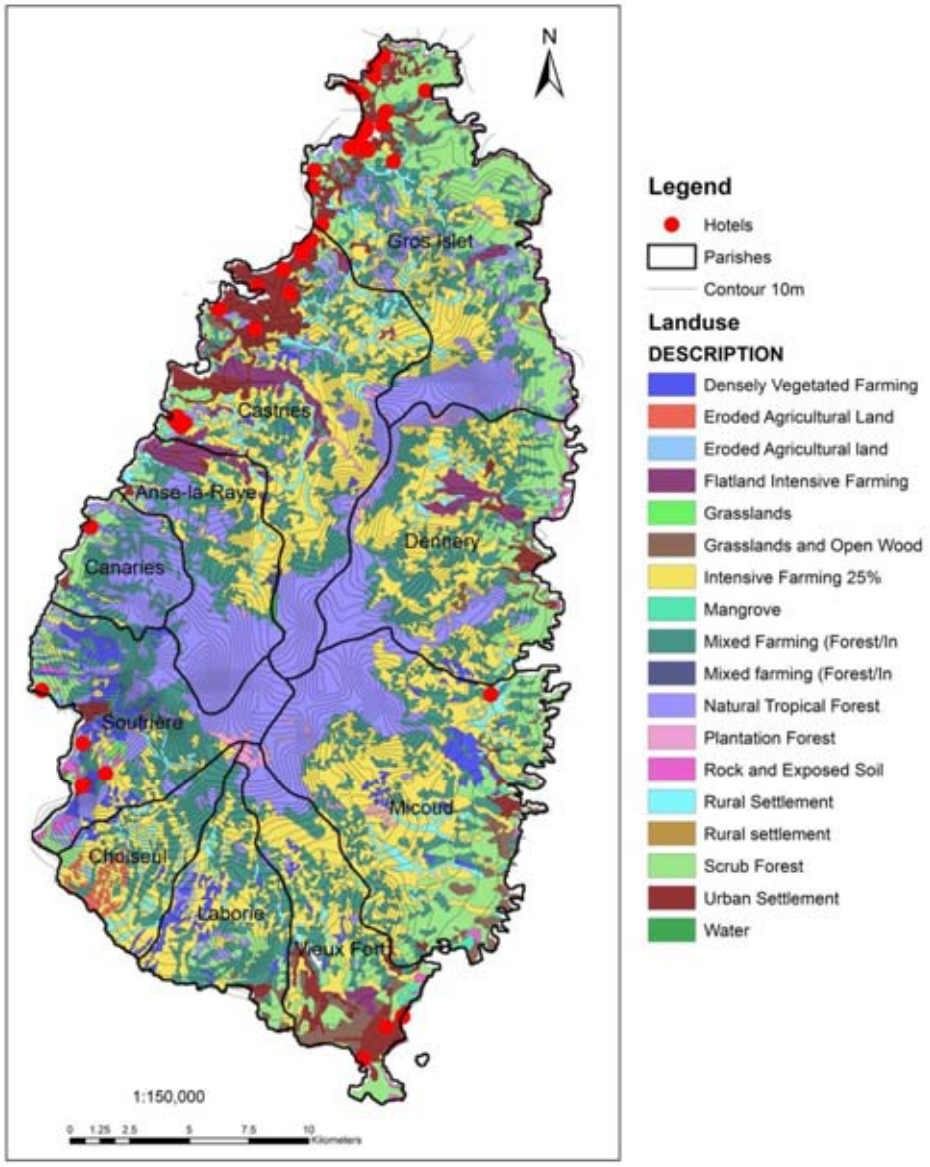


Source: Seismic Research Unit, The University of the West Indies, Trinidad and Tobago

Figure 3-8 Topographic and geological distribution maps of St. Lucia

(3) Land use

Urban areas and tourism-related accommodation facilities are primarily located along the coast. The accommodation facilities are concentrated in the northwestern areas of Gros Islet and Castries, the southwestern area of Soufrière, and the southern tip of Vieux Fort. Farmland is distributed along the rivers in Castries and Dennery.



Source: CCCCC (2015)
Note: The main farmland areas are indicated as "Flatland Intensive Farming" in the diagram.

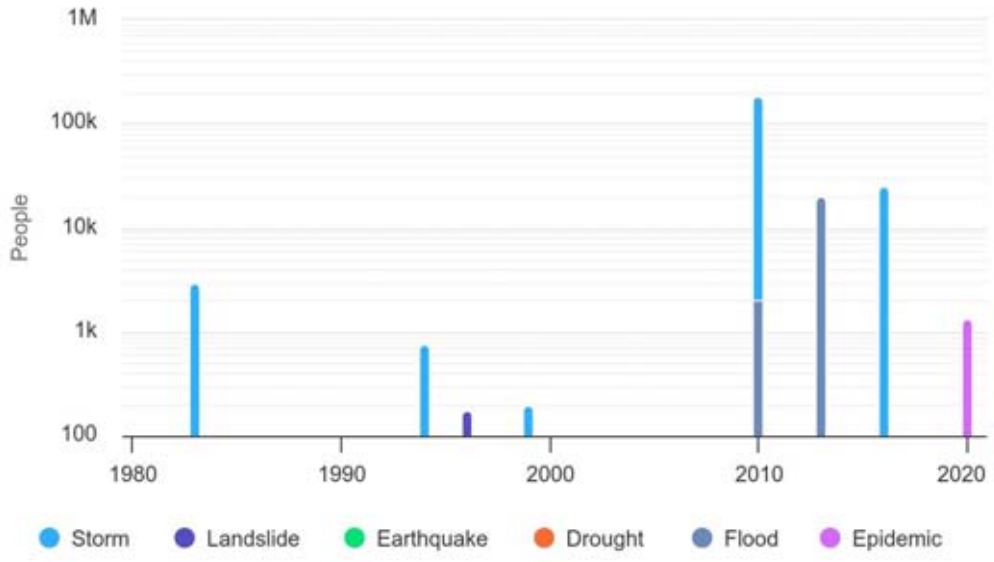
Figure 3-9 Land use map of St. Lucia and locations of major accommodations

3.1.4 Natural disasters

(1) Occurrence of natural disasters

Figure 3-10 shows the number of victims of various disasters that occurred in St. Lucia. The World Bank's risk analysis also estimates that hurricanes are the highest degree of natural disaster risk, with average annual economic losses from hurricanes amounting to USD 9.5 million.[11]

[11] Source: OHCA reliefweb, Saint Lucia: Country Disaster Risk Profiles (December 2016)



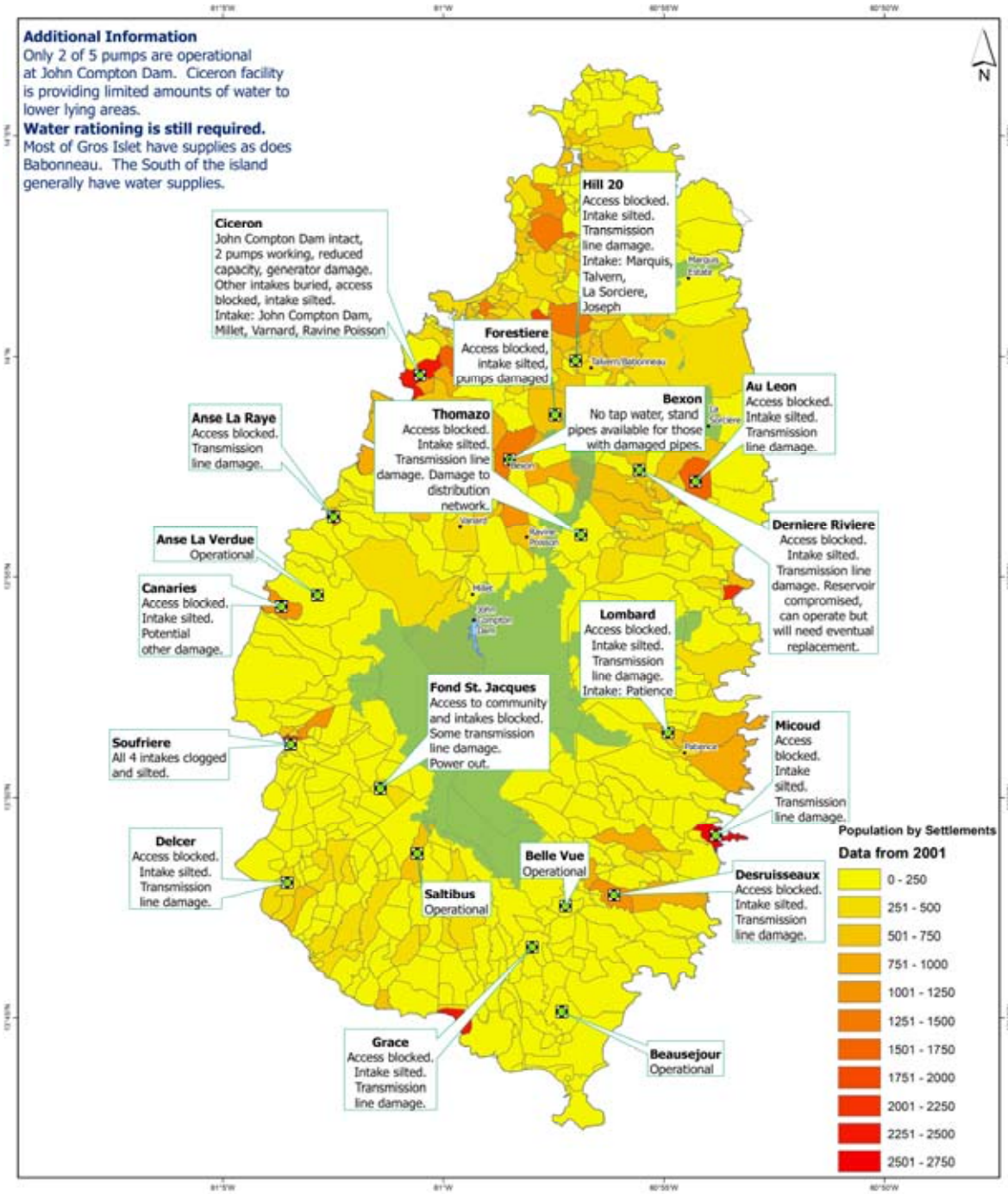
Source: World Bank Climate Change Knowledge Portal

Figure 3-10 Number of victims due to various disasters that occurred in St. Lucia

(2) Example of hurricane damage

Eight people died in St. Lucia as a result of Hurricane Tomas (October 2010), described in the previous chapter. Strong winds caused trees and power lines to fall, and severe rains caused flooding, landslides, and the destruction of many houses, commercial buildings, roads, bridges, and other important agricultural crops. The total damage in St. Lucia is estimated at USD 330 million.[12,13,14] The effects of Hurricane Tomas still remain at present, and river sedimentation from flooding continues to increase each year.

[12] Source: National Hurricane Center (2011) Tropical Cyclone Report Hurricane Tomas
[13] Source: Dept. of Finance, Saint Lucia Gov. (2016) Disaster vulnerability reduction project
[14] In recent years, a large-scale dredging operation has been carried out under CDB loan as the John Compton Dam Rehabilitation Project.



Source: MapAction, St. Lucia Tropical Cyclone Water & Sanitation Damage (as of 12 November 2010)

Figure 3-11 Damage to water supply facilities caused by Hurricane Thomas (2010)

(3) Example of flood damage

In 2013, tropical cyclones passed over St. Lucia from December 24 to 25, which resulted in very intense rainfall, particularly in the southern part of the island, with precipitation of 224 mm or greater, during a three-hour period, although the hurricane period was beyond the usual hurricane period.

This caused rapid flooding and landslides throughout the island, killing six people and displacing more than 550 people, and it is said that approximately 19,984 people, which accounted for approximately 10% of the total population, were directly affected. Economic losses totaled USD 99,880,000 (equivalent to 8.3% of the country's GDP). By sector, transport infrastructure accounts for the majority of damage (72%), followed by agricultural infrastructure (13%), water supply and sewerage (6%), and housing (4%). In particular, the heavily damaged areas were those in the southeastern part of the island, where the maximum amount of precipitation was observed and where the rate of poverty was high.[15]

Source: Global Voices, Christmas Flooding in the Eastern Caribbean

Figure 3-12 Situation of flood damage in St. Lucia (2013)

In the water supply facilities, the majority of the intake facilities controlled by WASCO are river intakes, which resulted in blockage of the intake facilities by flooding flow containing sediment in many places, and damage of pumping facilities and intake weirs were also caused by flushed rocks. In addition, 52,772 (86%) of the 61,341 houses served by WASCO throughout the island due to damaged water pipes and pipes to Theobalds water treatment plant (WTP), which supplies water not only to intake facilities but also to the northern region including the capital city Castries.[16]

As an emergency water supply measure during the water cut-off period, emergency water purification equipment were installed by dispatching water trucks by WASCO and NEMO (National Emergency Control Organization), a governmental organization.

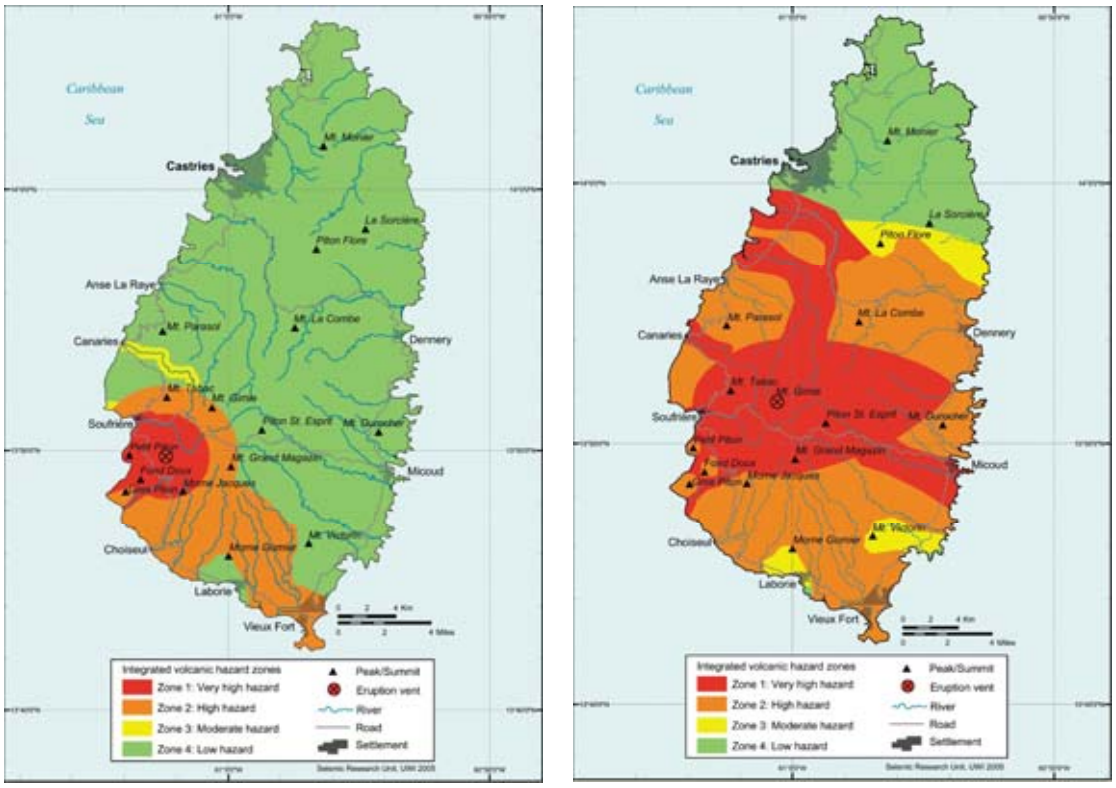
[15] Source: World Bank (2014) Joint Rapid Damage and Needs Assessment

[16] Note: It is presumed that the restoration response was delayed due to damage to access roads to the intake facilities and loss of traffic caused by debris. Such accessible roads were managed by WASCO themselves, and the majority of WASCO's disaster costs accounted for in road repairs.

The system was restarted from small WTPs. At one WTP in Theobalds, the system was restored to normal operation on day 9, with 80% of the throughput within about 5 days after the disaster. In most regions, the water supply status was restored within seven days.[15]

(4) Volcanic activity

In St. Lucia, large-scale magmatic eruptions have not occurred in recent years, and even the newest eruptions have been traced back to 1766. The left diagram in Figure 3-13 shows a hazard map for dome-forming eruptions, while the right diagram depicts one for Plinian eruptions. Within the shaded areas, Zones 1 and 2 highlighted in orange represent regions susceptible to direct volcanic hazards such as pyroclastic flows, volcanic bombs, and intense ashfall. Although Plinian eruptions indicate a wider area of disaster, such large-scale explosive eruptions have not occurred in the past 20,000 years. Dome-forming eruptions are considered to be the more likely type of eruption to occur.[17]



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

Figure 3-13 Volcanic Hazard Maps in St. Lucia

In early April 2021, the La Soufrière volcano, located in the northern part of St. Vincent, a neighboring country, erupted, and its ash fell on St. Lucia, affecting the water supply

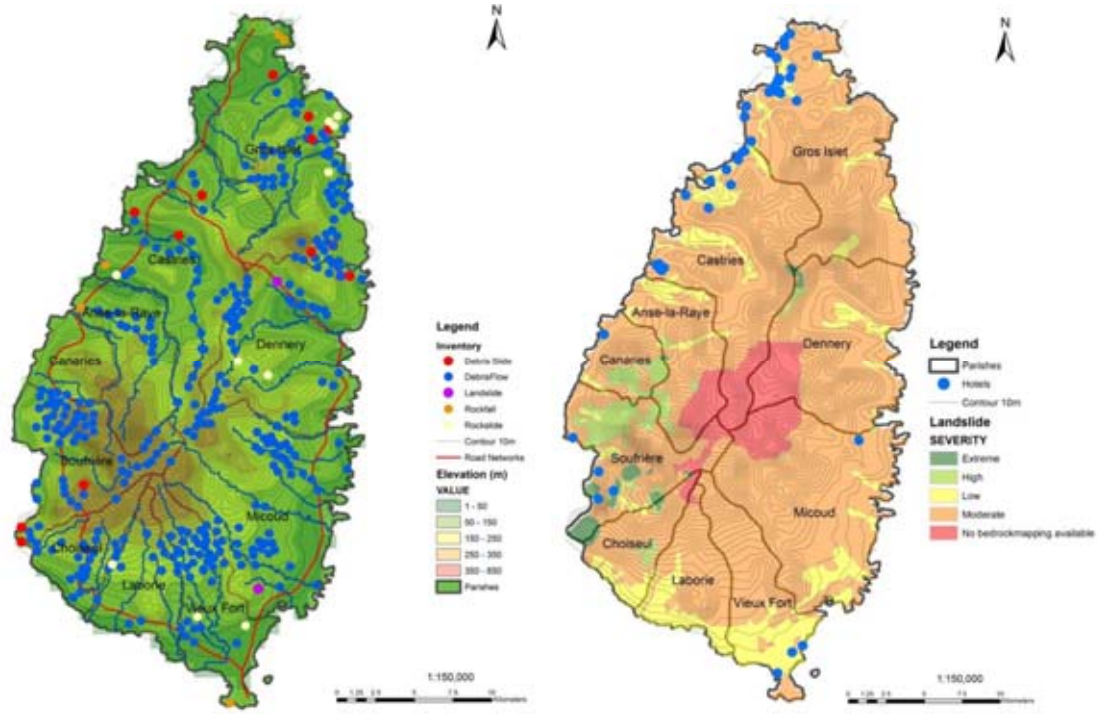
[17] Source: Seismic Research Unit (https://uwiseismic.com/island-profiles/st-lucia/)

in the southern region of the island, which is particularly dependent on fishing. Furthermore, on July 2 of the same year, the direct hit of Hurricane Elsa against St. Lucia caused many houses to be damaged by strong winds, and approximately 30% of the electricity supply and approximately 60% of the water supply were temporarily suspended. According to the Ministry of Agriculture, the hurricane damage affects 75-80% of the island crops and the loss is estimated to be approximately USD 12.5 million.[18]

Based on the same hazard map, in the event of a large-scale volcanic eruption, the direct impact on the major urban areas, particularly in the northwestern region, may be avoided. However, depending on wind direction and other meteorological conditions, there is concern about the possibility of widespread ashfall damage, including impacts on water supply facilities, similar to what occurred in St. Vincent.

(5) Landslides

In St. Lucia, due to steep terrain and volcanic geology, there is an increased risk of landslides during heavy rainfall.[19] Figure 3-14 shows the locations where landslides occurred in the past and a landslide hazard map. From the history, it can be inferred that areas with valley terrain along rivers have a particularly high risk of landslides.



Source: CCCCC (2015)

Figure 3-14 Disaster history and hazard map for landslides in St. Lucia

[18] Source: OHCA Reliefweb, Saint Lucia: Country Profile (July 2022)
[19] Source: CCCCC (2015) Impact assessment and national adaptation strategy and action plan to address climate change in the tourism sector of Saint Lucia

(6) Natural disaster risks to major industries and livelihoods

In the Eastern Caribbean region, including St. Lucia, hurricanes pose the highest risk in terms of frequency and magnitude of damage. In addition to wind damage, hurricanes can increase the risk of flooding and landslides depending on their scale. Given that tourism-related facilities, a major industry, are located along the coast, wind damage is the primary concern. However, since rivers, which serve as water sources for various regions, are exposed to the risks of flooding and landslides during hurricanes, the entire country faces the risk of water supply disruptions due to natural disasters, including residential areas.

Moreover, manufacturing industries such as food processing, beverage production, and textiles are concentrated in the northwestern and southern regions which have port facilities. As these areas overlap with residential areas, water scarcity can significantly impact manufacturing activities. In such situations, water use for manufacturing is typically limited to prioritize domestic water supply, as outlined in the water resources management plan (Table 3-7) mentioned later. Therefore, the manufacturing sector is also severely affected.

3.2 Policy and legal framework related to the water sector

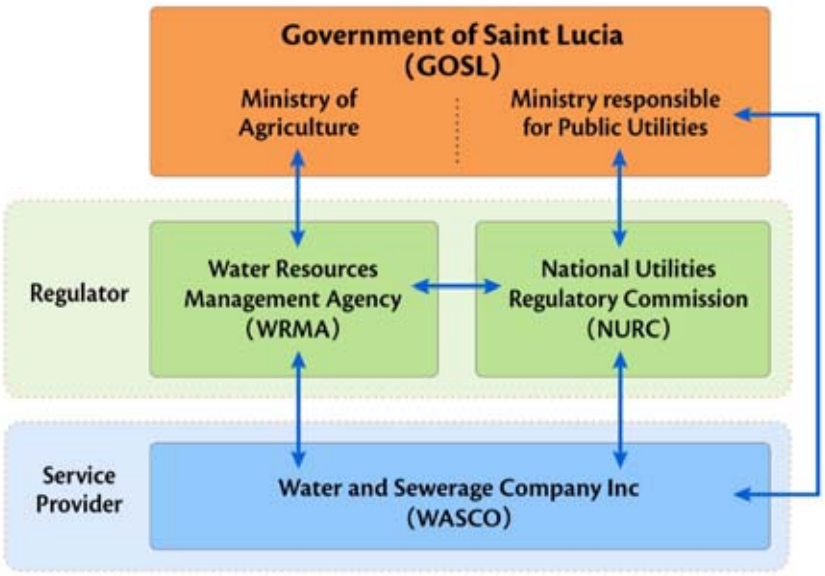
3.2.1 National water policy

The National Water Policy was drafted by WRMA under the Ministry of Agriculture, Fisheries, Food Security and Rural Development (MAFFSRD) as a basic water sector policy in St. Lucia, and is currently being deliberated by the Cabinet.[20]

3.2.2 Related organizations

(1) Structure of the water sector

The structure of the water sector in St. Lucia is shown in the figure below. Governmental agencies WRMA and NURC oversee the water utility, WASCO.



Source: GCF (2023) Concept Note

Figure 3-15 Structure of the water sector in St. Lucia

(2) Water Resource Management Agency (WRMA)

WRMA, a governmental agency under the Ministry of Agriculture, Fisheries, Food Security and Rural Development (MAFFSRD)[21], has control over a wide range of water sectors, such as protecting, managing, distributing and utilizing water resources, and has the authority to permit and supervise water intake operations, including licensing to water utilities.

In some cases, WRMA reports to related organizations such as the Ministry of Health and Ministry of Physical Planning, and NEMO to prevent inappropriate actions such as water contamination and illegal water intake, or to respond to emergencies. The national

[20] The currently published policy was developed in 2004.
[21] WRMA does not have its own budget, but works with the budget allocated from MAFFSRD.

strategy of the water sector is also drafted by WRMA. Matters related to developing water sources in river basins are governed by the Department of Forestry in MAFFSRD.

(3) National Utilities Regulatory Commission (NURC)

NURC is an independent regulatory body for the water and electricity sector and a legal entity established with the approval of the Parliament in 2016. It is responsible for the regulations such as water charges and technical regulations on water and sewerage services provided by public utilities in the water and electricity sector.

In addition, NURC exchanges opinions with the Ministry of Education, Sustainable Development, Innovation, Science, Technology and Vocational Training (MESDISTVT), a central government agency responsible for public services of water and power sectors, on the formulation and implementation of national policies.

While WASCO plays a role as a direct, primary contact point with customers regarding water and sewerage services, NURC does as a secondary by responding to customers' complaints about the performance of WASCO, representing consumers to ensure their best interest as its key responsibility. It is also responsible for issuing service licenses to enable companies to operate water intake and supply.

(4) St. Lucia Water and Sewerage Company Inc. (WASCO)

The establishment of water supply in St. Lucia can be traced back to 1848 when the water supply was operated by the Castries City Council. Afterwards, based on Water Authority Act (1965), the Central Water and Authority (CWA) was established as a organ of the Ministry of Health (MoH).

The CWA was transferred to the Ministry of Communications, Transport and Public Utilities in 1984 and, following a change of its name to Water and Sewerage Authority (WASA), positioned as an organization responsible for water supply and sewage works. As a successor of the WASA, WASCO was established in 1999, becoming independent from the governmental organization. WASCO, subjected to oversights by the Ministry of Infrastructure, Ports, Transport, Physical Development and Urban Renewal, is a public enterprise under the corporate law, 100% owned by the central government and responsible for domestic water supply.

Source: Received from WASCO

Figure 3-16 WASCO Organizational Structure (as of December 2023)

Table 3-5 Breakdown of WASCO staff

Description	Male	%	Female	%	Total	%
All Staff Members	307	74.2%	107	25.8%	414	100.0%
Technical Staff Members	221	90.6%	23	9.4%	244	58.9%
Administration Staff Members	80	50.3%	79	49.7%	159	38.4%
Management Staff Members	6	54.5%	5	45.5%	11	2.7%

Source: GCF (2023) Readiness Proposal
Note: In the interview with WASCO, the number of employees at the time of this survey was 440 (regular: 232 and contract: 208).

3.2.3 Related laws and regulations

(1) Water and Sewerage Act

It constitutes a basic law on water supply and sewerage service in St. Lucia. The composition of all 99 articles is as follows.

- ✓ Preliminary (Articles 1 to 2)
- ✓ Water Resources Management (Articles 3 to 35)
  - WRMA (Articles 3 to 5)
  - Crown Rights in Water, Protection of Water and Gathering Grounds (Articles 6 to 9)
  - Emergencies (Article 10)
  - Abstraction of Water (Articles 11 to 22)
  - Water and Waste Control Areas and Permits (Articles 23 to 35)
- ✓ Water Supply and Sewerage Services (Articles 36 to 92)
  - Commission (Articles 36 to 59)
  - Service License (Articles 60 to 66)

Service Licensee (Articles 67 to 75)
Customer (Articles 76 to 77)
Tariff Scheme, Tariff, Tariff Review, Subsidies and Levy (Articles 78-85)[22]
Breaches, Offences and Penalties (Articles 86 to 92)

- ✓ Miscellaneous (Articles 93 to 99)
- ✓ Schedule

(2) Water and Sewerage Authority Act

This law stipulates a wide range of WRMA matters[23]. The composition of all 36 articles is as follows.

- ✓ Preliminary (Articles 1 to 2)
- ✓ National Policy and Establishment of the Water and Sewerage Authority (Articles 3 to 5)
- ✓ Functions and Powers of the Authority (Articles 6 to 14)
- ✓ Finance (Articles 15 to 30)
- ✓ Transitional and Miscellaneous (Articles 31 to 36)
- ✓ Schedule

(3) National Utilities Regulatory Commission Act

This law has been enforced since 2016 as the basis for the establishment of NURC. Composed of all 48 articles and its schedule, and besides clearly describing the establishment of NURC, it regulates a wide range of matters related to NURC such as powers and functions, organizations and conferences, officials and rewards, budgets and accounting, and auditing and reporting.

(4) Water and Sewerage Regulations

Section 97 of the Water and Sewerage Act empowers MAFFSRD and MESDISTVT to make regulations necessary for the implementation of the Act. Based on this, the Code of Conduct, General Provisions, Courts of Appeal and Tariff Regulations came into force in 2008.[24]

3.2.4 Related plan

(1) Water SASAP 2018-2028

In 2018, the Department of Agriculture, Fisheries, Natural Resources and Cooperatives under MAFFSRD and the Department of Sustainable Development under MESDISTVT developed St. Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector

[22] Levy is charged on potable water users apart from tariff.
[23] The name of the law leaves WSA, the WRMA's predecessor.
[24] At the same time, a Cabinet Order to implement the levy on potable water services provided in Article 85 of the Water and Sewerage Act came into force.

(Water SASAP) 2018-2028 for the Water Sector, in accordance with the National Adaptation Plan[25]. The development was supported by the Japanese Government through the Japan-Caribbean Climate-Change Partnership of United Nations Development Programme (UNDP). The following table shows the four outcomes required for achieving the overarching goal as well as 13 strategic objectives in total linked to each outcome.

Table 3-6 Overarching goal, outcomes, and strategic objectives for Water SASAP

The overarching goal of the Water SASAP: to drive the implementation of effective adaptation actions across all sectors and at all levels of society for safeguarding St. Lucia's water resources and services under a changing climate.
Outcome 1. Enhanced enabling environment and improved behavior for water-related climate adaptation action
Strategic Objectives: 1. Improve the national policy, legal and regulatory framework to facilitate climate adaptation in the water and water-dependent sectors 2. Scale-up national human capacity for the design and implementation of water-related climate adaptation projects 3. Increase public awareness of integrated water resource management
Outcome 2. Increased water access, availability and quality
Strategic Objectives: 1. Strengthen Integrated Watershed Management to build climate resilience 2. Promote the sustainable use of alternative water sources to ensure water availability under a changing climate 3. Improve wastewater management to reduce pollution and increase water availability under a changing climate 4. Set and scale-up water quality and pollution control in a changing climate
Outcome 3. Increased water efficiency and conservation
Strategic Objectives: 1. Improve water infrastructure to build climate resilience 2. Encourage water efficiency under a changing climate by improving water pricing, water utility revenue and water conservation incentives 3. Promote climate smart agriculture
Outcome 4. Strengthened preparedness to climate variability and extremes
Strategic Objectives: 1. Improve hydrometeorological monitoring, emergency planning and decision making 2. Minimize water-related climate change risks by adopting ecosystem-based adaptation solutions 3. Promote climate resilient business development

Source: Saint Lucia (2018) Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028 under the National Adaptation Planning Process

[25] The Nationally Determined Contribution (NDC) in Saint Lucia was updated in January 2021.

3.3 Status of water resources

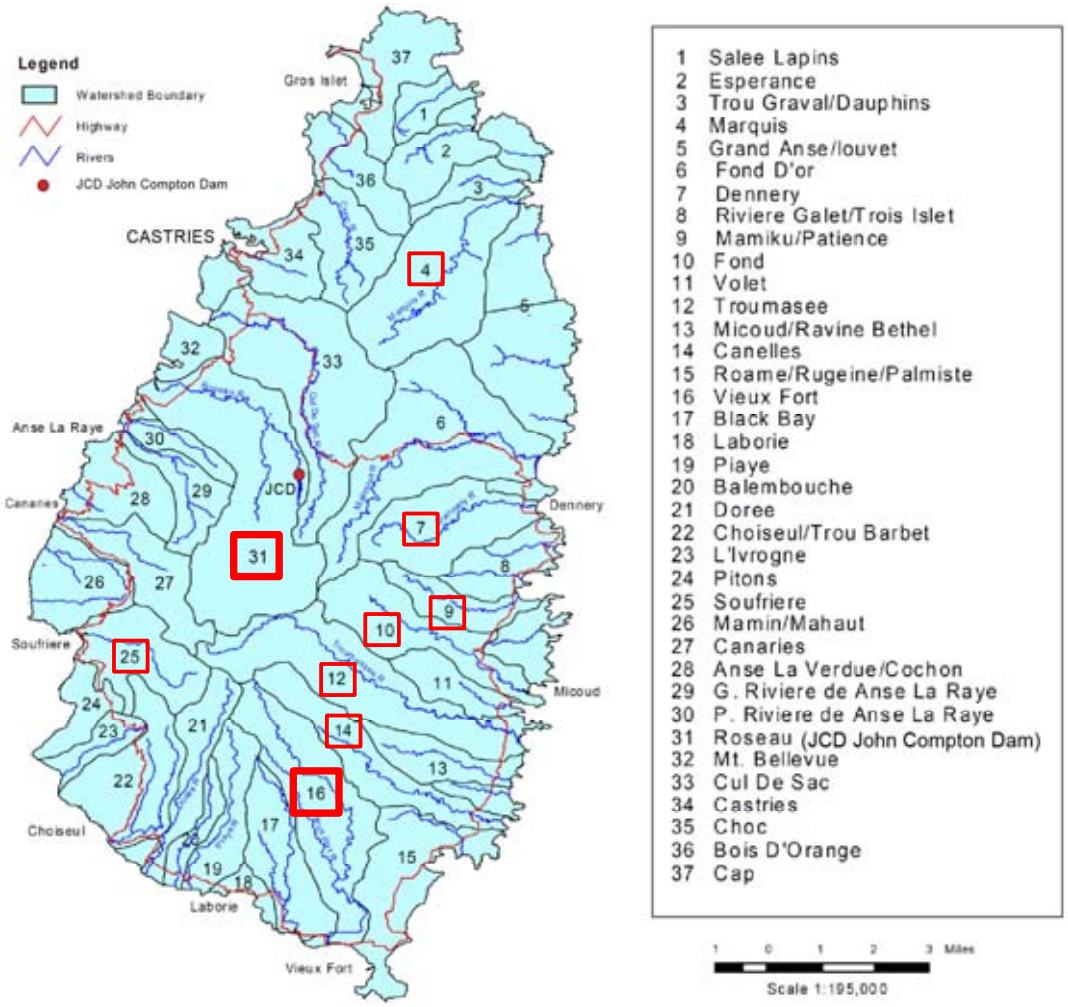
3.3.1 Water resource use

(1) Water source

Because St. Lucia has a steep topography and rocky geological formations with low rainwater permeability due to volcanic geological conditions, the island itself has a poor water storage function, most of the rainfall runs off into the sea, and groundwater recharge is also small. For this reason, surface water sources such as rivers, dams, and springs are the main sources of freshwater, and all WASCO tap water sources use surface water. Groundwater resources are very limited and are mainly used for domestic and irrigation purposes.[26]

The land of St. Lucia is divided into 37 basins, of which Roseau, Vieux Fort, Marquis, Dennery, Soufrière, Troumassee, Canelles, Patience, and Fond Doux are used as surface water sources. In particular, the Northern Roseau and the Southern Vieux Fort basins are the main sources of water. During the drought season, which lasts from December to May, river discharge is reduced by half, and water shortages will become serious especially in the southern region where there are no water storage facilities.[27]

[26] Source: GoSL (2018) Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028
[27] Source: UNOPS (2020) Saint Lucia: National infrastructure assessment



Source: GCF Concept Note (2023)[28]
Note: The red box indicates the watershed where the water source is used, especially the thick red box indicates the main water source area.

Figure 3-17 Watershed in St. Lucia

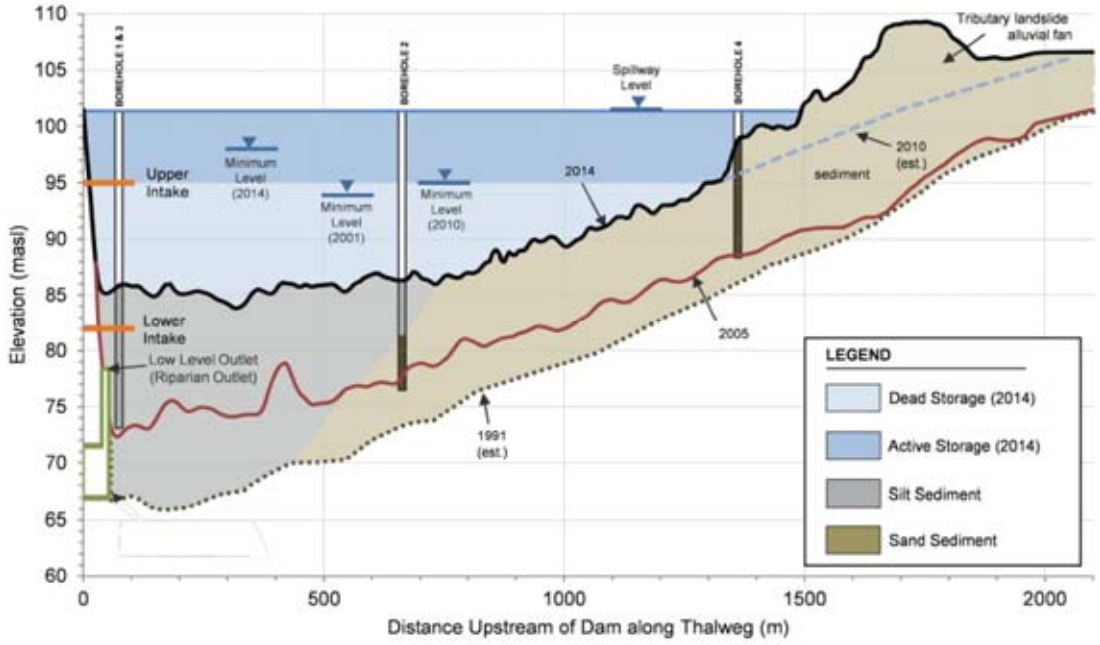
(2) Water storage facility

The John Compton Dam, located in Roseau, is a source of water in the densely populated northern regions (Castries and Gros Islet), with five mainstream rivers and several tributaries flowing into it. Its storage capacity is 3,182,000 m^3, and its annual water supply is 18.9 million m^3. However, it is 16,550,000 m^3 if losses due to pipe leakage are taken into account[28]. On the other hand, during the dry season, the water supply decreases by approximately 25% compared to the rainy season, sedimentation on the bottom of the dam reservoir increases due to landslides caused by repeated hurricanes, and the water

[28] Source: GCF (2023) Mainstreaming Climate Resilience into Water Sector Planning, Development and Operations in Saint Lucia

storage capacity was halved. As a result, its vulnerability to climatic change has been exposed.[28,29]

As shown in the figure below, the intake for low-level water was buried by this sludge, and the reserved water deeper than the intake for high-level water could not be used. As a measure, the dredging project has been started with the support of CDB and the German International Cooperation Organization (GIZ). As of January 2021, up to approximately 80,000 m^3 of sludge around the intake of the dam had been removed, improving the water intake capacity, but no dredging work has been done since then, and full restoration of function has not yet been achieved. In addition, according to the interview with WASCO staff, it was confirmed that the sludge was moving forward, and there is a fear that the intake would be blocked by the sludge again.



Source: Golder Associates (2016)[29]

Figure 3-18 Situation of sludge in John Compton Dam (as of 2014)

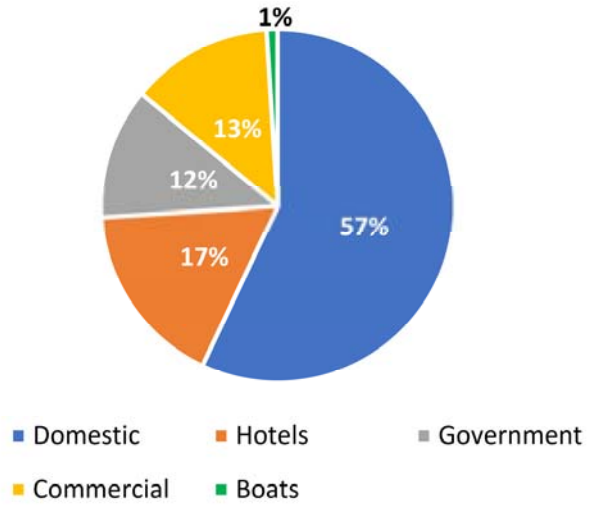
[29] Source: https://www.canadianconsultingengineer.com/cce/awards/2016/H3_Golder_JohnComptonDam.pdf

Date: February 2024

Figure 3-19 John Compton Dam and pump facilities for low water level

(3) Sector wise water demand

In St. Lucia, household water accounted for the majority at 57% of domestic water demand, followed by the tourism sector at 17%, the commercial sector at 13%, and the public sector at 12%. On the other hand, NRW is reported to be 47-55%, which indicates a shortfall of approximately 35% of the national water demand.



Source: GoSL Water SASAP (2018)

Figure 3-20 Sector wise water demand in St. Lucia

(4) Rainwater usage

Most households have tanks to store tap water in preparation for water interruptions. Currently, such tanks are manufactured in the island and can be purchased at an affordable price. It is characteristic that the storage of such tap water is more popular than that of rainwater storage tanks.

Rainwater harvesting is used by 60-80% of households in rural areas, although it has not penetrated into urban areas. It is mainly used for cleaning and sprinkling, and

filtration, disinfection, boiling, etc. are carried out when it is used for domestic water. The WRMA is also actively promoting the use of rainwater by encouraging the installation of underground rainwater storage tanks and providing manuals on rainwater harvesting and treatment to the public.

(5) Recycled water usage

There is only one sewage treatment plant (STP) in the country, and the treated water is sold to private businesses operating golf courses in the neighborhood after filtration and disinfection treatment and is used as water for sprinkling.

3.3.2 Implementation status of integrated water resources management

(1) Implementation organizations of water resources management

In St. Lucia, WASCO responsible for the maintenance and operation of water and sewerage facilities, WRMA responsible for developing water sources, developing watershed management programs and protecting water resources, and the Department of Forestry, which implements watershed management, mainly protecting forests, are working on integrated water resources management. In WRMA, water rights are issued, illegal water abstraction, water source pollution control, and water source monitoring are carried out as water resource control.[30,31]

(2) Integrated water resources management plan

Integrated water resources management (IWRM) is considered to be advanced compared to other OECS countries. This is due to the establishment of the aforementioned WRMA, policies and regulations on water abstraction, and the development of an IWRM roadmap. Though the IWRM plan has not yet been decided, WRMA is working on IWRM based on the action plan of the SASAP (Sectoral Adaptation Strategic Action Plan).

(3) Status of implementation of water source monitoring

For monitoring water volume and quality, remote automated monitoring facilities are being tested and introduced as a pilot-scale project for CCCCC support, and continuous monitoring of pH, temperature, TDS (total dissolved solids), dissolved oxygen, salinity, and conductivity is being conducted.

[30] Conduct a survey of the status of incidents that may interfere with water sources using WASCO and report to Ministry of Health, Ministry of Physical Planning, NEMO, etc.
[31] Source: https://moaslu.govt.lc/saint-lucias-first-automatic-water-quality-station/

(4) Response to water shortages

The amount of river water is decreasing due to the effects of climate change, and it is always below the water demand. The latest state of emergencies was declared due to the drought that occurred in 2020.

As shown in Figure 3-7, the state of emergencies was declared in 2015. During the dry season of the same year, the amount of rainfall was lower than that of the previous year, and the decline in the amount of water stored in the dam was confirmed at an early stage. In addition, the St. Lucia government declared a water emergency throughout the island from May 20 to July 31 of the same year, assuming that rainfall would be reduced in the same year.[32]

Governmental, WASCO and NEMO measures against droughts in 2015 include the following:[33]

1) Two old intake facilities in the Banado area, which had been shut down, were urgently put into operation to increase the intake capacity by approximately 5,000 m^3.

2) Emergency repairs were carried out at 13 water leakage points identified in the non-recharge water reduction program conducted at the time to reduce water leakage by approximately 3,000 m^3.

3) A portable water purification device was installed in the river in Deglos to secure water access of the surrounding residents as a public water tap.

4) Measures such as the installation of water supply tanks and the use of spring water sources were taken for areas where water shortages were particularly serious in other districts.

5) Awareness-raising activities were carried out on water conservation for inhabitants so that they would not use water for sprinkling or washing trucks.

In 2006, NEMO developed the Water Resource Control Programme (Water Management Plan for Drought Conditions) to strengthen resilience against frequent droughts. As shown in Table 3-7, the level of drought is set in five stages and an action plan is formulated according to each stage.

[32] A declaration of this type of emergency is made by reporting from WRMA (Water Source Administration) to the Government when a serious water shortage occurs or is feared due to a lack of rainfall or water pollution.

[33] Source: Government of Saint Lucia (2015) National Address on the Measures to Deal with the Drought

Table 3-7 Water resources management plan for drought in St. Lucia

Government and water utilities	Beverage manufacturers, etc.	Industrial and manufacturing	Agriculture, hospitals and private sectors
1. NORMAL CONDITIONS			
Development of emergency response plans Conducting water resource surveys Promoting the use of rainwater	Development of emergency response plans Installation of water storage/purification facilities	Development of emergency response plans Installation of water storage facilities/water-saving devices Installation of wastewater storage facilities Installation of water reclamation equipment	Development of emergency response plans Reservoir expansion/well drilling Installation of water storage facilities Water conservation measures
2. Drought Monitoring (WATCH): Reduced rainfall, reduced river water and dam levels			
Establishment of drought countermeasure committee Intensification of the inspection system Enlightenment through media	Confirmation of required water consumption	Confirmation of required water consumption Water quality monitoring	Confirmation of required water consumption
3. Drought Warning (WARNING): Reduction in source water volume and quality			
To hold regular meetings Response to requests for assistance Publication of drought conditions Raising awareness of water conservation to the public	Implementation of water conservation measures Water conservation target not achieved ⇒ Water supply limit Status report to WASCO	Restriction of production activities Shift to emergency production activities Wastewater storage/water reuse Status report to WASCO	Conservation of water for household/ agricultural use Status report to WASCO
4. Restriction of use (RESTRICTION): Generation of insufficient water supply, intermittent reduction of water resource			
Issuance of a declaration of an emergency Water intake and water supply restrictions	Water conservation measures under restricted use Prohibition of Use of Water Sprinkling, etc. Status report to the committee	Further restrictions on production activities Status report to WASCO	Continuation of the above measures Irrigation limitation by WASCO Status report to WASCO
5. Accident-response (EMERGENCY): Severe water shortages and water quality declines			
Prime Minister's declaration of disaster NEMO for emergencies Installation of seawater desalination equipment	Provision of bottled water, etc. Compliance with instructions such as NEMO	Compliance with instructions such as NEMO Installation of seawater desalination equipment	Compliance with instructions such as NEMO Request for Living/Living Water Support Installation of seawater desalination equipment

Source: Government of St. Lucia (2006) Water Management Plan for Drought Conditions
Note: Beverage manufacturers, etc. (Water Suppliers [e.g. Bottling Companies])

3.3.3 Challenges in water resources management

(1) Challenges in water resources development

Although groundwater sources are not currently used, hydrological maps are required to identify groundwater sources for the development of new sources, but sufficient investigations have not been conducted to date.

(2) Impacts on agriculture and tourism

Although WASCO also supplies agricultural water, there are also farmers who take water from rivers without acquiring water rights because water shortages have an impact on yield reductions. While new farmers are aware of the need for water rights, they do not enforce their obligations. There are also illegal buildings in the water resource conservation district because there is no policy on land use, and these measures are also necessary.

In addition, although major hotel facilities have water storage tanks and desalination facilities, there is concern that they will bring a negative impression to the tourism industry.

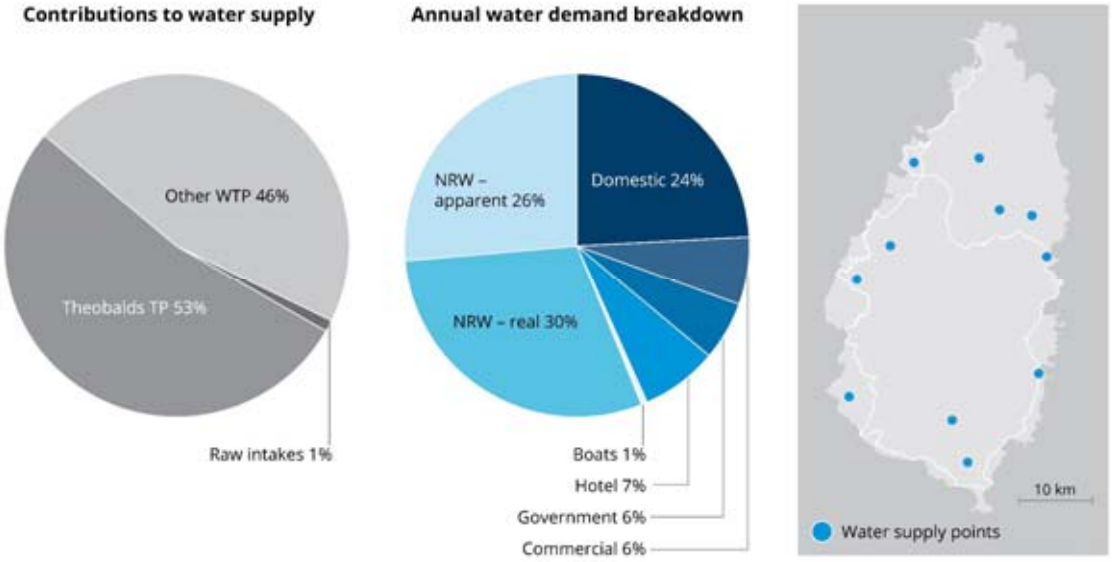
(3) Issues in integrated water resources management

It was pointed out that staff shortages and land-use policies at each institution are stalled only by drafts, and that although there is a desire to work on realizing IWRM at each institution, they are influenced by political decision-making.

3.4 Status of water supply

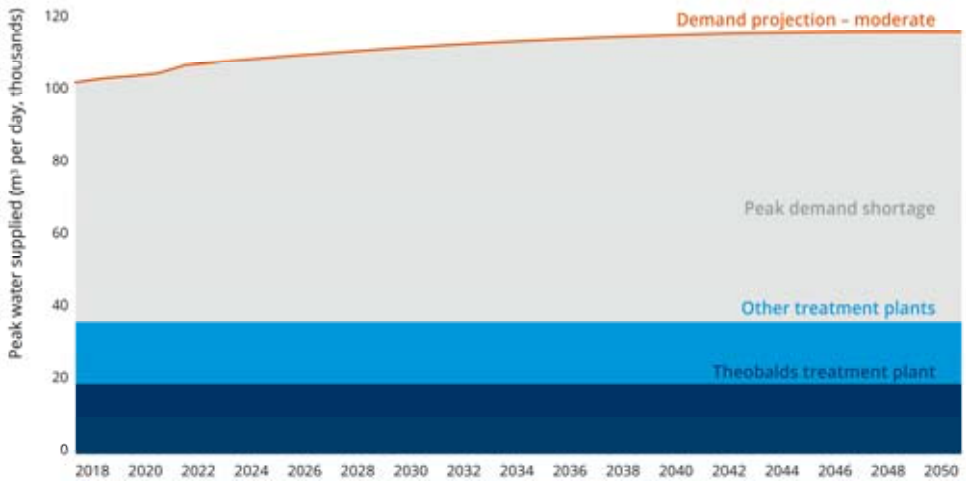
3.4.1 General conditions of water supply

The water supply in St. Lucia is operated by WASCO, a public utility. The domestic population is 183,630 (2020), which is the largest among the countries surveyed. The water supply coverage is 98%, the number of customers is 73,914 (of which, households account for approximately 90%), and approximately 59% of all customers are concentrated in the capital city, Castries. As for the achievement status of 24-hour water supply, 75% of the total in the rainy season and 60% of the total in the dry season receive water supply for 24-hours, and once every two to three days in other regions, and the situation of water shortage is remarkably evident. Water demand throughout the island is approximately 60,000 m^3/day (peak time: approximately 100,000 m^3/day), but water supply capacity is expected to drop to approximately 40,000 m^3/day during the dry season.[27]



Source: UNOPS (2020)

Figure 3-21 Water Supply Situation and Main Water Treatment Plant Locations in St. Lucia



Source: UNOPS (2020)

Figure 3-22 Peak Water Demand and Water Supply Capacity in St. Lucia

3.4.2 Water supply systems

Currently, WASCO operates and manages 26 water supply systems, as shown in Table 3-8, with Theobalds WTP, which uses John Compton Dam as a water source, having the largest capacity. While there are no WASCO-owned seawater desalination facilities, some private tourism companies own small-scale seawater desalination plants as a response to the dry season.

Table 3-8 Water Supply System in St. Lucia

Sl No.	Water Supply System	Region Served	Capacity (m3/d)	Total No. of Customers*	Total No. of Households (Domestic)
1	John Compton Dam Theobalds	Castries / Gros Islet	38,642	38,677	35,813
2	Hill 20	Castries	4,091	6,000	5630
3	Desbarra	Castries	41	100	96
4	Anse La Raye	Anse La Raye	455	943	871
5	Anse La Verdue	Canaries	182	59	50
6	Canaries	Canaries	1,364	630	476
7	Bouton (Not in Use)	Soufriere	191	0	0
8	Ruby	Soufriere	773	1355	1057
9	Upper Diamond	Soufriere	200		
10	Lower Diamond	Soufriere	414		
11	Upper Fond St. Jacques	Soufriere	45	971	729
12	Lower Fond St. Jacques	Soufriere	455		
13	Delcer	Choiseul	1,964	1711	1369
14	Toucousson	Choiseul	273	761	625
15	Upper Saltibus	Laborie	455	214	182
16	Lower Saltibus	Laborie	682	323	274
17	Thomazo (Tourness)	Dennery	341	3266	2417
18	Dennery (Bois Jolie)	Dennery	2,273	2002	1442
19	Aux Leon (Not in Use)	Dennery	341	0	0
20	Derniere Riviere (Not in Use)	Dennery	259	0	0
21	Patience	Micoud	3,819	1721	1514
22	Micoud	Micoud	2,728	3067	2301
23	Desruisseaux	Micoud	1,391	1606	1446
24	Bellevue	Vieux Fort	918	1780	1638
25	Beausejour	Vieux Fort	6,819	8179	6135
26	Grace WSS	Vieux Fort	5,001		
	TOTAL		74,115		
	TOTAL w/o WTPs (not in use)		**73,324**	**73,365**	**64,065**

Customers = Domestic + Commercial + Government + Boats

Source: GCF Concept Note (2023) Data as of November 2022

The facilities in the northern part of capital city Castries are aging, and there is a growing demand for labor and migration from other areas, particularly in new residential development areas, where water shortages are becoming more severe. On the other hand, pipes are relatively new in the southern part of the capital city of Castries, and the water supply situation tends to be better than in the northern part.

The largest WTP, Theobalds WTP, is the plant with the rapid sand filtration system constructed in 1991 with a maximum capacity of approximately 54,500 m^3/day (12

million imperial gallons per day). Raw water is withdrawn from two surface water sources: the John Compton Dam and Millet Intake on the river that feeds the dam. Raw water from Millet Intake flows by gravity to the WTP, and raw water from John Compton Dam flows by gravity when the water level is high, and is pumped through a regulation tank when the water level is low. The water treatment process flow is as follows; Injection of Polyaluminum Chloride (PAC) → Rapid Mixing → Horizontal Flow Flocculator → Inclined Plate Clarifier → Rapid Sand Filter → Chlorine Gas Disinfection. The treated water is then distributed by gravity flow to the capital city, Castries, and pumped for distribution to the surrounding high-elevated area.[34]

Date: February 2024

Figure 3-23 Theobalds Water Treatment Plant

The most common pipe materials, in descending order, are polyvinyl chloride (PVC) pipe, ductile iron (DI) pipe, and high-density polyethylene (HDPE) pipe. DI pipes are used only for raw water pipelines from water sources to WTPs and water distribution main pipelines. Aging is a serious problem as most pipelines were installed more than 50-60 years ago. Until now, WTPs have been developed and distribution pipeline networks have been expanded. As a result, water leakage from aged pipes has increased with increasing water pressure. The District Metered Area (DMA) of the distribution pipeline network is in the early stage of implementation, and it is planned to be constructed in 6 places by June 2024.

In St. Lucia, where costs are high due to the import dependency of many materials and equipment, the biggest challenge for WASCO in developing water supply facilities is the securing of a budget.

[34] Value obtained through interview on February 16, 2024. Note that this value differs from the value in Table 3-8.

3.4.3 Water supply operation

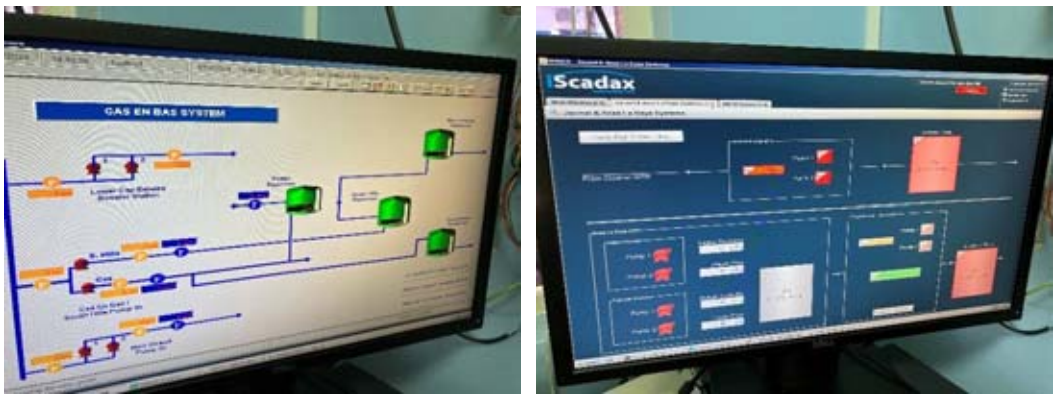
(1) Operation and maintenance of facilities

All operations and maintenance (O&M) are carried out by WASCO and are not outsourced. The equipment is managed by Operation Department of WASCO.

The SCADA (Supervisory Control and Data Acquisition) room is located at the WASCO Headquarters and implements the monitoring and control of three major WTPs (Theobalds, Hill 20, Thomazo WTPs) and associated distribution tanks and pumping facilities.[35]

The Strategic Planning Department manages facility information with GIS, and the registration status of pipeline network information in GIS is only approximately 20% in the northern region where the water supply system is concentrated, and approximately 70% in the southern region where the water supply system is scattered, and the registration works of data is progressing. In addition, all sewer pipeline data have been registered because the sewerage pipeline network is limited.

On the other hand, the asset management system is not currently implemented and is managed by Excel. And, the system is planned to be introduced by the internal budget in the near future.



Date: February 2024

Figure 3-24 SCADA system installed at WASCO Headquarters

(2) Water quality management

A water quality testing laboratory has been established in Theobalds WTP, and requests for water quality testing from outside parties such as private companies that operate water trucks are also accepted. Full parameter tests for raw and treated water are conducted once every four months in accordance with WHO standards. The quality of the treated water is checked by an on-line water quality meter for turbidity, pH, and residual chlorine. The quality of the tap water is measured daily by measuring the residual chlorine, turbidity, and pH in the field. If the residual chlorine is less than or equal to 0.2mg/L, the

[35] SCADA was introduced in 1996 and made by SCADAX

samples are taken back and are tested for the biological indicators of the general bacteria, E. coli, and coliform groups.

Date: February 2024

Figure 3-25 Water Quality Testing Laboratory in Theobalds WTP

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

As mentioned above, water leakage is increasing due to the aging of water pipes and the increase in water pressure caused by facility expansion. In addition, the corrosion of metal pipes laid in coastal areas is progressing, which contributes to the increase in water leakage.

Given this situation, WASCO reported the NRW rate of 47-55%, of which approximately 30% was a physical leakage[36], as shown in Figure 3-21, the rest being uninstallation of water meters, failure and misreading, and theft such as illegal connection [24]. Many water meters are manufactured in China, and there is a mechanism in place to provide incentives to water leakage detectors. WASCO does not know the volume of water intake and water distribution, and only measures the volume of water treated at the treatment plant and the volume of water billed.[26]

In addition, according to a NRW survey conducted by GIZ in 2014, although facilities managed by WASCO are operated by skilled staff, problems such as insufficient maintenance of efficient workflow and shortage of skilled engineers are also pointed out.[37]

In response, with the support of ministries and agencies including WRMA, WASCO is proceeding with the NRW reduction program including DMA construction, digital technologies such as GIS, SCADA, and smart meters.

[36] According to the interviews with WASCO, the percentage of NRW is estimated to be 55%, and 85 % of 55%, or 47% of total NRW is physical leakage. Though it differs from the literature value, the serious water leakage situation can be observed in any case.

[37] Source: GIZ (2014) Fact-finding study WASCO utility management support Focus: non-revenue water

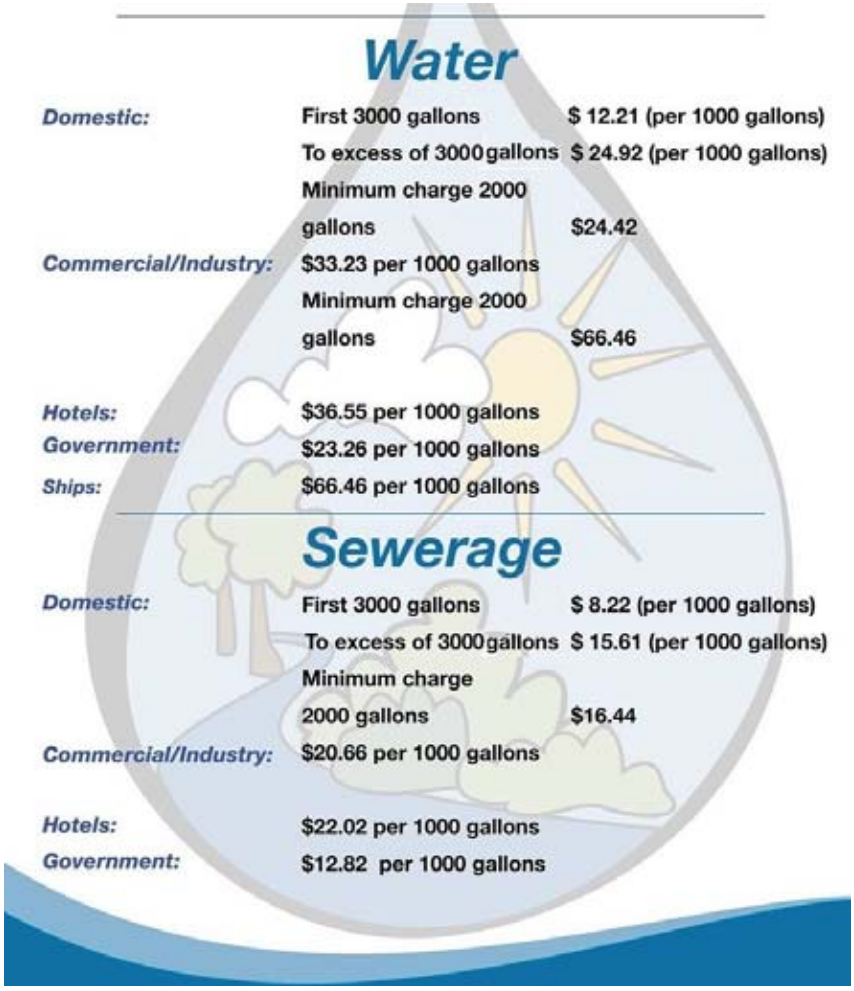
(4) Water rates and collection status

Figure 3-26 shows WASCO's current water rate table. Based on the table, the billing rate per 20 m^3 for domestic use is calculated EC$ 71.99, which is the second highest among the countries surveyed, after Antigua and Barbuda. (see Section 2.3.2 for comparisons of water rates across countries). There are five categories of water rates based on use, i.e., domestic, commercial and industrial, hotel, government, and ships, and the rate is metered based the amount used. The metered rate is set to be higher as the amount used increases in order to promote water conservation. In St. Lucia, there are 4,453 sewerage customers, and there are 4 categories of sewerage rates: domestic, commercial and industrial, hotel, and government. As with water rates, sewerage rates are based on water volume.

WASCO's water rate table has not been updated for more than 10 years, ending in 2013. Although WASCO is requesting NURC, an authorized agency, to increase rates due to rising operating costs, the increase has not yet been implemented so far because of the common belief that everyone should have access to water services.

The reading of water meters is carried out once a month by the meter readers, and ABECAS insight is introduced in the customer management and billing system. Regarding the status of water tariff collection, the actual result in 2023 was EC$ 62.9 million for the billing amount and EC$ 69.3 million for the collection amount, and the collection rate exceeded 100%, and there is no problem.[38]

[38] When there is the timing gap between the billing and the collection, the case of exceeding 100% occurs.



Source: WASCO provided

Figure 3-26 Water Rate Table of WASCO

(5) Issues related to customer management

The challenges related to customer management obtained from interviews with WASCO are as follows.

1) WASCO staff are not experienced in responding to customers, and training is required.
2) It is necessary to set up a system where customers can confirm the charge at any time. Although it can now be confirmed through the website, there are still many telephone inquiries.
3) There are cases when the necessary heavy machinery is not sufficient to connect the water supply connection of a new customer and rental is required, in which case, the rental of the heavy machinery is also a burden on the customer.
4) Complaints have arisen due to the fact that a mechanical meter weighs both water and air due to air entrainment into pipelines that accompanies frequent water interruptions.

The Customer Services Department responds to customer billing complaints, and the Water Services Department responds to other complaints. Billing complaints occur daily. Complaints other than water rates include the largest 80% of complaints about water distribution times during pipe repairs and drought, followed by water pressure and turbid water. Customer satisfaction surveys have not been conducted, and follow-up is only done when there are major problems.

3.4.4 Technical training system

(1) Implementation of internal training

There are also difficulties in securing the training budget, and the internal training program has not been prepared. In the interview with WASCO, the following areas were mentioned as needing training: Water distribution management, sewerage management, NRW management, water leakage detection, hydraulic computation (WaterGEMs), human resource management, customer management, safety management, financial management, communication skills, conflict management, construction management, etc.

(2) Implementation of external training

For training in business skills other than water supply skills, training programs offered by the St. Lucia Employers Federation are used. It also uses ABC testing, a certification programme, offered by CAWASA to test the operation and maintenance of water supply and sewerage systems. In addition to the training in JICA Japan, the training is conducted on the island of Martinique, a French territory in the neighboring country, under the CARIBSAN project.

When we interviewed a returning trainee who is currently in WRMA, it is said that the teaching materials used in JICA training are stored in a data base so that they can be shared with the staff. The contents obtained in the training are presented for the staff, and the understanding of the staff is promoted for the integrated water resources management.

3.4.5 Trends in the private sector

WASCO sometimes funds developers to install water supply facilities in areas where accommodations are located and in areas of small communities. Even in those cases, WASCO is implementing the operation and maintenance of the facilities.

There is no direct relation with WASCO, but there are private companies related to the water supply selling bottled water. As shown in Table 3-7, the government sometimes asks the private sector to provide bottled water during droughts.

3.4.6 Situation of NRW reduction

(1) NRW reduction plan

NRW reduction plans have been developed several times in the past, and those developed with CDB support are the latest editions. A pipeline replacement plan has also been formulated. However, since the fundamental problem is that the project budget cannot be secured and the implementation support is not carried out, the plan has not been carried out.

(2) Implementation of NRW reduction

Water audit has been carried out based on AWWA standards and with CDB support. The history of the water leakage repair is managed by the data base, and linking to the GIS system is a challenge. In the near future, it is planned to establish a NRW reduction team.

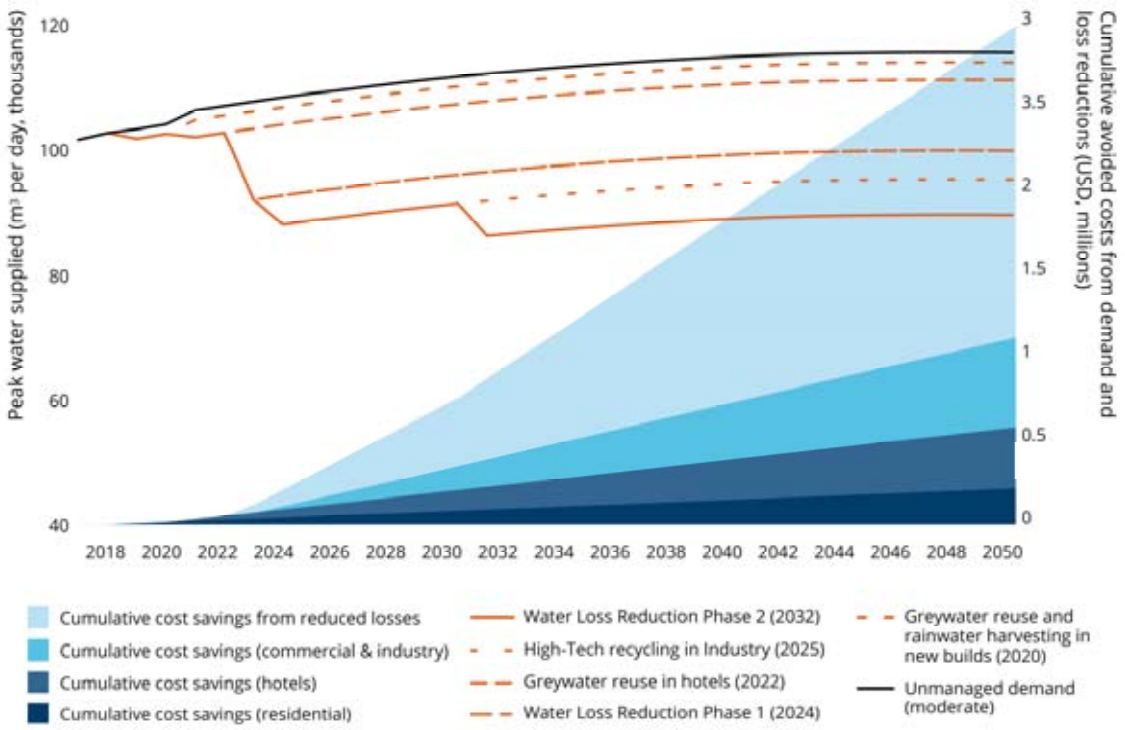
(3) Pilot project of smart meter introduction

Currently, a pilot project for smart meters is planned, and the cost of upgrading to smart meters is now being applied for via the GCF Fund. If the application is not accepted, WASCO will bear the cost, and new customers will purchase these at their own expense.

3.4.7 Facility development plan

(1) Water demand forecasting

In St. Lucia, water demand is expected to increase by 9% in 2030 and by 13% in 2050 (both compared to 2018 levels) if no measures are taken to reduce NRW. By taking measures to reduce NRW and promoting the use of reclaimed water and rainwater, the government plans to curb the increase in water demand by approximately 90,000 m^3/day as of 2050.



Source: UNOPS (2020)

Figure 3-27 Water demand forecast for St. Lucia and loss mitigation effect by implementing countermeasures

(2) Ongoing project

In the northern part of the capital of Castries, where water demand is increasing, the diameter of the water transmission pipelines is being increased within the national budget. The reason is that water leakage due to corrosion of the pipes has been observed in the coastal areas, and that the capacity of the transmission pipeline is insufficient. Therefore, the transmission pipeline from Mongiraud to Rodney Bay will be renewed with DI pipes.

(3) Planned project

WASCO has developed 10 strategic priorities for the period 2023-2028, which are expected to be compiled as the Facilities Development Master Plan by the end of 2024. The main project activities currently being planned are as follows.

- The Readiness and Preparatory Support Programme of the "Mainstreaming Climate Resilience into Water Sector Planning, Development and Operations in St. Lucia", an application project to the GCF Fund, is being carried out for two years from February 2023 with the support of CDB. In parallel, they are moving towards finalizing the Concept Note of the project. The final version is to be submitted by the end of 2024. Measures to enhance climate resilience will include strengthening the water supply systems, such as restructuring the water supply systems and implementing water leakage reduction programs using smart meters, as well as

strengthening integrated water resources management and strengthening governance.

- In March 2024, the Caribbean Action for Resilience Enhancement (CARE) Programme, a technical cooperation project funded by a grant from the CDB as a donor agency, was approved, and the implementation plan is currently being discussed. The project aims to improve WASCO's organizational capacity for climate risk assessment and planning for climate resilience, and to develop a water and wastewater master plan for climate resilience enhancement.
- There is a plan to install a 20,000 m^3/day desalination plant in Gros Islet in the northern part of the island as a countermeasure against future increases in water demand and the effects of climate change. However, there is no concrete movement at the present.[39]

[39] Around 2020, when the UNOPS Report was prepared, the water shortage in the northern region became serious due to the sedimentation conditions of the John Compton Dam. Therefore, a plan for the construction of seawater desalination plants was raised. However, in 2021, dredging was carried out, and the water supply situation improved. Therefore, the priorities of the plan were reduced.

3.5 Wastewater treatment status

3.5.1 Status of sewerage system development

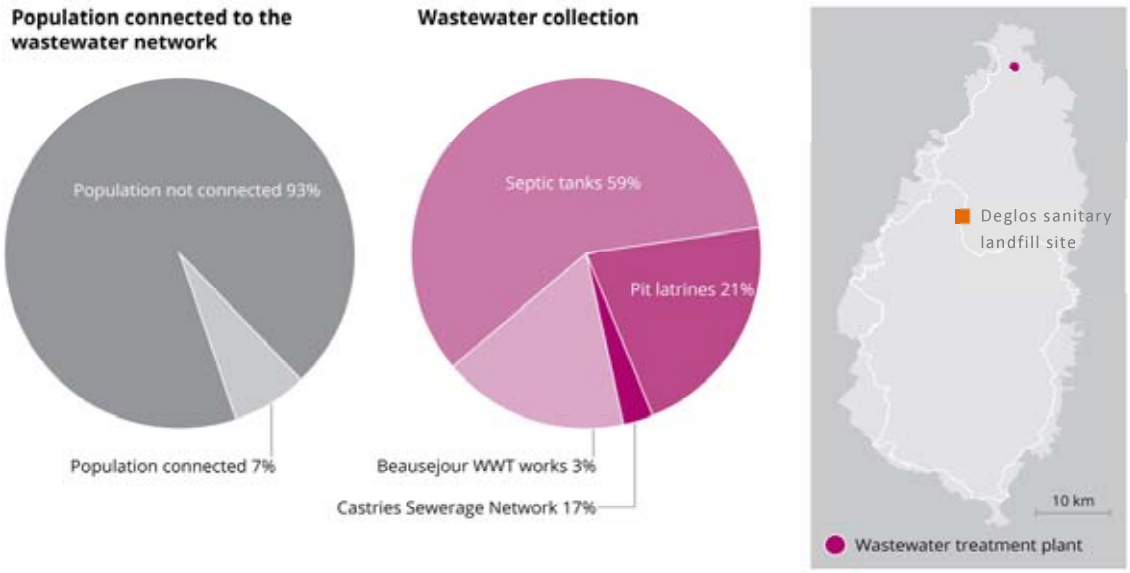
(1) Overview of the sewerage system

WASCO manages three public sewerage systems as follows:[27]

1) Beausejour, in the northern Gros Islet region of the island, has Rodney Bay STP, which treats approximately 3% of the sewage generated in the island as a separate sewage system. However, due to insufficient sewer capacity, the plant is operating at a significantly lower influent flow than original designed.

2) 6,800 m^3/day of sewage collected through sewer pipes is discharged into the port of Castries without any treatment. This has led to complaints from residents and tourists about deteriorating water quality. Although there is currently no sewage treatment including disposal, the sewage fee is collected under the same fee system as the Beausejour treatment area.

3) In Black Bay/Vieux Fort in the southern part of the island, a small-scale treatment system of septic tank type is used.



Source: UNOPS (2020)

Figure 3-28 Sewage treatment status and STP location in St. Lucia

The amount of sewage generated by the rest of the area (equivalent to approximately 80% of the amount of sewage generated in the island) is treated by on-site treatment (septic tanks and collection toilets). However, the frequency of sludge removal from septic tanks is not properly managed as once every 10-25 years. 20% of the septic tank sludge is taken to the Deglos disposal sites, and the remaining 80% is taken to the Rodney

Bay sewage treatment plants. In addition to sewage, water quality degradation is also observed in coastal areas and harbors due to sewage discharged from ships and yachts.[27]

(2) Operation status of sewage treatment plants

The country's only sewage treatment plant is the Rodney Bay sewage treatment plant, which was commissioned in 1995. The treatment system is a stabilization pond method which consists of Stabilization pond, Facultative pond, Maturation pond, Polishing pond and is operated in a Facultative pond with 16 hours of aeration and 8 hours of no aeration.

The sludge that accumulates at the bottom of each pond is dredged at a frequency of once every five years. The sewage sludge is stored in the field after drying in the sun, and sometimes trucked to farmers as soil improvement materials (no fee is charged and it is distributed free of charge). There have been no particular complaints from local residents about the operation of the sewage treatment plant.

As the only country in the target countries to which reclaimed sewage water is being used, recycled water is sold to private businesses operating golf courses as sprinkling water, and part of the treated water from this treatment plant is pumped to the golf course.

Date: February 2024

Figure 3-29 Rodney Bay STP

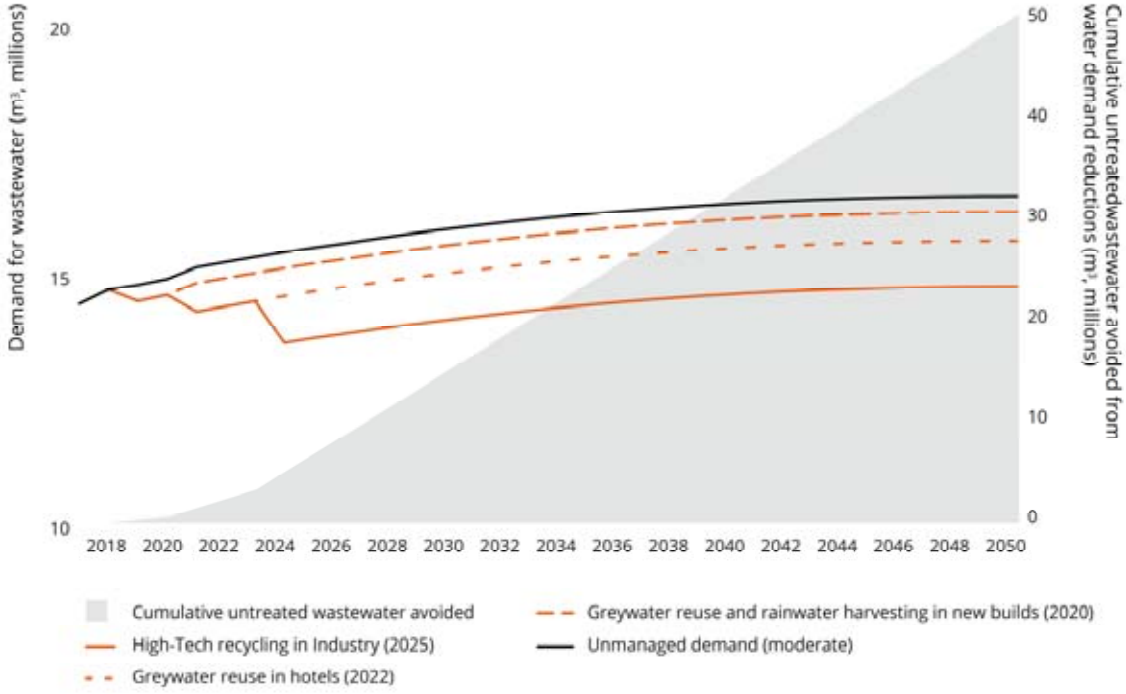
(3) Situation of waste disposal plant

There used to be two landfills, but the Ciceron landfill was closed in 2020 after being landfilled. Currently, only the Deglos landfill, which was commissioned in 2020, is in operation. The remaining years of disposal space are more than 10 years. Waste has not been separated into combustible and non-combustible waste, and has been transported directly to the landfill site.

(4) Prediction of sewage inflow

Hotels and resort facilities use a large amount of water for recreational and sprinkling purposes. In response to this, the policy is to promote the use of recycled water, mainly

from domestic sewage in order to reduce the burden on water demand and the generated sewage.



Source: UNOPS (2020)

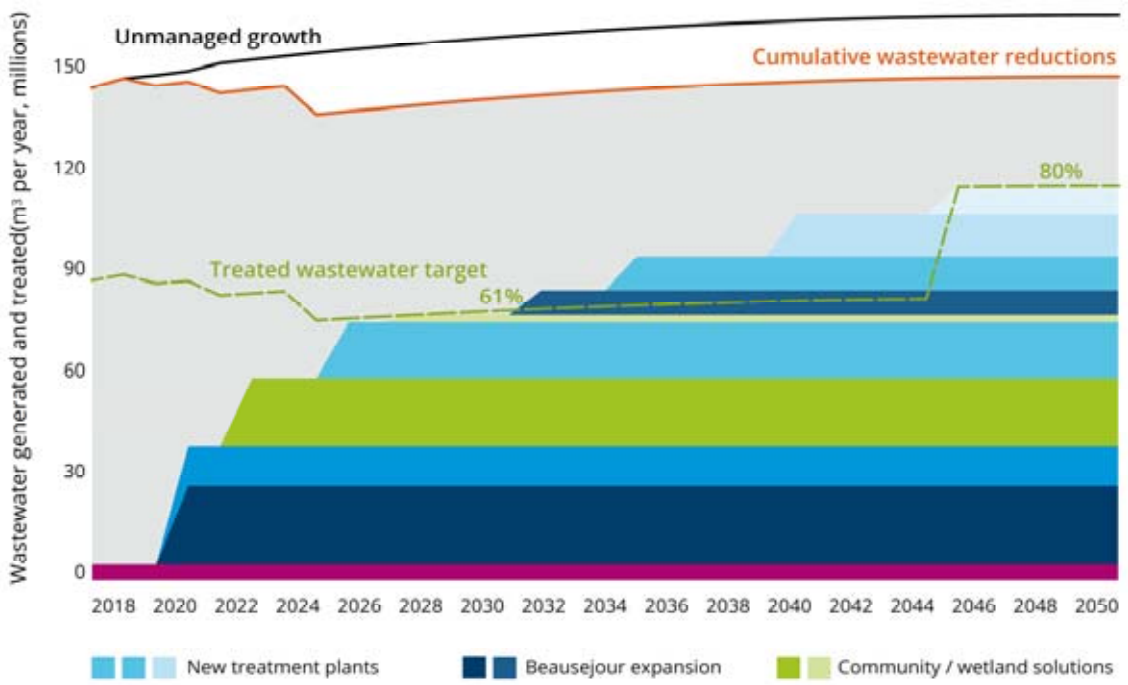
Figure 3-30 Prediction of the sewage inflow generated in St. Lucia and the effects of measures on the reduction of sewage generation

(5) Development plan

In order to utilize the design capacity of 7,500 m^3/day of the existing Beausejour STP, the rebuilding of sewer pipes in the same system is a priority measure. A plan to construct a new sewage treatment plant (capacity: approx. 5,600 m^3/day) in the Castries area, where only primary treatment is carried out, is also mentioned. This improvement will eliminate the discharge of untreated sewage into Castries Harbor. As a decentralized treatment method for other sparsely populated areas, the Wet land Purification System trial project is being carried out in Dennery and it is highly effective.[40]

However, the sewerage master plan has not been decided until now, and there is no plan to prepare it at this time. Although some WASCO staff recognize the importance of sewerage development, there is no awareness that sewerage development is a high-priority project.

[40] Currently, it is in the design stage, and it is planned that the construction cost will be financed by the government's Blue Bond, and WASCO will be in charge of the operation after it is put into service.



Source: UNOPS (2020)

Figure 3-31 Prediction of the volume of sewage generated in St. Lucia and the project to increase sewage treatment capacity

3.5.2 Pollution status of public water bodies

As mentioned above, the collected sewage is discharged untreated into the Castries port. Unlike in other countries where sewage is discharged into the ocean through open ocean pipes, there are unpleasant odors in the area and complaints from residents and tourists.

In the area where septic tanks are used, the treated water is subjected to soil infiltration treatment. Since groundwater use is not common in the country, although there is no impact on the quality of tap water, there is a possibility that groundwater pollution risk may be experienced in the future if groundwater is used in the future, or if inhabitants and others currently use shallow wells. In addition, there may be spills of various types of wastewater into the roadside ditches and waterways, and there may be complaints of foul odors.

Date: April 2024

Figure 3-32 Terminal sewage pump station and discharge situation in the Castries

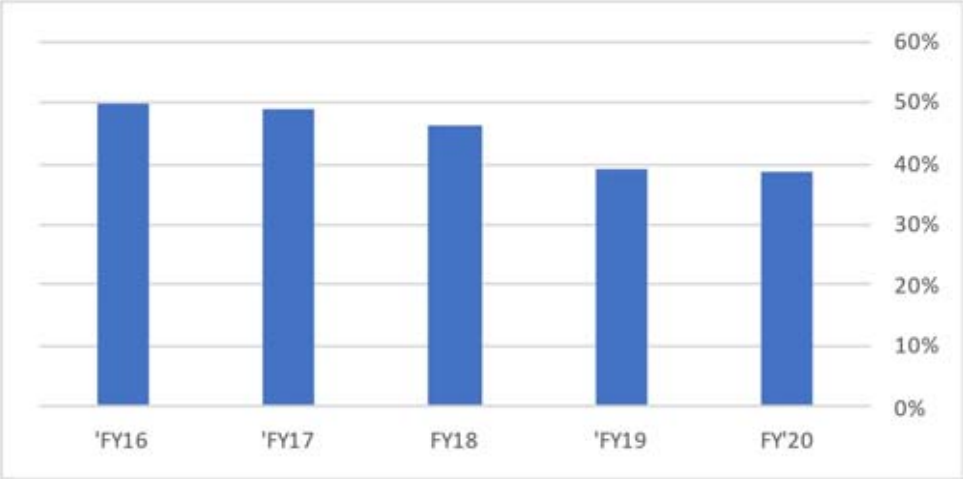
3.6 Financial position

WASCO fiscal year runs from January to December[41]. Their externally audited financial statements are submitted to WRMA, NURC and the Parliament, but are not available on the website due to lack of public disclosure requirements.

3.6.1 Key financial indicators

(1) Stability

WASCO's debt ratio[42] is generally in the range of 40% - 50%, which shows WASCO is not as dependent on borrowing as other countries in the Eastern Caribbean.[43]



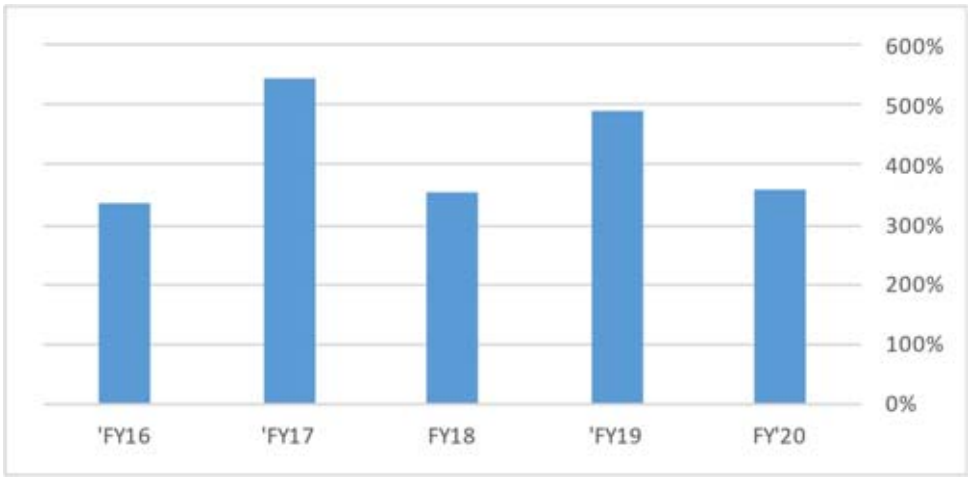
Source: Created by the survey team using WASCO financial statements

Figure 3-33 WASCO Debt Ratio

(2) Liquidity

Although the current ratio[44] fluctuates from year to year, even at its lowest level, current assets are more than three times current liabilities, which does not indicate a significant financial liquidity problem.

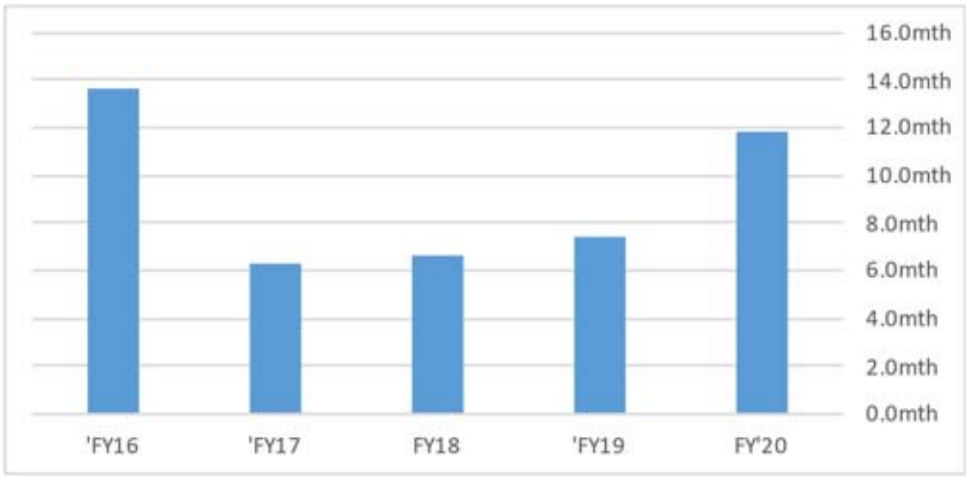
[41] The central government's fiscal year is from April to March of the following year.
[42] Calculated as total liabilities/total assets. The higher, the more significant in external borrowing burden, indicating the negative factor for financial stability.
[43] Dominica, Saint Vincent and the Grenadines, and Grenada in the countries covered by the survey.
[44] Calculated as current assets divided by current liabilities. The higher the level, the better the repayment capacity of short-term debt, and the more positive the funding liquidity.



Source: Created by the survey team using WASCO financial statements

Figure 3-34 WASCO Current Ratio

As another financial indicator for analyzing liquidity, the accounts receivable collection period can be calculated, which is one of the measures of cash flow ability from the collection status of water charges. In FY 2020, it reached an extremely long-term level of almost one year. If the similar trends were found by checking the same indicator for recent fiscal years, it would be necessary to investigate possible structural causes for the longer collection period of water charges.



Source: Created by the survey team using WASCO financial statements

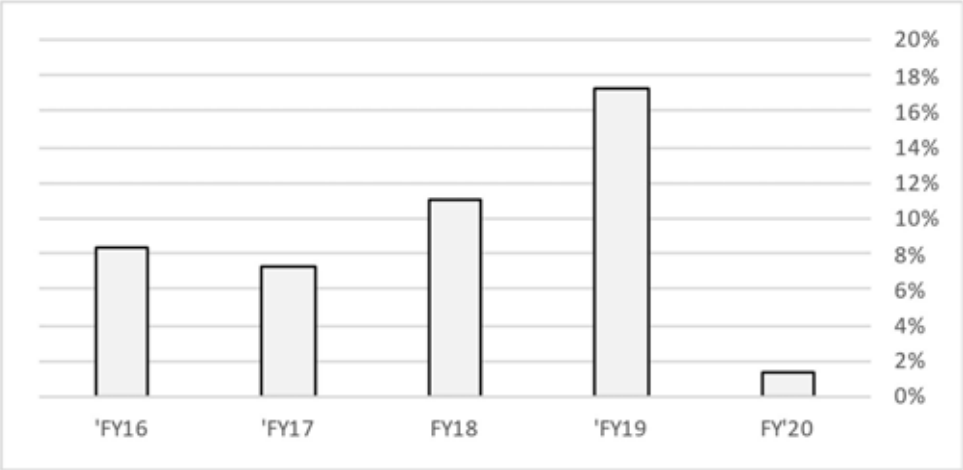
Figure 3-35 WASCO Accounts Receivable Collection Period

(3) Profitability

The historical change in the net profit margin on sales[45] has been analyzed. It can be seen that there was a sharp deterioration in FY 2020. In order to confirm whether the

[45] Calculated as net income ÷ sales. The larger the ratio is, the better the water charges would be in financial efficiency to cover operating costs, interpreted as a positive factor for profitability.

phenomenon is temporary due to COVID-19, it would be useful to analyze the ratio for recent fiscal years.

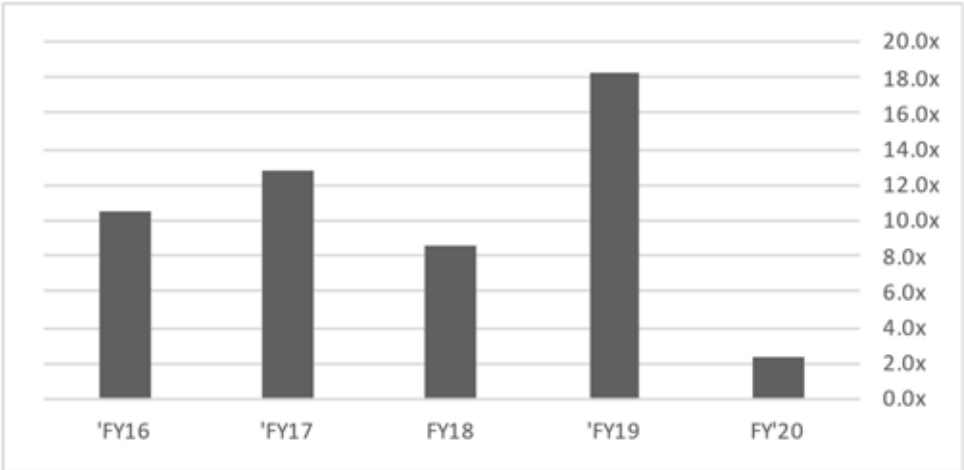


Source: Created by the survey team using WASCO financial statements

Figure 3-36 WASCO Net Income Margin on Sales

(4) Interest payment capacity

The Interest Coverage Ratio (ICR)[46], an indicator of the ability to pay interest, fell to approximately two times in fiscal year 2020. This is a level at which there may be concerns about the ability to repay interest on borrowings if operating profits fall due to the occurrence risk events such as disasters, and where there is a permanent deterioration in subsequent years as well, it is necessary to consider drastic measures to improve profitability or curb the burden of interest payments.



Source: Created by the survey team using WASCO financial statements

Figure 3-37 WASCO ICR

[46] Calculated as earnings before interest and taxes ÷ interest expense. The higher the ratio is, the more capacity the profits from water services can have to cover interest expense on borrowings, interpreted as a positive factor for interest payment capacity.

3.6.2 Financing and investment plans

WASCO has a government-appointed board of directors that determines how WASCO spends its revenues. There is no obligation to pay WASCO's dividend to the government, while there is no government subsidy. The government pays the construction cost and user fee for the public faucet, but the user fee has not been properly paid by the government.

In order to provide stable water supply to the people and continue water services resilient to climate change and natural disasters, a system to formulate and implement financing and investment plans from a medium- to long-term perspective is required. Currently, WASCO expects to formulate a master plan for the investment program by the end of 2024.

Chapter 4 Antigua and Barbuda

4.1 Basic information

4.1.1 Outline of the country

The Antigua and Barbuda is located near 17 degrees north and 61 degrees 40 minutes west, which are the central parts of the Leeward Islands, and is a small island country consisting of the Antigua with an area of approximately 280 km^2 and the Barbuda Island with an area of approximately 160 km^2.

The capital is St. Johns in the northwestern part of Antigua, and the population composition is African system (87.3%), mixed race (4.7%), Hispanic (2.7%), Caucasian (1.6%), etc. The official language is English, and the per capita income is high, giving it a richer profile than other former British territories.[1]

4.1.2 Socio-economic conditions

(1) Population dynamics

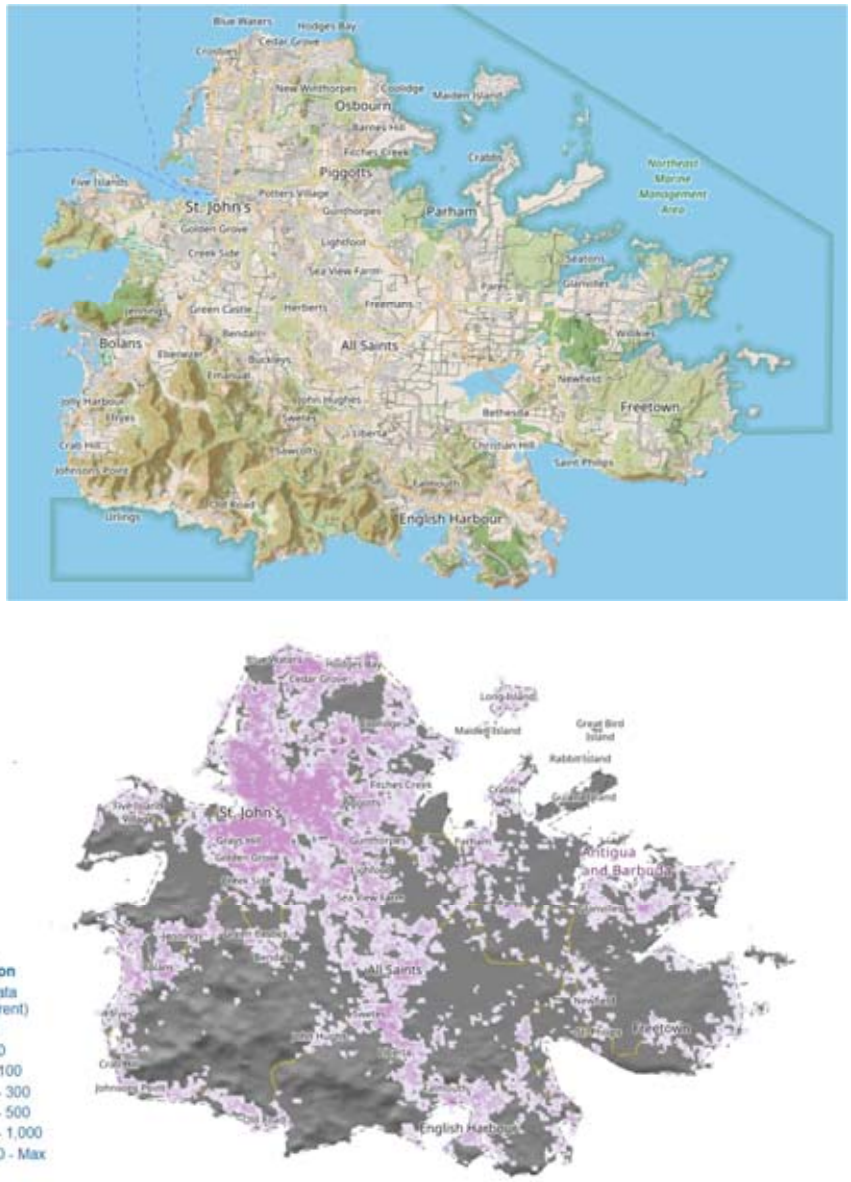
Population dynamics in 2010 are shown in the table below, with a population growth rate of 0.8%. Although flat landform conditions are conspicuous among the target countries this time, and the population is mainly concentrated around the capital, it is characteristic that the population is distributed throughout the island, except for the mountains in the southwestern part.

Table 4-1 Demographic and Economic Status of Antigua and Barbuda

Items		Unit	2010	2015	2020
Basic info.	Total population	inhab	88,030	93,570	97,930
	Urban population	inhab	24,840	24,980	25,680
	Rural population	inhab	69,820	74,940	79,430
	Population density	inhab/km2	200	213	223
Economics	Gross Domestic Product (GDP)	current US$	1,148,700,000	1,336,692,593	1,370,351,852
	Agriculture	value added to GDP	X	18,762,963	21,551,852
	Industry	value added to GDP	X	143,937,037	163,666,667
	Services	value added to GDP	X	854,188,890	990,418,519
	GDP per capita	current US$/inhab	13,049	14,286	13,993

Source: FAO AQUASTAT

[1] Source: Embassy of Japan, Tobago, Trinidad (2022), Overview of Antigua and Barbuda



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

Figure 4-1 Population distribution map of Antigua in 2020

(2) Macroeconomics

The key economic indicators are shown in Table 4-2. The GNI per capita in 2022 is USD 19,050, which takes ANU out of the DAC list. Since the GDP per capita is USD 19,920 and GDP per capita growth rate is 8.9% per year, the GDP per capita in 2027 would be USD 30,509 if this growth rate continues for five years.

While the tourism and service industries, which account for a little under 50% of GDP, are at the core of the economy, the diversification of industries and government revenues is being pursued through the promotion of offshore business and the introduction of the

Economic Citizenship Program[2], which allows foreign investors to obtain citizenship by making a specified financial contribution. ANU has an economic structure that is vulnerable to external factors; it is prone to hurricanes and other natural disasters, and its main industry, tourism, is easily affected by global economic trends.

Agriculture is mainly targeted in the domestic market, but production is sluggish due to insufficient supply of water and shortage of workers caused by preference of many labor forces toward high-wage tourism or construction industries. The manufacturing industries are mainly based on offices and factories established by foreign companies to produce export products (so-called enclave economy), where the main products consist of light industrial goods such as clothing, alcohol, and home appliances.

Like other Eastern Caribbean countries, the economy of Antigua and Barbuda was hit by the financial crisis of 2009. Between 2009 and 2011, the country struggled with the collapse of leading companies, a significant slump in the tourism industry, increased debt, and severe recession, and in 2010 it received financial recovery assistance from the IMF. Since 2014, the economy has generally experienced strong economic growth, except in 2017, the year affected by a hurricane, driven by robust tourism. In 2020, the economy of ANU recorded negative growth of 15.9% due to the impact of the spread of COVID-19, but recovered to 9.5% growth in 2022.

Table 4-2 Key Economic Indicators of Antigua and Barbuda

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)
1,810	19,050	No data	No data	7.5	-662.8
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)
1,868	19,920	9.5	8.9	No data	376.0

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

The central government's current account balance had revenues of USD 338 million in FY 2022, but its expenditures reached USD 360 million, a deficit of approximately USD 32 million. In FY 2023, revenues were USD 358 million and expenditures were USD 373 million, indicating a declining deficit trend. In FY 2024, the budget for the surplus balance was projected. The public debt had not been below 80% of GDP since 2009; but the government's efforts in recent years have steadily shown some results, the debt fell below 80% to 75% in FY 2022, and is expected to fall further to 66% in FY 2023. The

[2] In the area covered by the survey, the program is introduced by the following countries, where the year of introduction is shown in parentheses: St. Christopher and Nevis (1984), Dominica (1993), Antigua and Barbuda (2013), Grenada (2013), and Saint Lucia (2015).

Government has indicated its intention to target 60% by 2035, a publicly-perceived benchmark for the Eastern Caribbean Currency Union (ECCU) countries.

Table 4-3 Current Accounts and Public Debt in Antigua and Barbuda

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
338	358	360	373	1,407	1,407	75	66

Source: Antigua and Barbuda (2023) 2024 BUDGET STATEMENT

(4) Business environment

The Ease of Doing Business Index is 60.3 (2020). This ranks 113th 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 third highest among the six countries surveyed. On the other hand, the Corruption Perceptions Index does not cover ANU.

(5) National Development Plans

A National Development Plan, which constitutes the successor to the Medium-Term National Development Strategy (2016-2020), has not yet been published at this time.

(6) Outline of electric power business operation

The electricity business on the island is run by the Electricity Business Unit of the APUA, as are the water and telecommunications business. However, more than 80% of the electricity generation business is purchased from Antigua Power Company Limited, a private company, and APUA is responsible for distribution. According to the 2021 business plan, the Electricity Business Unit itself is expected to maintain the profitable operation[3]. Electricity tariff is 0.38 XCD per kWh (approx. 22.0 JPY; for industrial category, May 2024), excluding fuel surcharge. Although the fuel surcharge rate is not publicized, the rate is presumably as high as the other East Caribbean countries[4].

(7) Power infrastructure development status

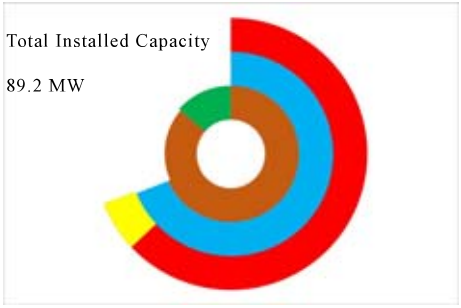
With regard to the supply-demand balance in ANU, the peak demand is 56.2 MW while the installed capacity excluding renewable energy is 77.0 MW[5]. If the supply capacity is estimated to be say 80%, it can be said that the redundancy of approximately 9% is ensured.

[3] Business Plans for 2021-2023, Ministries of Government of Antigua and Barbuda, 2021

[4] An average electricity tariff of targeted countries (including fuel surcharge) is 1.051XCD.

[5] Energy Report Card (ERC) for 2021; Caribbean Center for Renewable Energy & Energy Efficiency (CCREEE), 2022
Antigua and Barbuda's First Biennial Update Report 2020; Government of Antigua and Barbuda, 2020
Business Plans for 2021-2023, Ministries of Government of Antigua and Barbuda, 2021

In 2021, the country's electricity generation consists of thermal power generation (installed capacity 77 MW) and solar power generation (installed capacity 12.2 MW), as shown in Figure 4-2 Power Situation in Antigua and Barbuda. Thermal power generation relies entirely on imported fuel.



■	Peak Demand	56.2 MW
■	Available Cap.	5.4 MW
■	Firm Cap.	61.6 MW
■	Fossil-fuel Gen.	77 MW
■	RE Gen.	12.2 MW

[6,7]

Source: Prepared by JST

Figure 4-2 Power Situation in Antigua and Barbuda

There are many plans to introduce solar power generation with the support of various donors. Major projects include the airland use of international airport (3 MW), government buildings of the Antigua (6 MW), and the Barbuda Island (1 MW).

The country is also estimated to have wind power potential reaching 400 MW, and ADFD[8] is currently planning 4 MW class wind power generation on the Crabbs Peninsula.

The ANU government sees LNG as a clean energy source to reduce air pollution. To increase the island's firm capacity, they are planning to install 40 MW class LNG thermal power plants on the peninsula.

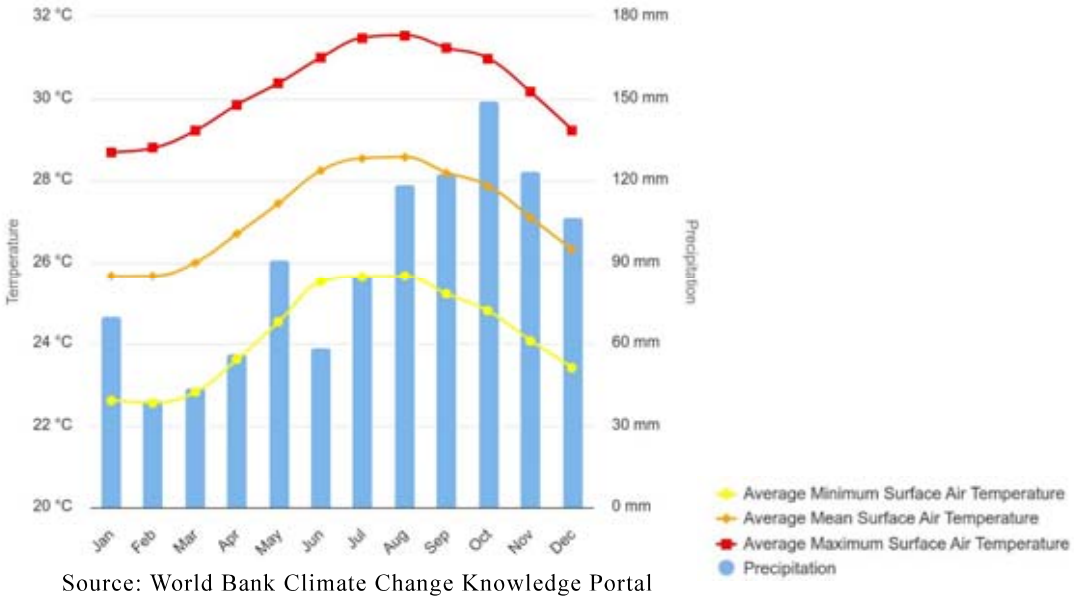
As a "Conditional Mitigation Target" in NDC[9], the country has set a renewable energy introduction target of 50 MW (approx. 65% of peak demand), but as of 2022, the ratio is still less than 15%. With regard to the "Conditional Adaptation Goals", they include a more challenging target of substituting 100% of electricity demand in the water sector (and other essential sectors) with off-grid renewable sources. In the country, which relies on desalination for 95% of its water supply, it is essential to not only replace it with renewable power plants, but also to introduce new technologies, such as large-scale energy storage system, to achieve this goal.

[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.
[8] Abu Dhabi Development Fund
[9] NDC: Antigua and Barbuda First Nationally Determined Contribution

4.1.3 Natural condition

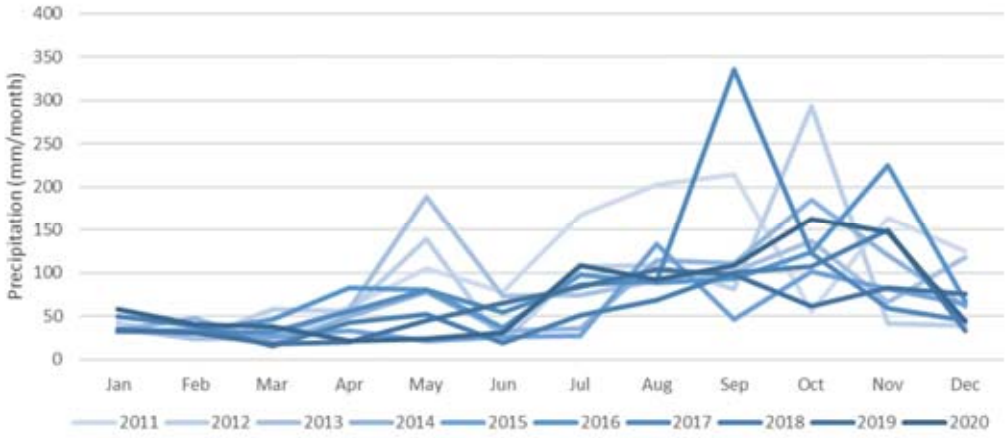
(1) Weather conditions

Antigua and Barbuda has a tropical climate with average temperatures of around 26-29°C, dry season from December to April, rainy season from May to November, and hurricane season from June to October. Figure 4-4 shows the monthly rainfall for 10 years. Even in the dry season, rainfall is less than 50mm, especially from January to March. Normally, the rainy season starts in May, but the latest rainy season tends to be delayed. Among the countries covered this time, it can be said that the rainfall is especially small together with St. Christopher and Nevis. Normally, the rainy season starts in May, but the latest rainy season tends to be delayed.



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

Figure 4-3 Antigua and Barbuda's average temperature and precipitation



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

Figure 4-4 Monthly Precipitation in Antigua and Barbuda

Table 4-4 Monthly precipitation in Antigua and Barbuda

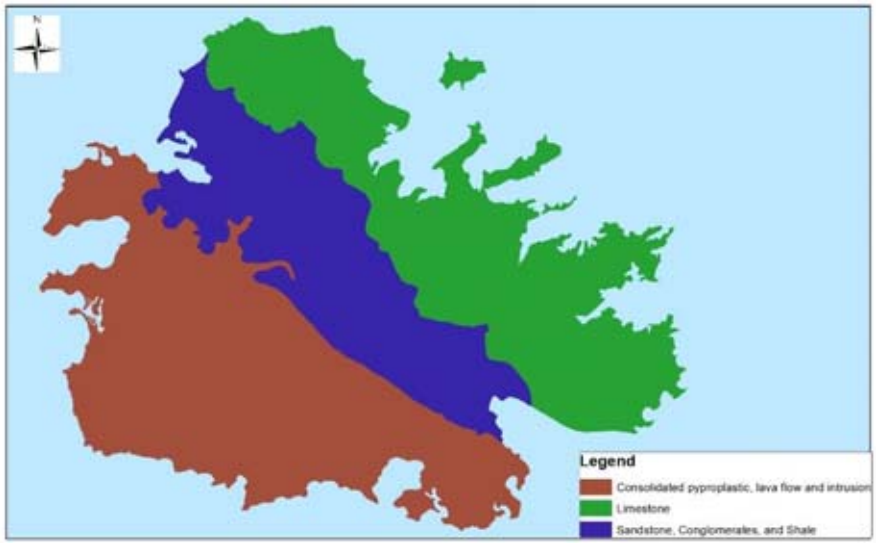
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
2011	39	29	29	61	106	79	168	202	214	55	164	125	**1,271**
2012	42	24	58	55	139	19	107	109	82	293	42	39	**1,009**
2013	36	24	25	58	188	73	75	91	102	136	67	118	**993**
2014	34	47	18	50	78	33	36	115	111	185	120	62	**889**
2015	32	35	26	33	22	26	27	134	47	101	81	64	**628**
2016	33	32	46	83	81	37	98	89	93	124	226	67	**1,009**
2017	34	31	33	55	80	54	86	91	336	123	60	46	**1,028**
2018	50	40	16	42	52	19	51	68	100	107	149	33	**727**
2019	34	31	18	21	45	65	83	104	97	61	83	76	**718**
2020	57	40	38	22	24	31	108	93	109	162	148	43	**876**

Source: Prepared by JST based on World Bank Climate Change Knowledge Portal
Annotation: mm/month

(2) Topographical and geological conditions

Antigua and Barbuda consists of three islands, Antigua, Barbuda, and Redonda, as well as other smaller islands. Many of the islands are low-lying, and the elevation of Mount Bogie on Antigua, the highest point in the country, is only approximately 400m.

There is no active volcano at present, and as a geological distribution of the Antigua, the southwestern part where the geological age is the oldest is composed of volcanic rocks and volcanic sediments, the central part is composed of sedimentary rocks mainly composed of mudstone and conglomerate, and the northern part is composed of limestone.



Source: https://environment.gov.ag/programs#data/maps

Figure 4-5 Geological distribution map of Antigua

4.2 Policy and legal framework related to the water sector

4.2.1 National water policy

As a document related to water sector policies in Antigua and Barbuda, the Business Plan for 2023-2025 of the Antigua Public Utilities Authority (APUA) is open to the public. It advocates that all potable water should be supplied by RO, that World Health Organization (WHO) standard water quality should be made available at all times, and that non-revenue water should be reduced.

4.2.2 Related organizations

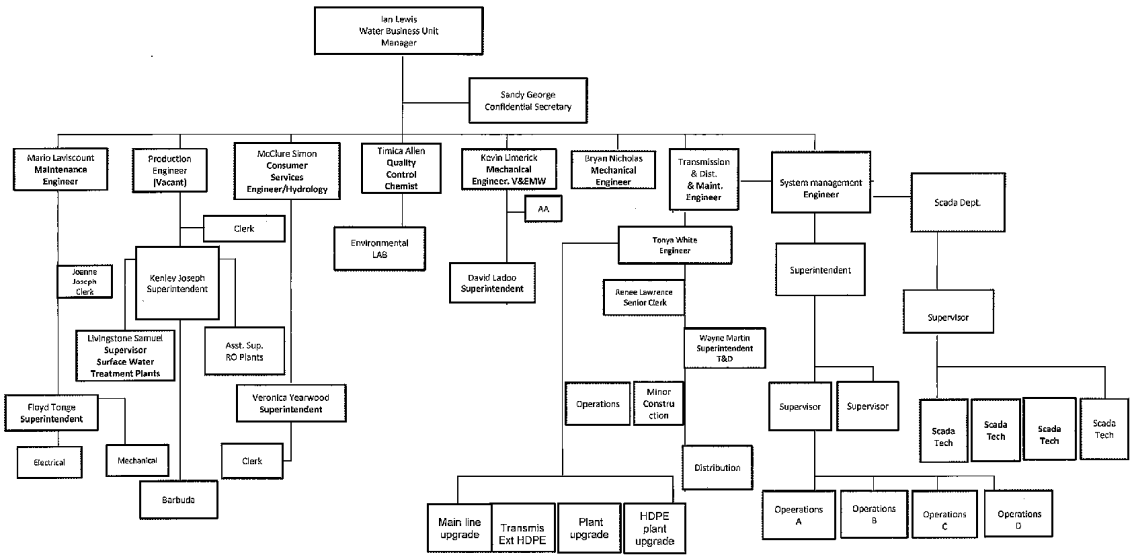
(1) Antigua Public Utilities Authority (APUA)

The water sector division[10] of APUA, which was established in 1973 as one of the Statutory Body[11] of Antigua and Barbuda, provides the country's services for water supply and sewerage control and water resource security. APUA's operations are supervised by the Ministry for Information Communication Technologies, Utilities and Energy, a higher-level ministry.

As of February 2024, APUA has 868 officials working under the supervision of the Board of Commissioners, including 231 belonging to the Water Supply Division. The executive management team consists of nine members, including the general manager, three division heads leading sectors of water, power, and telecommunications, and the managers of finance, planning, human resources, customer services, and public relations. Figure 4-6 shows the current organizational chart of the water supply sector.

[10] In addition to the water sector, APUA covers three sectors including electric power and telecommunications.

[11] A type of administrative organization of the British system which is a legislation-based entity empowered to enforce specific laws or regulations on behalf of the country or municipality concerned and which may be empowered or delegated to establish regulations in the field of jurisdiction.



Source: Received from APUA

Figure 4-6 Organizational Chart of Water Supply Division of APUA (2024)

(2) Ministry for Information Communication Technologies, Utilities and Energy

It is a central government agency responsible for the three sectors covered by APUA. In addition to receiving reports on service activities from APUA, the ministry has the authority on APUA to issue instructions and to establish, supervise, and inspect relevant standards including fees for use of public services. In the water sector, this authority is exercised mainly from the standpoint of maintaining appropriate water supply operations, rather than integrated water resources and watershed management that takes into account climate change, environmental protection, and disaster risk reduction.

(3) Ministry for Health, Wellness and Environment

For the purpose of addressing climate change and environmental protection, the ministry covers the water sector as a central government agency. It has no oversight authority over APUA, but receives reports from APUA on specified water quality test results. The Department of Environment of the ministry is an accredited entity of the Green Climate Fund (GCF), and has submitted a concept note of Sustainable Integrated Water Resources Management to Build Resilience to Climate Change in the Water Sector of Antigua and Barbuda (April 2018).

4.2.3 Related laws and regulations

(1) Public Utilities Act

This is a law that defines basic matters related to APUA. The composition of all 45 articles is as follows.

- ✓ Preliminary (Articles 1 to 2)

- ✓ Establishment of Authority and Vesting of Property (Articles 3 to 4)
- ✓ Rights, Powers, and Duties of Authority (Articles 5 to 10)
- ✓ Financial Provisions (Articles 11 to 22)
- ✓ Offences and Injurious Acts (Articles 23 to 36)
- ✓ Miscellaneous (Articles 37 to 45)
- ✓ Schedules

(2) Essential Services Act

Ten public services including hospital, fire, prison, air traffic control, meteorological, government printing, and port authority, as well as the three which APUA covers, are defined as essential services. The act aims to provide these services stably and continuously.

(3) Environmental Protection and Management Act

This law sets forth the basis for sustainable environmental management of the Antigua and Barbuda, consisting of all 124 articles as follows.

- ✓ Preliminary (Articles 1 to 3)
- ✓ Administration (Articles 4 to 11)
- ✓ Special Powers of Inspector and Director (Articles 12 to 16)
- ✓ Environmental Policies and Plans (Articles 17 to 23)
- ✓ Pollution Control (Articles 24 to 39)
- ✓ Environmental Impact Assessment Process (Articles 40 to 46)
- ✓ Environmental Management and Monitoring (Articles 47 to 52)
- ✓ Natural Resources Management (Articles 53 to 75)
  - Management of Protected Areas (Articles 54 to 58)
  - Watersheds Management (Articles 59 to 64)
  - International Trade in Wild fauna and flora (Articles 65 to 75)
- ✓ Access to Genetic Resources and the Sharing of Benefits (Articles 76 to 83)
- ✓ Environmental Information (Articles 84 to 89)
- ✓ Multilateral Environmental Agreements (Article 90)
- ✓ Sustainable Island Resources Framework Fund (Articles 91 through 101)
- ✓ Compliance and Enforcement (Sections 102 to 108)
- ✓ Offences and Penalties (Articles 109 to 112)
- ✓ Environment Information, Research, Education and Training (Articles 113 to 116)
- ✓ Miscellaneous (Articles 117 to 124)
- ✓ Schedules

4.2.4 Related plan

(1) Environmental Social Impact Assessment and Management Plan

In 2020, the Department of the Environment in the Ministry of Health, Wellness and Environment developed the plan for the construction sector in accordance with GCF's plan for environmental and social safeguards and gender issues. The plan lists the desired outcome, mitigation measures and monitoring performance indicators, timeframe, responsible party, incremental budget (USD), and capacity building and training requirements for each of the impact areas shown in the table below.

Table 4-5 Impact Areas of the Environmental Social Impact Assessment and Management Plan

Positive - opportunities
✓ Employment opportunities, including for women, youth and disadvantaged groups ✓ Vocational training and skill building ✓ Participatory and consultative approach
Negative - impacts
✓ Construction phase ✓ Noise pollution ✓ Ecological impacts referred to will entail impacts on fauna, flora and changes in the micro climate of some sites as well as transfer of pests and diseases ✓ Increase in greenhouse gas emissions ✓ Air pollution ✓ Operational phase ✓ Solid waste and hazardous pollution ✓ Public disclosure of Environmental and Social Impact Assessment and Environmental and Social Management Plan ✓ Compliance with Building Code

Source: The Government of Antigua and Barbuda (prepared by 2020) Environmental Social Impact Assessment and Management Plan

4.3 Status of water resources

4.3.1 Water resource use

(1) Water source

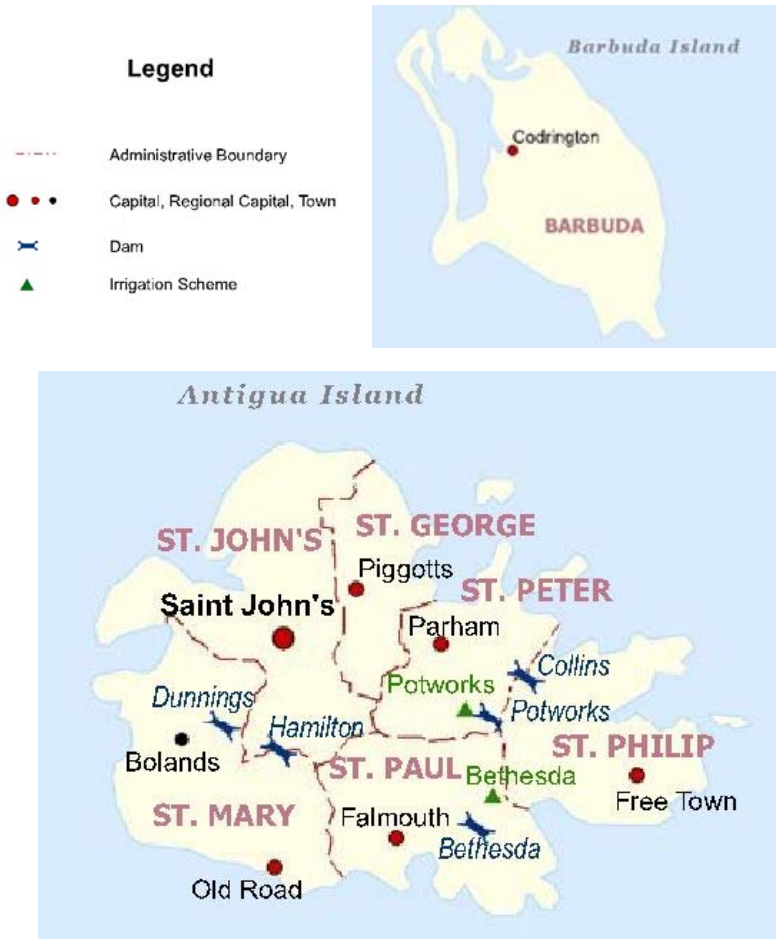
The islands of Antigua and Barbuda do not have natural rivers. In the Antigua, the surface water source from dams has been the main source of water supply, but groundwater has also been used as water demand has increased. In recent years, both surface water and groundwater production have decreased due to climate change. In addition, groundwater sources in coastal areas are affected by seawater intrusion, and it is necessary to monitor the salinity in groundwater by means of electric conductivity and to reduce the salinity by recharging freshwater by stopping groundwater pumping whenever the WHO standard of 1,000 ppm is exceeded. Many wells were decommissioned as a result of these water-pumping shutdown measures, and the use of groundwater sources has reduced to approximately 30% of its historical level.

Given this situation, most of the water supply now depends on desalination. In the rainy season when dam water sources are available, the rate of water supply from desalination facilities is approximately 70%, but in the dry season it will depend on approximately 90-95%. The island of Barbuda is 100% dependent on desalination.

(2) Water storage facility

The country's largest dam, Portworks, can provide water for six to nine months if there is sufficient rainfall during the rainy season. In addition, six smaller dams also serve as water sources for about a month and a half.

In recent years, however, it has become a problem that the water level cannot be expected to recover even in the rainy season due to a decrease in rainfall. In fact, the period from June 2021 to October 2023 was a drought period for the dam reservoir, forcing water restrictions. The frequency of water supply restrictions varies from district to district, and the further away the WTPs are, the greater the risk of water supply restrictions.



Source: FAO AQUASTAT (2015)

Figure 4-7 Water source location of Antigua and Barbuda (major dams and rivers)

(3) Rainwater usage

In accordance with the Building Law of the country, it is required by the law to install polyethylene rainwater tanks underground in all buildings, and although there is no government subsidy system, the tank installation rate is close to 100%. Since this regulation was introduced in the 1980s, older houses before that time were equipped with metal tanks. Harvested rainwater is used for all domestic purposes, including drinking water, and the habit of rainwater use is becoming widespread in the country. Chlorination is recommended by APUA, and in addition to this, many households use their own filtration systems such as activated carbon.

(4) Recycled water usage

Although households are not yet using recycled water, they are very interested because of the chronic water shortage. Since most households have septic tanks that separate black and gray water, they would like to see the use of recycled water mandated by law if the technology is found.

Although MoH previously installed membrane plants with the aim of reusing sewage from hotels and cruise ships, the staff control techniques are inadequate and they are not currently in use. For this reason, MoH is particularly interested in the MBR system. This is introduced as a Japanese technology.

In addition, the country is considering the introduction of technology to produce water from the atmosphere because the humidity is very high, and although it has been installed in some schools and good results are also obtained, the problem is the high cost. In addition, the advanced demonstration tests of WOTA Co., described in Appendix-1of this report, are scheduled to be conducted in the country, and it is clear that the nation is willing to introduce new technologies.

4.3.2 Implementation status of integrated water resources management

(1) Implementation organization of water resources management

IWRM in the country is being implemented by the Consumer Service & Hydrology Department of APUA, and it is being promoted with the Department of Environment of MoH. The department will establish a Watershed Management Committee according to the act established in 2019. The committee is planned to be established in the future, although securing manpower is a challenge and has not yet been established.

In addition, since the implementation of IWRM is decided by the Cabinet, the involvement of politicians is essential. APUA has been holding a workshop for stakeholders for more than 10 years and recommended that a similar IWRM be implemented with reference to the draft plan of St. Lucia. However, it has not been implemented at this time due to lack of Cabinet movement.

(2) Integrated water resources management plan

Current IWRM related methods include Environmental Protection Act, Public Utility Act. This Public Utility Act stipulates that the approval of water rights in the country belongs to APUA, and it is characteristic that the same organization assumes the roles of water supply and water right approval.

(3) Response to the shortage of water

In case of water shortage, APUA will send water tankers and other measures will be taken, and these conditions will be visited frequently.

(4) Water source monitoring status

There is no automatic monitoring system for dam water levels and groundwater levels, which are monitored manually by staff on a monthly basis. Since there is a risk of damage and theft even if automatic monitoring equipment is installed at the remote dams, and the period of use of the dam water sources is short due to basically low rainfall, APUA does

not feel the need to continuously monitor the fluctuation of the dam water levels at all times.

4.3.3 Challenges in water resources management

(1) Challenges in water resource development

There are limitations in developing surface water sources due to low rainfall. As for groundwater sources, no new aquifers could be found even after excavation of more than 100 meters surveyed in 2001. Therefore, although it is necessary to develop groundwater sources by using existing aquifers, i.e. increasing the number of wells, it is impossible to develop underground water because the recharge of groundwater is insufficient due to the low amount of precipitation, and excessive pumping causes salinization of groundwater. For this reason, it is essential to rely on desalination to secure new water sources. New water source development plans are currently being prepared, including the description of desalination facilities and new groundwater sources.

(2) Impacts on agriculture and tourism

Farmers suffer most from water shortages, and APUA also provides water supply, but farmers tend to avoid the use of chlorinated water. Since there are cases of farmers grazing around and occupying wells to secure water for livestock, the Environment Bureau is also seeing this situation as a problem, and is seeking ways to reuse livestock water and domestic water (washing, laundry, etc.) in an energy-saving manner.

(3) Issues in integrated water resource management

Since APUA is mainly engaged in business operations, including water supply projects, it was pointed out that there was no organization to oversee IWRM in the country. In addition, since APUA does not provide information to various organizations on the specific issues that the Environment Bureau needs to support the water components, the Environment Bureau believes that it is necessary to conduct detailed surveys on their NRW status, etc.

4.4 Status of water supply

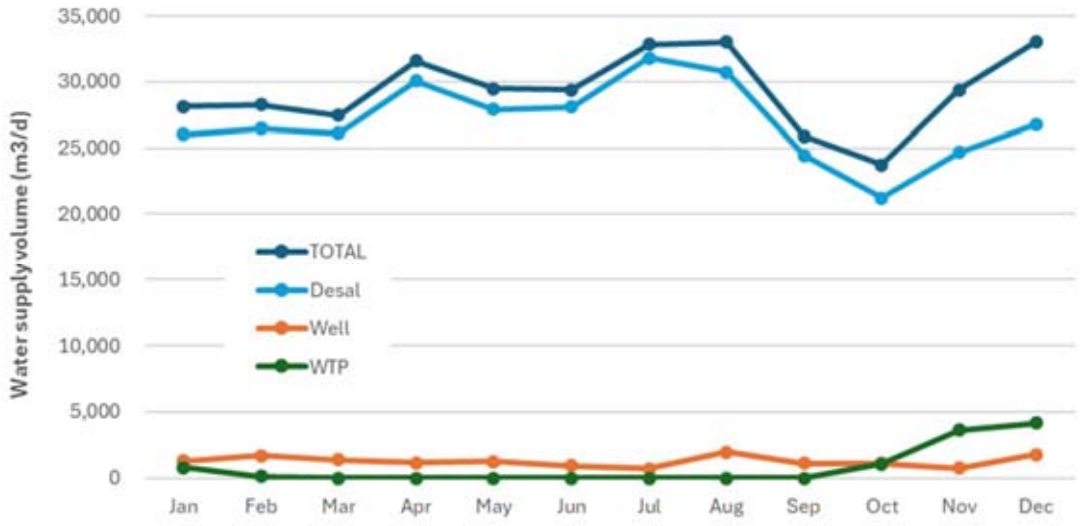
4.4.1 General condition of water supply

The water supply coverage is approximately 90%, and as of 2024 there are 27,759 customers for APUA water service, of which 25,899 are for domestic use. The remaining 10% is equipped with storage tanks that can be filled by water trucks or rainwater collected and used. The current water demand is estimated to be approximately 36,000 m^3/day (8 million gallons/day). On the other hand, APUA water supply is approximately 31,000 m^3/day, which is only approximately 88% of the water demand. In addition, water demand in 2024 is expected to reach approximately 41,000 m^3/day (9 million imperial gallons/day), and there is concern about a shortage of approximately 10,000 m^3/day. In addition to APUA, which is a public company, there are two private water companies in the country, each of which owns desalination plants that supplement the above shortage of water supply by connecting to a water distribution network managed by APUA.[12]

Figure 4-8 shows the water supply by source for each month in 2023. As an annual trend, there is a decrease in water supply during the hurricane season from September to October, which can be attributed to a decrease in tourism demand. The availability of water from the dam is variable from year to year, although the absence of water supply from the WTP that uses the dam as its source from February to September in the same year is a unique feature. Groundwater use is relatively stable, but accounts for about 5% of the total water supply, and the situation can be read as one of dependence on desalination for 80% to 95% of the water supply throughout the year.

In regions where water supply is mainly provided by desalination, 24-hour water supply is achieved even in the dry season, but in regions where dam water sources are used, it is limited to 18-hour water supply in the dry season and 20-hour water supply in the rainy season. In areas far from desalination plants, there are also cases where the depletion of dam water sources leads to several days of water cut-off.

[12] There are no laws and regulations for private water companies, and APUA monitors them based on the Public Utility Act of 1973. Specifically, the daily water production of private water companies is measured, and water quality tests are conducted in the laboratory to evaluate water quality in accordance with WHO standards.



Source: APUA provided

Figure 4-8 Water supply by source on the Antigua (2023)

4.4.2 Water supply facilities

(1) Water intake and water treatment facilities

The Antigua has two WTPs, of which the Delapps WTP, located in the southern part of the Antigua, was constructed in 1975 with the support of the United Kingdom, and the water source is the surface water source of the Portworks Dam. The facility has a capacity of approximately 6,800 m^3/day (1.5 million imperial gallons/day)[13], and the WTP has a sedimentation + rapid filtration system. In terms of chemical injection, potassium permanganate is used to remove iron and manganese in the influent, and aluminum sulfate and polyaluminum chloride (PAC) are used in combination as flocculants. Pre-and post-chlorination are adopted for chlorination, and bleach powder and chlorine gas are used in combination.

The other is the Bendals WTP, which also uses dams as its water source. The facility has a capacity of approximately 3,200 m^3/day (0.7 million imperial gallons/day).

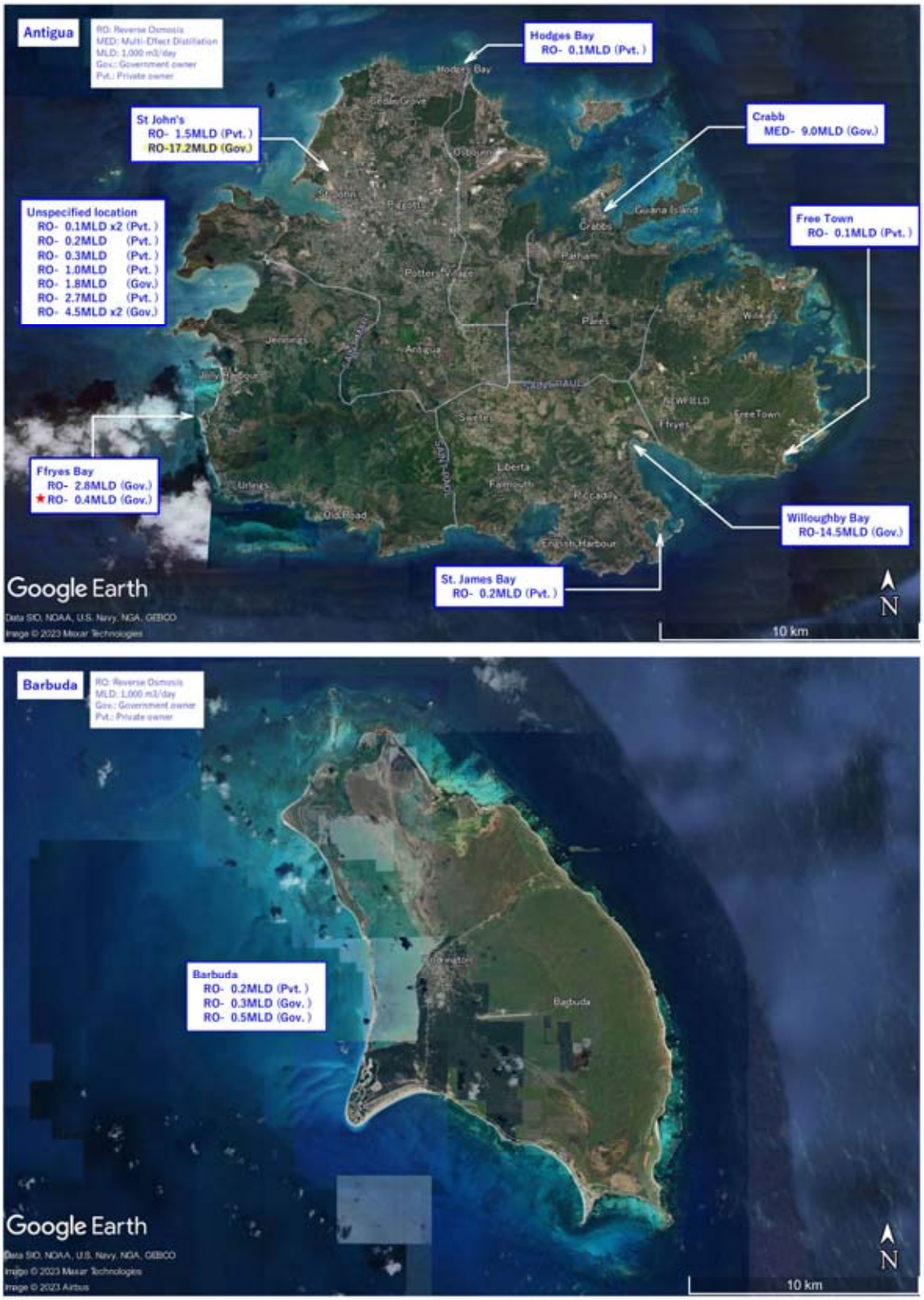
[13] From APUA Website (http://www.apua.ag/business-units/water-business-unit/water-provision-in-antigua/)

Date: February 2024

Figure 4-9 Portworks dam and Delapps WTP

(2) Desalination plant

Antigua and Barbuda has the largest number of desalination plants in operation among the countries surveyed and the largest capacity Crabbs Desalination Plant (approximately 18,000 m^3/day (4 million imperial gallons/day)). Figure 4-10 shows the location of desalination plants on the islands of Antigua and Barbuda.



Source: Survey team based on DesalData.

Notes: ★ in the figure shows provision of JICS grant scheme of "economic and social development program" and the above drawings include private-owned desalination plants

Figure 4-10 Desalination plants on the islands of Antigua and Barbuda

In addition to the above, Figure 4-11 shows the location of the desalination plants owned by APUA. A detailed discussion is provided in Section 4.4.7, of which the Bethesda Desalination Plant (14,500m^3/day (3.2 million imperial gallons/day)) is currently under construction and is expected to be completed within this year.

Source: Received from APUA

Figure 4-11 APUA owned desalination plants

The Crabbs desalination plant (Figure 4-12), the largest in the country, was built under a Build-Operate-Transfer (BOT) contract with Enerserve, and has been operated and maintained by APUA since 2017, when the 12-year contract expired. The seawater intake is a mixture of seawater obtained by two methods: surface intake and beach well.

The Ffryes Beach Desalination Plant has a capacity of approximately 4,200 m^3/day (0.93 million imperial gallons), and after three units of RO equipment were installed in 2014 with the support from the Venezuelan government, one unit was added in 2020 through Japan's grant aid "Economic and Social Development Program". Although the exact location could not be confirmed on site, seawater is drawn from the intake located in the offshore area away from the beach.


Date: February 2024

Figure 4-12 Crabbs Desalination Plant


Date: February 2024

Figure 4-13 Ffryes Beach Desalination Plant

(3) Water transmission and distribution facilities

The total length of the pipeline is approximately 966 km (600 miles) in total for both water transmission and distribution pipelines, and some district metered areas (DMAs) have been constructed in the distribution network. Ductile iron (DI) pipe has been used as the main pipe material, but in recent years, high-density polyethylene (HDPE) pipe has been adopted to strengthening the resilience.

4.4.3 Water Supply Operation

(1) Operation and maintenance of facilities

Several of the standard operating procedures (SOPs) for operation and maintenance (O&M) have been prepared for some plants, but not for water distribution management.

For the operation and maintenance (O&M) of WTPs, water intake is accomplished by pumping from the Portworks Dam, and water intake is stopped when the water level in the dam drops to three (3) feet (0.91m). The water level is checked when the operators arrive at work, and the decision to stop water intake is made by the supervisor or the manager. Regarding water quality control at the WTPs, measurements of turbidity, residual chlorine, and pH are reported to supervisors and managers every two hours.

Regarding the O&M of the Crabbs Desalination Plant, APUA staff have acquired the O&M know-how from the private company during the term of BOT contract, and APUA staff are currently performing O&M by themselves. Therefore, APUA is not considering outsourcing O&M. Raw water quality is maintained because the quality of the treated water is not affected even though the turbidity of SDI is not measured. The treated water quality is measured every two hours for residual chlorine. Other items are checked at the APUA laboratory once a day. Concentrated salt water (brine) from the desalination process is discharged untreated into public waters, but there are no beach or fishing grounds in the neighborhood, no claims have been filed, and no effects on marine organisms have been reported so far.

Spare parts and other items required for maintenance are procured through CWT (Caribbean Water Treatment Ltd), which is based in Antigua as described in Section 2, and installation and product operation guidance are provided by the company. In addition, they do not have a dedicated contract, but are responding to requests from APUA on a case-by-case basis.

A SCADA system for monitoring and controlling of the facilities has not yet been installed, but is scheduled to be installed within the next six months. In terms of facility information management, in APUA, the Planning Department records and manages information on major facilities and pipelines using ArcGIS, but updating information is becoming a problem. Cloud-based Q-GIS is also being used, and the use of ICT is progressing in that it can be accessed on demand without having to select a location (Figure 4-14).

Source: APUA provided

Figure 4-14 Cloud Q-GIS system of APUA

Disaster management is headed by the manager of each department, who is working with the National Office of Disaster Services (NODS) and others to develop a hurricane disaster management manual. Although the water supply facilities have not been severely damaged in the past, backup power supply (power generator) is not yet in place, and water supply may be interrupted due to power outages in the event of natural disasters.

(2) Water quality management

Drinking water quality standards are in accordance with WHO standards. The only accredited water quality testing laboratory is the Ministry of Health laboratory, and APUA's laboratory is positioned as an internal control. On the other hand, the laboratory is currently undergoing accreditation procedures, and once accredited, it is expected to be able to accept water quality analysis orders from the private sector. Water quality tests are performed daily on six parameters (pH, turbidity, electrical conductivity, iron, residual chlorine, etc.) and biological tests (E. coli and general bacteria) as needed.

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

The NRW rate of the water supply systems managed by APUA is estimated to be over 50%. The main pipe material is ductile iron (DI), but the majority of the pipeline network, which has been expanded without renewal until now, is about 50 years old, resulting in frequent water leaks due to aging. As a result of increasing the water supply capacity, the water pressure in the network has increased and the amount of water leakage has also increased. Illegal connections by some farmers have also become a problem.

While the installation rate of water meters is 98% of the total, 25% of them have malfunctioned due to sedimentation and scale formation in the pipes, etc., making it impossible to accurately measure the amount of water billed and only the minimum rates can be charged. The water meters are mainly made in China, and often fail within 2-3 years, and the current stock is approximately 2,000 meters.

(4) Water rate and collection status

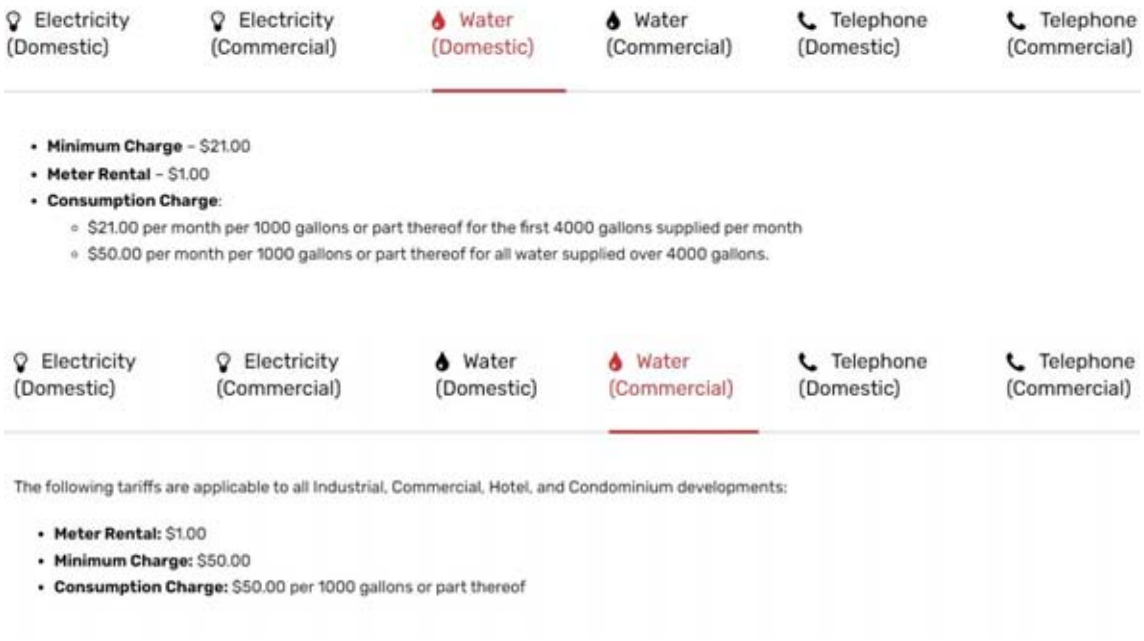
Figure 4-15 shows the current water tariff table of APUA. Based on the table, the water rate per 20 m^3 for domestic use is calculated as 104.95 XCD, which is the highest among the countries surveyed (see Section 2.3.2 for comparisons between countries). There are three categories of water tariffs by use: domestic, commercial, and public, which is not listed in the tariff table. The billing rate consists of a metered charge based on consumption plus a rental fee of 1 XCD/month for the water meter. The rate is not set for sewerage because the sewerage facilities are not yet developed.

When water rates are changed, APUA proposes the change to the Cabinet Government and the Cabinet approves the change. The last water rate increase dates back to 1992. The change in water rates is a political issue, and the policy that everyone should have access

to water services has not been realized. Therefore, the Cabinet do not allow the rate increase.

On the other hand, the source of water used has shifted from surface water to groundwater, but in recent years, approximately 95% depends on desalination, resulting in the cost increase for water production. In the "Antigua and Barbuda Roadmap to Improve Water and Energy Services" carried out in 2016 with the support of the World Bank, the tariff study for the water, electricity, and telecommunications sectors, in which APUA operates, was conducted and recommended an increase in tariffs. The Government decided that further financial burdens could not be overlooked, and in March 2024, the commercial water rate was increased from 50 XCD to 60XCD for 1,000 imperial gallons.

In addition, APUA has 150 public standpipes, and water rates are to be borne by the Government. However, the payments for these standpipes are suspended.



Source: APUA's website
Note: In March 2024, commercial water rates were revised from 50 XCD to 60 XCD per 1,000 imperial gallons.

Figure 4-15 APUA Water Rates

(5) Status of customer management

As for the breakdown of customer complaints, 50% received complaints about water supply time, 30% about water pressure, 10% about taste and color, and 10% about others, and the majority of complaints are about water supply time.

While the installation rate of water meters is 98% of the total, 25% of them have malfunctioned due to sedimentation and scale formation in the pipes, etc., making it impossible to accurately measure the amount of water billed and only the minimum rates can be charged. The shortage of manpower is also serious, for example, one person is

constantly driven to repair the meter. Instead of APUA paying for the maintenance and upgrading of water meters, they collect 1 XCD per month from the customers as a rental fee for the water meters, along with the water charges.

4.4.4 Technical training system

(1) Implementation of internal training

APUA has a training department where seminars and workshops are held. In addition to internal training, external trainers are sometimes invited. In the past, Seven Seas Water Group Company of Florida, U.S.A. held a seminar on products in the field of desalination. The online sharing platform for training materials is used, and the trainers distribute the materials on the platform and test the employees.

However, on-site technical training has not been provided. APUA deals not only with water supply but also with electric and telecommunications, which makes it difficult to find trainers who can provide comprehensive training in a wide range of technological fields. In addition, trainees who receive the training in Japan have not had the opportunity to report on the content of their training in Japan.

(2) Implementation of external training

Seminars based on the U.S. Certification Program are offered by CAWASA as a three-month program every two years, but they are technical in nature and do not include hands-on training in the field. Therefore, the need for practical training is high. CAWASA distributes U.S. training materials related to this program and rarely conducts seminars. There is no special support from CWWA for training.

(3) Knowledge sharing among other countries

APUA believes that it is difficult to share knowledge between multiple countries because the dispatch cost must be accompanied between normal operations.

4.4.5 Trends in the private sector

(1) Privatization of business

At present, APUA has not been privatized, but the water supply business is not in a good financial condition, and the development of some desalination plant is being advanced by the private finance initiative. For example, the Crabbs Desalination Plant was built under a 12-year partnership contract (BOT) with a private company, and transferred to APUA at the end of the contract. A similar partnership contract was signed with Seven Seas Water Group in March 2024, and the expansion and subsequent O&M of the desalination plants are planned, and it can be said that there are many cases of public-private cooperation among the surveyed countries.

(2) Major private company

CWT, described in Section 4.4.3, is involved not only in APUA, but also in EPC[14] of water supply and sewerage facilities, including desalination plants, in Caribbean countries. In addition to the construction of plants, it is also involved in the subsequent repair, supply of spare parts, consultancy, and operation of facilities. However, the company does not cover civil construction, for which it is necessary to conclude separate contracts and cooperate with other companies.

The products handled by the company are mainly Allen-Bradley in the United States and Schneider Electric products in France, but when desalination units were provided by JICS, there was a direct contact from a Japanese company, and it is thought that it could be the agent of a Japanese company in the same way in the future project.

(3) Barriers to the implementation of private-sector projects

When we interviewed CWT about the challenges they face when conducting business in the Caribbean, they cited political instability. As an example, CWT was awarded a long-term contract to construct and operate a facility in Anguilla, and had been operating the facility for three years when a change in government resulted in the termination of the contract and the water utility contracted with another company.

Based on this experience, the company considers Public Private Partnerships (PPPs) to be risky because they are easily influenced by politics. Therefore, the Company's intention to enter the market is not high. It seems to prefer OECS countries where it is easy to obtain work permits, even if they are deployed in other countries through the other entry method.

4.4.6 Situation of NRW reduction

(1) NRW reduction plan

The water supply systems are about half a century old and, as mentioned above, are experiencing a high rate of NRW. In response, APUA recognizes the need for an overall system restructuring to achieve a hydraulically efficient water supply system, but no such plan has been formulated at this time.

The Revenue Assurance of Consumer Service Department is responsible for the NRW measures in APUA, and the NRW reduction program is being prepared. The plan includes water pressure optimization, DMA construction, and smart meter implementation.

(2) Implementation of NRW reduction

There are 41 water leakage repair plumbers and 2 water leakage detectors in the organization, and the repair work is mainly based on the water leakage of the exposed

[14] A contract system for the execution of facility construction work as a complete design (Engineering), procurement (Procurement) and construction (Construction) project

pipes and the water leakage report from the customers. The Customer Service Information Center manages the history of water leakage repairs and is currently in the process of connecting to the GIS system.

In addition, the replacement work of faulty water meters is carried out daily by four persons in charge. In addition, there is no outsourcing policy for APUA's NRW reduction activities.

(3) Pilot study of smart meter introduction

As a part of the NRW reduction measures, a pilot area was set up covering 1% of all connected households, and smart meters were installed on a trial basis, resulting in a reduction of the NRW rate from the original 50% to 25%. In response, the APUA has secured self-funding for 8,000 smart meters and is considering applying for financial support for the deployment of a further 16,000 smart meters. Smart meter implementation in APUA is progressing in the OECS countries, with even water tariff collection in place, and NAWASA and CWSA staff have visited APUA in the past to inspect smart meters.

As in Saint Lucia, there have been claims of overcharge (the amount of air is also measured because of the mechanical meter) due to air entrainment in the pipeline caused by frequent water interruptions, and this is one of the factors driving the transition to the smart meter.

4.4.7 Facility development plan

(1) Water demand forecasting

In APUA, only the most recent water demand is estimated, and the long-term water demand forecast is not implemented because there is no urban planning.

(2) Support by other international donors

Only the Ffryes Beach Desalination Plant has been built with donor support in the past. Three units were installed in 2014 with support from the Venezuelan government, and one unit was added in 2020 with support from JICS. APUA also has a track record of obtaining loans from commercial banks for facility construction and renovation projects.

At present, there is no international donor intervention, but APUA operates with internal funding.

(3) Ongoing projects

Currently, the Bethesda Desalination Plant (14,500 m^3/day (3.2 million imperial gallons/day) is being constructed on a self-financing basis and construction is expected to be completed by the end of this year.

In addition, APUA and Seven Seas Water Group signed a 12-year PPP contract in March 2024, and are planning to expand two desalination plants in Ffryes Beach and Ivan

Rodrigues on a BOT basis. This is expected to increase capacity by approximately 13,500 m^3/day (3 million imperial gallons/day). According to interviews with APUA, Ffryes Beach and Ivan Rodrigues are expected to be completed in October 2024 and April 2025, respectively.

(4) Planned projects

A request to donors for financial support for the implementation of smart meters and pipeline rehabilitation is under consideration, and for the latter, APUA is preparing a pipeline rehabilitation plan including a prioritization list for pipeline rehabilitation. Upgrading pipelines requires approximately USD 20 million in total, but currently only USD 4 million in internal funding is available. The interviews with CDB were held in the past. However, nothing has yet been decided. They intend to continue to have opportunities for consultation with many donor organizations. Therefore, the timelines for requests, etc. are still undetermined at this time.

The Department of Environment under the Ministry of Health, Wellness and Environment became the accredited entity, and the concept note was submitted to the GCF in April, 2018, and the updated version of the concept note is expected to be submitted in early May, 2024. According to interviews with the Department of Environment, the content has been changed from the previous concept note; it will include water reuse and the development of water storage tanks for the poor and farmers, but will not include support for APUA, such as the rehabilitation of water distribution pipeline networks and the development of desalination plants.

4.5 Wastewater treatment status

4.5.1 Development status of sewerage system

Antigua and Barbuda does not have a sewerage system (sewers and sewage treatment plants). Although the master plan for sewerage was prepared more than 30 years ago (the exact year is unknown), it has not been updated up to date. There has been no movement towards the full development of the sewerage system, although several studies on the development of the sewerage system have been carried out with the support of other donors.

4.5.2 Pollution status of public water bodies

Although each household is equipped with a septic tank in conjunction with a soak pit for soil infiltration of the effluent, the soil infiltration has not been done properly due to geological conditions, and currently septic tank effluent and untreated gray water are discharged into nearby canals through the roadside drains.

Residents sometimes complain about foul odors caused by sewage flowing through waterways. The point of discharge is the coastal area, but since it is located away from the desalination plant, there is no impact on the water supply system. The situation is similar on the island of Barbuda.

Date: April 2024

Figure 4-16 Water pollution status of waterways and discharge site to St. John's Harbor in Antigua

4.6 Financial position

APUA's externally audited financial statements are submitted to the Ministry of Information Communication Technologies, Utilities and Energy and to the Parliament, but are not available on the website due to lack of public disclosure requirements.

4.6.1 Key financial indicators

Some analyses of profitability and cash flow have been conducted herein using information available online: the FY 2023 income and expenditure projection on APUA business plan 2023-2025; and the FY 2021 income and expenditure projection on the plan 2021-2023.

(1) Profitability

The net profit margin projection for FY 2021 is -13.0%, and the target for FY 2023 is -12.2%; both projections assume a one-year deficit.

(2) Cash flow

Operating cash flow, investing cash flow, and borrowing from the Antigua Commercial Bank (ACB) for both projections are shown in the table below. The projection for each year shows a negative cash flow in total, even when bank borrowings are included.

Table 4-6 APUA Cash Flow Projection

(in XCD)	FY2021	FY2023
Operating cash flow	△11,440,958	△13,074,009
Investing cash flow	△56,730,000	△56,410,050
ACB borrowing	12,390,000	16,870,842
Cash flow in total	△55,780,958	△52,613,217

Source: Created by the survey team using the Budget Estimate 2021 and 2023 by the Government of Antigua and Barbuda

The analyses above indicate that APUA has been chronically in deficit and facing a negative cash flow such that its water revenues are considered insufficient to cover requisite expenditures and investments. It can be assumed that APUA's ongoing water services are on a schedule where financial support from the government is essential to offset the deficit and cash shortfall.

4.6.2 Financing and investment plans

APUA's business plan is titled for a three-year period but includes financial data projections for only one subsequent fiscal year, which means that it does not constitute a medium- to long-term financial or investment plan.