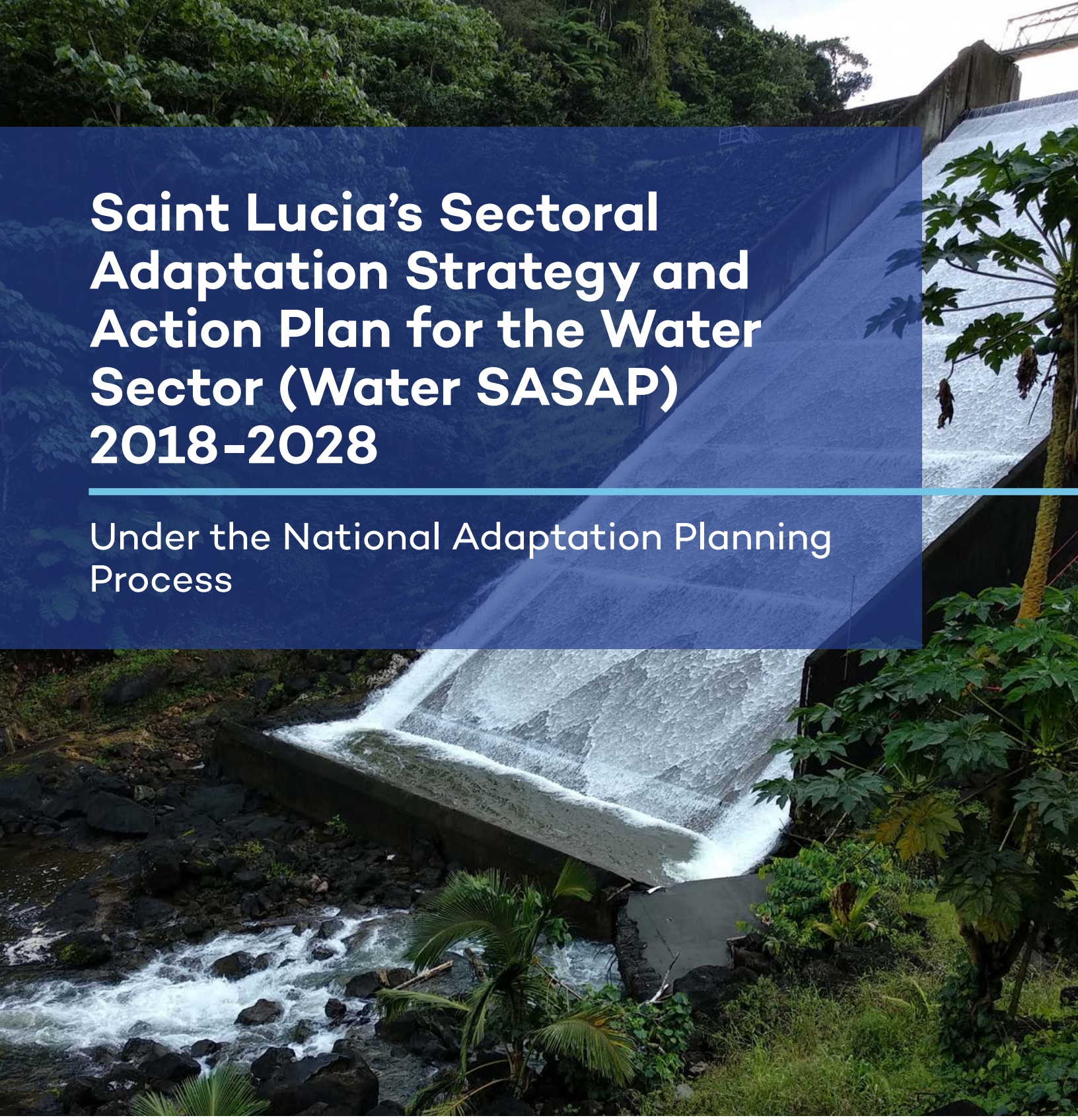

Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028

Under the National Adaptation Planning Process

Japan-Caribbean Climate Change Partnership

From the People of Japan

UNDP

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

Prepared under the guidance of:
Department of Sustainable Development; and,
Department of Agriculture, Fisheries, Natural Resources and Cooperatives

With the support of:
Government of Japan, through the United Nations Development Programme's Japan-Caribbean Climate Change Partnership (UNDP J-CCCP)

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Saint Lucia National Adaptation Plan logo by Alexandra Grant.

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Foreword

Saint Lucia's National Adaptation Plan (NAP) has been defined as a ten (10)-year process (2018-2028), consisting of priority cross-sectoral and sectoral adaptation measures for eight key sectors/areas and a segment on the 'limits to adaptation', complemented, incrementally, with Sectoral Adaptation Strategies & Action Plans (SASAPs). Priority sectors for adaptation action include: Tourism; Water; Agriculture; Fisheries; Infrastructure and spatial planning; Natural resource management (terrestrial, coastal and marine); Education; and Health. Other key sectors will be identified through a cyclical, iterative NAP process.

Saint Lucia's NAP process is spearheaded by the Sustainable Development and Environment Division (SDED) of the Department of Sustainable Development, currently housed within the Ministry of Education, Innovation, Gender Relations and Sustainable Development. The NAP process has benefitted from the inputs of multiple stakeholders, comprising public, statutory, academic and private sector bodies. Indeed, this process has involved State and non-State actors, such as media personnel, who play an important role in helping efforts to positively influence thinking, mould outcomes, change behaviour and instigate action across the populace, at all levels.

Saint Lucia's overarching NAP continues to be supplemented by several documents:

- *Saint Lucia's National Adaptation Plan Stocktaking, Climate Risk and Vulnerability Assessment Report*
- *Saint Lucia's National Adaptation Plan Roadmap and Capacity Development Plan 2018-2028*
- *Saint Lucia's Climate Change Communications Strategy*
- *Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028*
- *Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Agriculture Sector (Agriculture SASAP) 2018-2028*
- *Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Fisheries Sector (Fisheries SASAP) 2018-2028*
- *Saint Lucia's Portfolio of Project Concept Notes for the Water Sector 2018-2028*
- *Saint Lucia's Portfolio of Project Concept Notes for the Agriculture Sector 2018-2028*
- *Saint Lucia's Portfolio of Project Concept Notes for the Fisheries Sector 2018-2028*
- *Monitoring and Evaluation Plan of Saint Lucia's National Adaptation Planning Process*
- *Guidelines for the Development of Sectoral Adaptation Strategies and Action Plans: Saint Lucia's experience under its national adaptation planning process*

This process also supported a climate change website, an animated video and training for government entities and journalists in communicating about climate change. A NAP Assembly and Donor Symposium were also all made possible under this process, through the support of several entities.

Specifically, the process has benefited from the financial support of the United Nations Development Programme's (UNDP) Japan- Caribbean Climate Change Partnership (JCCCP). Technical and financial support for Saint Lucia's NAP process has also been provided through the United States (U.S.) In-Country NAP Support Programme (NAP-SP), implemented by the International Institute for

Sustainable Development (IISD). Technical support for the chapter on the 'limits to adaptation' in the NAP was provided under the IMPACT project, funded by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), as part of the International Climate Initiative (IKI). The IMPACT project is jointly implemented by Climate Analytics, the Caribbean Community Climate Change Centre (CCCCC), Secretariat of the Pacific Regional Environment Programme (SPREP) and Charles and Associates (CAA) Inc. The Department extends its thanks to all of the foregoing and takes this opportunity to recognise the consultant, Ms. Clara Ariza, for her tireless efforts in Saint Lucia's NAP process, under the able guidance of SDED.

Saint Lucia looks forward to forging partnerships and alliances that will assist in developing additional SASAPs and implementing the measures, programmes, projects and activities outlined in its NAP, SASAPs and other support documents. Saint Lucia is prepared to welcome support, that is, finance, technology transfer and capacity building, from a variety of sources, including public, private, bilateral, multilateral and alternative sources, all in an effort to help the country build climate resilience and address the seemingly insurmountable phenomenon of climate change.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF BOXES

EXECUTIVE SUMMARY

Water is essential for life on Earth and is inextricably linked to development. Water supports ecosystems, human needs, traditional livelihoods and industrial and economic activities. However, unsustainable development pressures and climate change threaten the availability and quality of freshwater resources and have the potential to jeopardise hard-won development gains and the prospects of future economic growth in vulnerable countries.

Due to the cross-cutting nature of water, water-mediated climate change impacts are expected to affect, directly and indirectly, all development sectors in Saint Lucia, with serious implications for the island's population and economy. Through changes in temperature and in the amount, predictability and intensity of rainfall, climate change imperils the availability and provision of freshwater for domestic purposes, industry, agriculture, tourism, human health and even financial services. Flooding could increase the incidence of water and vector-borne diseases (such as dengue), and malnutrition could increase due to water-related impacts on food production. Further, stronger seasonal rains and hurricanes, more frequent landslides, flooding and coastal erosion will test the resilience of the island's infrastructure, livelihoods and emergency response systems. In consequence, securing the country's economic growth and development in the near, middle and long-term requires not only a good understanding of existing and emerging water-related challenges and of their common and cascading effects across sectors, but of the collaboration of all relevant stakeholders in strategically planning and implementing urgent actions to build climate resilience in the water sector. Of key relevance are actions geared towards protecting the integrity of freshwater resources, ensuring adequate water supply and protecting lives, health and property.

The Government of Saint Lucia recognises the challenges that climate change poses to its population, natural resources and economy, and has taken considerable measures to identify and address, to the extent possible, current and future climate risks at the policy and operational levels.

In 2017, the process to facilitate the integration of climate change adaptation considerations into all relevant policies and programmes and into development planning gained impetus through focused efforts on Saint Lucia's National Adaptation Planning (NAP) process. Through the NAP process, initiatives to address critical climate change-related risks and development priorities will take place in an integrated and coordinated manner, utilising existing and future synergies.

Saint Lucia's NAP has been defined as a 10-year process consisting of key cross-sectoral and sectoral adaptation activities outlined in the NAP document and complemented with Sectoral Adaptation Strategies and Action Plans (SASAPs), which detail adaptation objectives and priority measures, propose activities and timing for the execution of the measures, and offer project concept notes for implementation.

Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028, here presented, is the first of the NAP's SASAPs targeted in 2017* and has been designed on a similar ten-year framework for action to reduce water-related risks induced by climate change and

* In 2015, a National Adaptation Strategy and Action Plan for the Tourism Sector[16] was developed.

climate variability in Saint Lucia and to build capacities of relevant actors for ensuring the sustainable management of water resources and services under current and future climatic conditions. The Water SASAP, funded with the support of the United Nations Development Programme's (UNDP) Japan-Caribbean Climate Change Partnership (J-CCCP), builds on previous efforts and projects, and is the product of an in-depth contextual analysis and search for potential effective solutions to the country's water-related challenges under a changing climate, supported by a multi-stakeholder consultative process.

The Water SASAP consists of 70 adaptation measures deemed critical for improving water resource and service management and reducing water-mediated climate change impacts in the country. The measures, endorsed by relevant stakeholders, offer solutions to information, technical, institutional, financial, regulatory and policy limitations hampering adaptation in the water sector. In the SASAP, the adaptation measures are grouped under 13 strategic objectives and contribute to four major expected outcomes, namely:

Outcome 1. Enhanced enabling environment and improved behaviour 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. Minimise water-related climate change risks by adopting ecosystem-based adaptation solutions
3. Promote climate resilient business development

The SASAP provides direction on implementation and funding. Funding is expected to be derived from both national and international sources and implementation is expected to mostly occur through the inclusion and execution of SASAP components and adaptation measures in individual, national and regional development and climate change-focused projects and programmes. The SASAP integrates indicative outputs to facilitate the planning and design of such projects. To further provide support (finance, capacity building and technology transfer), the document is complemented with various project concept notes, all aligned with the outcomes, objectives and measures defined in the SASAP.

It is expected that the Water SASAP offers guidance to decision-making processes related to development and climate change adaptation in Saint Lucia's water sector. It targets policy makers and managers in the water resource and services sector. However, it is highly recommended that during the SASAP's execution, efforts are made to coordinate, and collaborate on, actions which directly or indirectly involve water and are undertaken in other sectors, by other organisations and across different scales. This will allow for synergies and will increase cross-sectoral adaptation benefits and accelerate adaptation action. It will also permit identifying and preventing potential detrimental effects that development actions in other sectors could have on water resources under a changing climate.

ACRONYMS

AMR	Automated Meter Reading
AR5	Fifth Assessment Report
ASYCUDA	Automated System for Customs Data
AUSAID	Australian Agency for International Development
BOD	Biochemical Oxygen Demand
BRCCC	Building Regional Climate Capacity in the Caribbean
CADM	Caribbean Disaster Management Project
CAM	Comprehensive Asset Management
CARICOM	Caribbean Community and Common Market
CARPHA	Caribbean Public Health Agency
CBO	Community-based Organisation
CCAP	Climate Change Adaptation Policy
5Cs	Caribbean Community Climate Change Centre
CCC	Castries City Council
CDB	Caribbean Development Bank
CDEMA	Caribbean Disaster Emergency Management Agency
CEC	Community Enterprise Centres
CEHI	Caribbean Environmental Health Institute
CIMH	Caribbean Institute for Meteorology and Hydrology
COD	Chemical Oxygen Demand
CRA	Climate Resilient Agriculture
CSO	Civil Society Organisation
DMAs	District Metered Areas
DoA	Department of Agriculture, Fisheries, Natural Resources and Co-operatives
DOS	Disk Operating System
DSD	Department of Sustainable Development
DVRP	Disaster Reduction Vulnerability Project
EbA	Ecosystem-based Adaptation
EHD	Environmental Health Department
EIA	Environmental Impact Assessment
ENSO	El Niño Southern Oscillation
FEWS	Flood Early Warning Systems
FS	Faecal Sludge
FSTP	Faecal Sludge Treatment Plant
GCF	Green Climate Fund
GCM	Global Circulation Model
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information Systems
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoSL	Government of Saint Lucia
GWP	Global Water Partnership
IICA	Inter-American Institute for Cooperation on Agriculture

INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IRD	French Institute for Development Research
IWECO	Integrating Water, Land and Ecosystems Management in Caribbean Small Island Developing States Project
IWO	Industrial Wastewater Ordinance
IWRM	Integrated Water Resources Management
J-CCCP	Japan-Caribbean Climate Change Partnership
JICA	Japan International Cooperation Agency
KAP	Knowledge, Attitude and Practice
MoA	Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Cooperatives
MoED	Ministry of Economic Development, Housing, Urban Renewal, Transport and Civil Aviation
MoEdu	Ministry of Education, Innovation, Gender Relations and Sustainable Development
MoH	Ministry of Health and Wellness
MoI	Ministry of Infrastructure, Port, Energy and Labour
MTDG	Medium Term Development Goals
NAP	National Adaptation Plan
NCA	National Conservation Authority
NCCC	National Climate Change Committee
NEMO	National Emergency Management Organisation
NEMS	National Environmental Management Strategy
NEP	National Environmental Policy
NGO	Non-Governmental Organisation
NRW	Non-Revenue Water
NURC	National Utilities Regulatory Commission
OECS	Organisation of Eastern Caribbean States
OMM	Operations and Maintenance Management
PPCR	Pilot Programme for Climate Resilience
RCM	Regional Climate Model
RWH	Rain Water Harvesting
SASAP	Sectoral Adaptation Strategy and Action Plan
SCFM	Sustainable Coral Fisheries Management
SIDS	Small Island Developing State
SLASPA	Saint Lucia Air and Sea Ports Authority
SLBS	Saint Lucia Bureau of Standards
SMM	Sustainable Mangrove Management
SMMA	Soufrière Marine Management Area (or Association)
SPCR	Strategic Programme for Climate Resilience
SRES	Special Report on Emission Scenarios
SWM	Sustainable Watershed Management
TNC	Saint Lucia's Third National Communication to the United Nations Framework Convention on Climate Change
TS	Total Solids

TSS	Total Suspended Solids
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
UWI	University of the West Indies
WASCO	Water and Sewerage Company Inc.
WHO	World Health Organization
WMO	World Meteorological Organization
WMP	Wastewater Master Plan
WRMA	Water Resources Management Agency
WWTP	Wastewater Treatment Plant
XCD	Eastern Caribbean Dollars

1. INTRODUCTION

Water is essential for life on Earth and is inextricably linked to development. Water sustains human health, food production, energy generation, industrial and economic activities and the natural environment, including the ecosystem services upon which societies depend. Water underpins poverty reduction and economic growth. However, development and economic pressures can also affect the quantity, quality, use and governance of water, threatening directly and indirectly the availability of this precious and finite resource. Since 1990, significant gains have been recorded in people's access to improved freshwater and sanitation. Nonetheless, water scarcity currently affects 40 per cent of the world's population[1]; preventable water-related health hazards continue to take thousands of human lives daily; freshwater resources are progressively polluted; and growing populations, industrialisation and trade are increasing the global demand for water, which is expected to increase by 55% by 2050.[2]

Climate change represents an additional cause of concern, as it affects the global hydrological cycle and many of its most visible impacts are mediated through water. These include, among others, changes in precipitation, runoff and streamflow patterns, an increased frequency of intense rainfall events and flooding, and frequent tropical storms, more severe droughts and Sea Level Rise (SLR)[3], all of which exacerbate current vulnerabilities and threaten development gains.

In the context of climate change, balancing the growing water demand and supply gap; ensuring universal access to water and sanitation (Sustainable Development Goal 6); and securing national water resources and services that generate equitable social and economic benefits, are major challenges for governments around the world. Addressing these challenges requires placing water and its management at the core of development and climate policies and ensuring that current and future decisions on investments and actions involving water resources, take climate change considerations into account and are based on careful, informed and strategic sectoral and cross-sectoral planning.

Saint Lucia is highly vulnerable to climate change due to three main conditions: (a) its small geographical area, which accounts for the fact that disasters take on country-wide proportions; (b) its location in an area of volcanic, seismic and cyclone activity; and (c) its dependency on economic sectors that are directly affected by climate variability and change. The vulnerability of the island is expected to increase with time as global temperatures rise, making adaptation to climate change an urgent national priority. Without adaptation, lives and livelihoods will be lost, and climate change could cost the country 12.1% of its Gross Domestic Product (GDP) by 2025, rising to 24.5% by 2050 and 49.1% by 2100.[4] A non-exhaustive list of potential climate change impacts on the country's water sector is presented in **Annex 1**.

The Government of Saint Lucia (GoSL) recognises the challenges that climate change poses to its population, natural resources and economy, and has taken considerable measures to identify and address, to the extent possible, current and future climate risks at the policy and operational level. Today, Saint Lucia has adopted a revised Climate Change Adaptation Policy (CCAP), various sectoral policies that address climate change and a wide range of interventions have been designed or established as adaptation measures; often facilitated or supported by international donors.

2. SAINT LUCIA'S NATIONAL ADAPTATION PLANNING (NAP) PROCESS

The NAP is a new and major government effort to facilitate the integration of climate change adaptation considerations into all relevant policies and programmes and into development planning. Through the NAP process, initiatives to address critical climate change-related risks and development priorities will take place in an integrated and coordinated manner, utilising existing and future synergies. Saint Lucia's NAP has been defined as a 10-year process, consisting of priority cross-sectoral and sectoral adaptation activities outlined in the NAP document and complemented with Sectoral Adaptation Strategies and Action Plans (SASAPs) which detail sectoral adaptation objectives and priority measures, propose activities and timing for the implementation of the measures and offer project concept notes for implementation. The formulation of the NAP and the parallel elaboration of the SASAPs for the water, agriculture and fisheries sectors have entailed consultations and focus group sessions with a multitude of actors.* More details on the NAP process are presented in the NAP document.

3. THE WATER SASAP IN THE FRAMEWORK OF SAINT LUCIA'S NAP

The Water SASAP has been designed as a 10-year framework for action to reduce water-related risks induced by climate change and climate variability in Saint Lucia, and to build capacities of relevant actors for facilitating the sustainable management of water resources and the adequate supply of water and wastewater services under current and future conditions. The Water SASAP forms part of Saint Lucia's wider policy response to climate change, builds on previous efforts and projects and is the product of a highly consultative process which gained impetus in May 2017.

The overarching goal of the Sectoral Adaptation Strategy and Action Plan for the Water Sector is *to drive the implementation of effective adaptation actions across all sectors and at all levels of society for safeguarding Saint Lucia's water resources and services under a changing climate*.

This document presents an overview of the main challenges that climate change poses to water resources and services and their management in Saint Lucia. It offers a series of 70 prioritised water-related adaptation responses (measures) that can be undertaken or at least initiated in the coming 10 years to address the major challenges identified. With the aim of attracting support (finance, capacity building and technology), various stand-alone project concept notes directly related to the SASAP's adaptation measures are included. In the SASAP, the measures respond to 13 strategic objectives and 4 major outcomes, all aligned with the CCAP's implementation elements (facilitation, implementation and financing).

* In 2015, the GoSL developed an Impact Assessment and National Adaptation Strategy and Action Plan for the Tourism Sector.

3.1. TARGET AUDIENCE

The Water SASAP will offer guidance to decision-making processes related to climate change adaptation in Saint Lucia's water sector during the next 10 years. This includes, among others, decisions on investments and activities for the reliable supply of safe and affordable water for human consumption and industry; improving sanitation services; extending, protecting, managing and financing water and sanitation infrastructure; promoting and implementing integrated watershed management schemes; appropriately valuing water; reusing wastewater; reducing vulnerability to water-related disasters and water-associated health concerns; exploring and developing new water sources; and improving water governance in the country.

This SASAP targets policy makers and managers in the water resource and services sector. However, it is highly recommended that during the SASAP's execution, attempts are made to coordinate effort and collaborate on actions which directly or indirectly involve water, but are undertaken in other sectors, by other organisations and across different scales. This will allow for synergies, increasing cross-sectoral adaptation benefits and accelerating adaptation action. It will also permit identifying and preventing potential detrimental effects that actions in the water sector could have on other sectors or the effects actions in other sectors could have on water resources under a changing climate. The parallel preparation of the water, the agriculture and the fisheries SASAPs* has provided a first opportunity for cross-sectoral coordination in adaptation. As a result, these SASAPs share some measures that were identified as common priorities among these sectors. It is expected that this same approach will be followed in the development of the remaining SASAPs.

3.2. SCOPE OF THE SASAP

Saint Lucia's Water SASAP has been designed to:

- Include investment priorities that contribute to the SASAP's overarching goal of safeguarding Saint Lucia's water resources and services under a changing climate.
- Ensure all adaptation priorities have been defined through a transparent consultation process with the participation of national stakeholders.
- Be implementable by encompassing programmes and projects that are within the implementation and monitoring capacity of the GoSL.
- Be led (implemented and monitored) by identified and committed national institutions.
- Be aligned with national policy and complementary to existing baseline or planned initiatives to minimise duplication and increase efficiency.
- Be composed of climate smart investments that can be funded with public resources or through international funding mechanisms. Given the difficulty of consistently monitoring investments by the private sector, Non-Governmental Organisations (NGOs) and Civil Society Organisations (CSOs), such investments are not included in the SASAP. Nevertheless, the

* The Agriculture and Fisheries SASAPs have been prepared with the support of the United States In-Country NAP Support Programme through the NAP Global Network, implemented through the International Institute for Sustainable Development (IISD).

SASAP promotes projects and programmes that catalyse private-sector investments and increase private-sector participation.

4. METHODOLOGICAL APPROACH AND SASAP FORMULATION PROCESS

The development of this Strategy and Action Plan started after the water sector was ranked as the most urgent among all development sectors for the elaboration of a SASAP in the framework of Saint Lucia's 2018-2028 NAP cycle. Among the key criteria that led to this ranking were its national significance, the repercussions of non-action and the cross-sectoral nature of water. The prioritisation of sectors for SASAP development took place during a process of cross-sectoral and multi-stakeholder NAP consultation held in 2017.

The formulation of Saint Lucia's Water SASAP followed an inclusive, participative and interactive approach. It was possible as a result of the collaboration and inputs of the Water Resources Management Agency (WRMA), the institution with the legal mandate to ensure the management of water resources in the country, the Department of Forestry, in charge of watershed management and the Water and Sewerage Company Inc. (WASCO), responsible for the provision of potable water and sanitation services. It also had the support of the Department of Sustainable Development (DSD), which leads the coordination of climate change adaptation efforts in Saint Lucia (climate change focal point) and used inputs received from a broad range of stakeholders, inclusive of the multi-sectoral National Climate Change Committee (NCCC).

The steps followed in the elaboration of Saint Lucia's Water SASAP included:

1. **Review of development, water and climate change related documentation,** including policies, plans, strategies, legislation, academic studies and project reports.

2. **Identification of key adaptation measures,** through the rigorous review of relevant national documentation, including, but not restricted to, the CCAP, the Second and Third National Communications to the United Nations Framework Convention on Climate Change (UNFCCC) (2012 and 2017, respectively), the State of the Environment Report (2015) and the Impact Assessment and National Adaptation Strategy and Action Plan to Address Climate Change in the Tourism Sector of Saint Lucia (2015). An initial list of climate adaptation measures identified as critical for Saint Lucia's water sector, was compiled. While some international climate change adaptation and water sources were reviewed, the list of measures extracted from the national sources was deemed comprehensive and contextualised and thus, no additional measures were included. The identified measures encompass technical solutions to current and future water-related challenges, as well as actions to close key knowledge, information, technology and policy gaps that hinder the implementation of solutions to climate change issues in the country's water sector. Some of the adaptation measures presented also offer mitigation co-benefits. This is aligned with, and promoted by, the CCAP. Also, in alignment with the CCAP, the identified measures were classified into facilitation, implementation and financing categories.

3. **Prioritisation of adaptation measures.** The initial set of measures was presented to, refined and ranked by participants from various ministries, the private sector and CSOs, using a multi-criteria approach, during broad-based consultations that took place in 2017. At this meeting, the participants split into mixed groups, and each group scored from 1 (low) to 5 (high), the level of implementation priority (urgency) of each adaptation measure according to three of the following 12 agreed criteria.

Ranking criteria:

1. Relevance and alignment with national and sectoral policies, strategies, plans and legislation
2. Upfront cost of the technologies
3. Implementing, operational and maintenance cost
4. Effectiveness and impact
5. Ease of implementation /feasibility
6. Social acceptability
7. Institutional capacity
8. Size of beneficiary group(s)
9. Potential environmental risks
10. Synergies with other initiatives
11. Sustainability
12. Scalability and replicability

It is worth noting that a weighting of 0.1 (least important) to 1.0 (very important) was attached to each criterion. Using an excel tool developed by the Department of Sustainable Development, the final score of each adaptation measure was calculated by adding the total scores of the 12 criteria (obtained by multiplying the weighting of each criterion by the score assigned by the group in charge). The excel tool then categorised the final scores into 3 groups that determined whether the implementation of each adaptation measure should start in the short-term (2018-2021), medium-term (2021-2024) or long-term (2024-2028), where short-term represents the most urgent.

Meetings with representatives of WASCO, the Forestry Department and WRMA were held after the broad-based consultation to finalise the wording of the adaptation measures, to incorporate all comments received from the participants, and to clarify any inconsistencies. The final list of ranked adaptation measures was used to prepare the Water SASAP (**Section 10**).

4. **Preparation of the Project Concept Notes.** During the broad-based consultation, participants were also invited to submit concept notes of proposals relevant to the adaptation measures discussed and scored. The concept notes received were reviewed, those deemed to be aligned to, and fundable under, the SASAP were further developed and when appropriate merged. The final set of concept notes prepared to date, is presented in **Section 11.**

5. **Formulation of the Water SASAP and preparation of the first draft SASAP document.** The overarching goal and main outcomes of the SASAP were established based on the review and discussion with stakeholders of the major adaptation needs in Saint Lucia's water and water-

dependent sectors. The strategic objectives were also identified, and each adaptation measure included under the most relevant strategic objective. Based on the discussions held, and on solutions presented in previous reports to the specific challenges addressed in the SASAP, activities with potential outputs associated with the prioritised adaptation measures were integrated into the document. The first draft of the Water SASAP was finalised and shared with stakeholders for review in advance of a focused group session to discuss the same. During the validation process of the first draft NAP document, participants also had the opportunity to comment and together, further refine the Water SASAP's main outcomes, strategic objectives and prioritised measures.

6. **Preparation of the second and final versions of the final Water SASAP document.** The second version of the Water SASAP document integrated the comments received during the SASAP and NAP validation workshops and was submitted to all the stakeholders consulted for final comments. These were integrated into the final version of the Water SASAP.

5. GENDER CONSIDERATIONS

The UNFCCC calls for the mainstreaming of gender across all activities involved in the NAP process, with the aim of decreasing gender-based vulnerabilities, promoting gender equality in decision-making and ensuring that the implementation of adaptation measures does not impose additional burden to women in particular, and does not promote the domination of any gender over others. At the same time, the NAP is an inclusive process, which places special attention on increasing the adaptive capacity of vulnerable groups for the planning and implementation of policy and actions to deliver resilience benefits across all levels of society. It is worth noting that in 2010, 40% of Saint Lucian households were headed by women and unemployment was about 7% higher in women than men.[5] However, this gap decreased to 4% in 2012[6], while the participation of women in the labour force increased from 45% to 47% and that of men decreased from 54% to 52%. Women in the country enjoy equal access to services such as education (Education Act of 1999) and although the level of public representation is not yet equal to men, it is growing. In Saint Lucia, some livelihood activities, such as fishing in the open sea, are by choice, dominated by men, which is culturally acceptable.

In Saint Lucia, poverty, age, and level of education achieved appear to be greater drivers of vulnerability than gender, but more research may be needed. The Minister of Education, Innovation, Gender Relations and Sustainable Development stated in early 2018 that a Gender Policy will be developed in the near future. While this is not specific to climate change, it is expected that the latter will be given due consideration. In addition, as in other Caribbean SIDS, the participation of women in politics and civil service has increased in the past years. Currently, four out of the 10 ministries in the country are headed by female Ministers. There are six female Permanent Secretaries (two in one Ministry) and seven Deputy Permanent Secretaries. It is important to note that among the Ministries headed by women Ministers, are the Ministry of Equity, Social Justice, Empowerment, Culture, Sports and Local Government and the Ministry of Health and Wellness. It can well be said that the responsibility of leading climate change-related policy falls mostly on women: the NAP process has been initiated under the leadership of the SDED of the DSD, housed under the Ministry of Education, Innovation, Gender Relations and Sustainable Development, where the Minister, the Permanent and

Deputy Permanent Secretary, the Chief of Department, the Deputy Chief of Department, the Chief Technical Officer and 9 out of 10 of the Division's technical officers are female. Incidentally, the Lead Climate Change Negotiator for Saint Lucia, who also serves as Thematic Coordinator for Loss and Damage for the Alliance of Small Island States (AOSIS) under the UNFCCC; and the SIDS representative on the Executive Committee of the Warsaw International Mechanism for Loss and Damage, is a Saint Lucian female based within the Division.

In this context, and to foster equality in adaptation benefits, Saint Lucia's NAP and associated SASAPs focus their attention on vulnerable groups, and although gender-disaggregated information will be collected and assessed, the NAP and SASAPs include activities focussing on women and men based on other vulnerabilities.

6. SAINT LUCIA'S WATER SECTOR

Saint Lucia's volcanic geology with rugged topography, steep terrains and impermeable rocks, results in most of the rainfall flowing to the sea, with very little opportunity for ground water storage. The country's freshwater resources are derived mainly from rivers, wetlands, streams and springs. Altogether, there are 37 watersheds, of which Roseau is the most significant. The John Compton Dam and the Millet Reservoir development serve the northern half of the country and together, have a total capacity of 3,182 M litres. Water production is ~18.9 M cubic metres per year; however, this figure is actually closer to 16.55 M cubic metres per year, due to water losses in the distribution. Dry season water production is estimated to be up to 25% less than during the wet season. Saint Lucia also has other natural and constructed wetlands used for irrigation and aquaculture ponds, as well as sewage treatment ponds. Although many of the island's wetlands are not used for freshwater extraction, they act as filters of sediment and pollutants, and contribute to maintaining water quality. Fresh groundwater resources are very limited and are used primarily for irrigation.[7]

WATER CONSUMPTION

A rapidly increasing population and growing tourism sector during the last decades have resulted in significant increases in surface water withdrawal and consumption.[8]

Domestic garden crop irrigation, together with in-household water use for cooking, showering and washing, has made the domestic sector the largest consumer of water in Saint Lucia; accounting for 57% of all water used. The hotel sector consumes 17% of the water, the commercial sector, 13% and notably, the Government (buildings and staff) consumes 12% (Figure 1).[9,10]

However, it has been reported that Saint Lucia has a 35% water supply deficit[11] and that approximately 42% of the water produced is lost as non-revenue water (NRW) due to, among other factors: leakage on distribution systems, authorised unbilled consumption (e.g. mains flushing, water used for fire-fighting purposes and other operational uses), meter errors, errors in the estimate of unmetered use, and illegal use -e.g. illegal connections.[9]

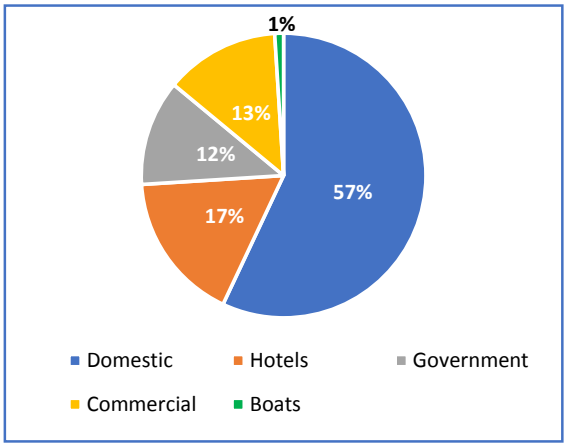

Fig. 1. Water consumption by sector
Source: GoSL, 2017 [9,10]

WATER MANAGEMENT

In Saint Lucia, WRMA is responsible for the protection, control, allocation and use of the country's water resources; the Forestry Department is in charge of watershed management; WASCO, a government-owned company, has the legal mandate of developing and managing water supply and sewerage services to consumers. The creation of the National Utilities Regulatory Commission (NURC), a multi-sector, independent, regulatory body for the water and electricity sectors, was approved by Parliament in 2016. The NURC is the authority responsible for ensuring the economic and technical regulation of utility supply services; establishing, approving, monitoring and reviewing tariff schemes and tariffs; monitoring and ensuring compliance with standards; promoting the economic regulation of utility supply services; ensuring the protection of the interest of consumers in relation to the provisions of the utility supply service; promoting competition and monitoring anti-competitive practices in the utility supply service; and reporting to, and advising the Minister with responsibility for Public Utilities on, the economic, financial, legal, technical, environmental and social aspects of the utility supply services sector.[12]

In 2014, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) conducted a fact-finding study on Saint Lucia's non-revenue water.[13] The study showed that WASCO's facilities are staffed by skilled personnel and are well equipped, although they lack institutionalised workflow, efficient response rates and skilled experts -i.e. more engineers. However, the study highlighted that field equipment, such as on-site meters, were either unreliable, partially installed or functioning or all together, doubtful.[13]

To reduce water losses, WASCO has set a NRW reduction strategic plan that encompasses:

1. The development of a Geographic Information System (GIS) and supporting databases which will be the foundation for:
    - Establishing District Metered Areas (DMAs) and,

- Redesigning the system and developing a hydraulic model to facilitate: a) the creation of clear distribution zones; b) pressure management; c) the location of tanks for effective storage and of pumps to reduce power consumption and; d) asset mapping.

2. The establishment of a Comprehensive Asset Management (CAM) system.
3. The establishment of a comprehensive Operations and Maintenance Management (OMM) system, with emphasis on the speedy response to reported leaks, the systematic change of pipes, the rehabilitation of tanks to eliminate overflows and leakage and the implementation of preventative maintenance on pumps, valves, meters, and tanks.
4. The meterisation of all facilities to assess system input flows and flows into the water distribution zones.
5. The change of WASCO's pre- Microsoft Windows (DOS-based) billing system for one more effective and appropriate to the NRW programme.
6. The installation of Automated Meter Reading (AMR) to eliminate human error in meter reading.
7. The monitoring and evaluation of the meterisation process and all relative aspects and, adjustment to ensure that targets are met.
8. The more effective supervision of newly established developments and residential development implementation.

Despite the ongoing inefficiency of the existing infrastructure, WASCO has managed to deliver water to most households and consumers and currently, 87% of Saint Lucia's population has access to pipe borne water for consumption.[14]

WASTEWATER MANAGEMENT

About 90% of households, most hotels and farms rely on on-site sanitation facilities, such as toilets with septic tanks, which are serviced predominantly by private companies, or pit latrines.[14]
Only about 7% of the population (Castries and Gros Islet districts) has access to a public sewer system.[14] Saint Lucia's public service provision and enforcement of safe standards for wastewater are lagging behind the island's capacity to provide water. WASCO is the only national wastewater utility company, yet its wastewater services are limited to the operation of the sewage networks and the sole Wastewater Treatment Plant (WWTP Beausejour); in all, only about 22% of properties are connected to a sewer system on the island. [14]

Due to limited resources for inspection and monitoring, the enforcement of sanitation regulations and the implementation of necessary remedial actions continue to be critical challenges for Saint Lucia as it faces the possible task of institutionalising a national sewage system on par with its water delivery network.[14]

7. CLIMATE CHANGE CONTEXT

As recognised in Saint Lucia's CCAP, and referenced earlier, the country is vulnerable to climate change due to three main conditions: (a) its small geographical area, which accounts for the fact that disasters take on country-wide proportions; (b) its location in one of the highest-risk areas of the planet. These risks include, high volcanic and seismic activity, being situated in the tropical cyclone belts, and direct exposure to the forces of the oceans; and (c) its dependence on few sources of income (the agriculture and tourism sectors) for a substantial part of its GDP. These sources of income have been severely reduced for months on end by single climate-related disasters. Another critical indicator of Saint Lucia's vulnerability, is its limited capacity to reactivate the development process after a devastating weather event.[15]

The cost of inaction on climate change in Saint Lucia has been conservatively calculated to be at 12.1% of GDP by 2025, rising to 24.5% by 2050 and 49.1% by 2100.[4] Recent extreme climate events have highlighted the vulnerability of the island to climate hazards and provided an indication of the additional costs that failing to prepare for climate change could represent to Saint Lucia in the future. For example, the impact of Hurricane Tomas (2010) had a total cost of 43.4% of the island's GDP.[15] It caused a total estimated USD 336 million in damages to housing, infrastructure and economic sectors, mainly agriculture and tourism, and claimed seven lives. Also, in 2013, an unseasonal low-level trough system passed over the island and produced greater than 224 mm of rainfall in a matter of two to three hours. The system impacted 2,600 persons directly, killed 6, destroyed 47 homes and caused USD 89.2 million in damages. Additionally, Saint Lucia has experienced drought conditions each year since 2012, resulting from a decline in both the total annual and temporal distribution of rainfall. The entire island has been periodically placed on water rationing.[9] To facilitate the understanding of the climate challenges Saint Lucia can expect in the coming decades, the following sections present the country's current climate conditions, observed regional climate trends and future climate projections.

7.1. CLIMATE CHANGE PROJECTIONS FOR SAINT LUCIA

Several studies have developed climate change projections for Saint Lucia in recent years.* While using different models, emission scenarios, baseline periods and projection periods**, all projections**

* In the National Adaptation Strategy and Action Plan for the Tourism Sector (2015),[16] the 5Cs and the GoSL present the results of statistical and dynamic downscaling approaches using SRES scenarios (and where possible or available, the IPCC's RCP4.5) for projecting Saint Lucia's temperature and rainfall in the 2031-2040 and 2051-2100 periods relative to the 1961-1990 baseline.

The Third National Communication to the UNFCCC (2016)[9] presents projections of temperature, precipitation and water excess and deficits (P-E) for the 2040-2069 and 2081-2100 periods relative to the 1981-2015 baseline. The projections were obtained using PRECIS-downscaled scenarios of two climate models (HadCM3 and ECHAM5) and one SRES scenario.

In 2012, the CARIBSAVE Partnership published *Climate Change Risk Profile for Saint Lucia,*[17] the most comprehensive climate change projections for Saint Lucia to date. This study generated climate model projections of future scenarios using both a Global Climate Model (GCM) ensemble of 15 models and the Regional Climate Model (RCM), PRECIS downscaled. The RCM was used to provide projections at a finer spatial scale (and thus give a better physical representation of the local climate) than GCMs.

indicate general trends of increasing mean annual temperatures and decreasing precipitation amounts with climate change in Saint Lucia.[9,16,17] For the sake of simplicity, the results of the climate projections produced by CARIBSAVE (2012)[17] for a high emissions scenario (Special Report on Emission Scenarios SRES A2) and relative to the 1979-2009 period, summarised below, indicate that the following could be expected in Saint Lucia:

Mean annual temperature increases in the order of:
0.3 to 0.8 ˚C by 2020; 0.9 to 1.7 ˚C by 2050 and 1.8 to 3.1 ˚C by 2080 (Global Circulation Model GCM).
2.4 to 3.3 ˚C by 2080 (Regional Climate Model RCM).

The frequency of hot days increases between 38 and 54% by 2050 and between 55 and 97% by 2080 (GCM).

The frequency of hot nights increases between 38 and 67% by 2050 and between 55 and 97% by 2080 (GCM).

Cold days and cold nights do not occur at all by 2050 and 2080 according to the Global Circulation (GCM) models.

Annual precipitation decreases in the order of:
-15 to 4mm by 2020; -19 to 4mm by 2050 and -37 to 6mm by 2080 (GCM).
-11% to -32% by 2080 (RCM).

Sea Surface Temperature increases by 0.8 to 3˚C by 2080s (GCM).

Wind speed increases by 2080 by up to 0.5 m/s (GCM); by up to 0.7 m/s (RCM)

The number of sunshine hours per day increases by roughly one hour by 2080 (RCM) due to a reduction in average cloud fraction.

Tropical storms and hurricanes become more intense, but not necessarily more frequent. North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in sea surface temperatures indicate potential for continuing increases in hurricane activity and model projections indicate that this may occur through increases in intensity of events, but not necessarily through increases in frequency of storms.

The proportion of total rainfall that falls in heavy events decreases, changing by -25% to +2% by the 2080s (GCM).

The rate of **sea level rise** is difficult to calculate as new evidence suggests that the contribution of ice sheet melting to global sea level rise will be greater than considered in IPCC projections. This increases

the range of potential mean sea level rise in the Caribbean from 0.18-0.56m (IPCC for an SRES A2 scenario) **to up to 1.45m by 2100,**[18] relative to the 1989-1999 baseline. It has been established that in the northern Caribbean, sea level rise could be 25% higher than the global average due to physical factors affecting land elevation.[19]

The high level of uncertainty in sea level rise and hurricane intensity creates difficulties in estimating future changes in storm surge height or frequency.

7.2. CLIMATE CHANGE IMPLICATIONS FOR SAINT LUCIA'S WATER SECTOR

Water is the primary medium through which climate change manifests. This occurs through changes in the hydrological cycle which directly and indirectly affect the availability, predictability and quality of water resources, and also through impacts caused by climate change-related weather extremes and sea-level rise.

Given the cross-cutting nature of water, water-mediated climate change impacts will directly and indirectly affect all development sectors in Saint Lucia, with serious implications to the island's population and economy. Key climate change concerns for the water sector in the country include:

Reduced freshwater availability: It is expected that global climate change will magnify the current human stressors on freshwater ecosystems, making it even more challenging to restore and protect freshwater resources. Changes in rainfall patterns and increased temperatures will have the most obvious impacts on the island's watersheds. Protracted periods of drought will likely impact all primary river systems, which are already experiencing reduced base flows because of land use change and result in water supply shortages.

Farmers are currently allowed to use river water for irrigation and farming activities, as long as they have an abstraction license. However, under water-related emergencies, farmers may be prohibited from abstracting if potable water supplies are compromised. With drier and warmer conditions brought by climate change, water shortages may affect all activities in the island and result in restrictions imposed on the farmers' use of water. Simultaneously, drier conditions and increased evaporation will likely increase the demand for water to maintain agricultural yields.

In addition, saltwater intrusion into coastal surface waterways, resulting from SLR and exacerbated by storm surges (linked to more intense tropical storms) may affect freshwater availability and increase the salinity of agricultural soils.

Damage to water supply infrastructure: Water intakes, dams and reservoirs may be damaged during hurricanes, and this can result in decreased water supply and quality. During these events, heavy precipitation can result in siltation of river courses and it may take several days before turbidity levels fall to a level that water treatment plants can handle. For example, Hurricane Tomas (2010) made the John Compton Dam inaccessible following landslides, leading many residents to resort to obtaining unsafe water from springs and other water sources.

Flooding may also damage dams and reservoirs or block them with debris, reducing water supply and quality and leading to the suspension of raw water treatment, especially in villages and rural communities. In addition, flooding erodes the topsoil and carries animal waste, pesticides, fertilisers, sewage and garbage, which may then contaminate groundwater sources, as well as marine areas.

Flooding also increases the risk of drainage infrastructure damage, sedimentation and inadequate capacity.

Growing health concerns include, among others: the increasing incidence of water and vector-borne disease outbreaks (such as dengue), especially with flooding brought by more frequent torrential rains; increasing rates of malnutrition due to water-related impacts on food production; and those risks related with the direct impact of hydrometeorological hazards, such as landslides, on people and households.

Increasing risks to the country's built environment and economic activities. Stronger seasonal rains and hurricanes, more frequent landslides, flooding and coastal erosion will test the resilience of the island's built environment, livelihoods and emergency response systems. Climate change-related deviations in the reliability of water supplies and the disruption of power and water services during extreme weather events will affect all economic activities.

In view of the above information, securing Saint Lucia's economic growth and development in the near, medium and long-term requires not only a good understanding of existing and emerging water-related challenges and of their common and cascading effects across sectors, but also the collaboration of all relevant stakeholders in strategically planning and implementing urgent actions to build climate resilience in the water sector. Of key relevance are actions geared towards protecting the integrity of freshwater resources, ensuring adequate water supply and protecting lives, health and property.

8. ENABLING ENVIRONMENT FOR CLIMATE ADAPTATION ACTION IN SAINT LUCIA'S WATER SECTOR

The Water SASAP offers guidance on key investments and capacity building activities (technical, institutional, and regulatory) required for safeguarding water resources and services and reducing the impact of hydrometeorological events under a changing climate. The Water SASAP therefore supports the efforts made by the GoSL to build climate resilience within and across sectors and facilitates the integration of climate change considerations into development projects, programmes and policies of the water and water-related sectors. To achieve this, the Water SASAP has been formulated in alignment with, and in the framework of, the relevant national and sectoral development and climate policy and building on the progress made in, and the lessons learned from, the implementation of adaptation projects in Saint Lucia's water sector.

8.1. NATIONAL DEVELOPMENT, CLIMATE CHANGE AND AGRICULTURE POLICY AND PLANNING FRAMEWORK

Saint Lucia's development agenda is guided by national policy imperatives and instruments, including the country's Medium-Term Development Strategy (MTDS), annual Budget Speeches, Annual Estimates of Expenditure (Budget) and corporate plans of individual ministries.[20,21]

In the field of climate change, the country became a party of the UNFCCC in 1993, submitted its Initial National Communication to the UNFCCC in 2001, its Second National Communication in 2012 and its

Third National Communication in 2017. Saint Lucia also submitted its Intended Nationally Determined Contribution (INDC) under the UNFCCC in 2015 and signed the Paris Agreement in 2016. Considerable progress has been made in the integration of climate change into national policies. Currently, the Saint Lucia CCAP of 2015 is the most important policy and guidance document on the matter at the national level. It is complemented by Saint Lucia's Strategic Programme for Climate Resilience (SPCR) of 2011 and the Climate Change Public Education and Awareness Strategy and Implementation Plan of 2014.

The most important legislation related to water resources in Saint Lucia is the Water and Sewerage Act (revised edition of 2008). However, the GoSL has also formulated a considerable number of additional policies, laws and regulations that relate either directly or indirectly to water resource management, water supply and wastewater management.

Key national development, water and climate policies, legislation and planning instruments for the Water SASAP are listed in **Table 1**.

Table 1. Key Policy, legislation and planning instruments for the SASAP.*

Policies	
• The Saint Lucia CCAP (2015) • National Climate Change Policy and Adaptation Plan (2003) • National Water Policy (2004) • National Wastewater Policy and Strategic Plan (2017, awaiting adoption) • National Environmental Policy & National Environmental Management Strategy (NEP/NEMS) (2005, revised in 2014)	• National Forestry Policy Revised draft (2008) • National Land Policy (2007) - Revised draft (2017, awaiting guidance on the establishment of an implementing mechanism -a National Land Commission- to be finalised before submission to Cabinet for approval) • National Environmental Education Policy Revised draft (2010)
Planning Instruments	
• National Vision Plan (2008) • MTDS (2018-2021, under development) • MTDS (2012-2016) Sectoral Action Plan	• Strategic Programme for Climate Resilience (SPCR) • National Biodiversity Strategy and Action Plan (under review) • Framework for Integrated Environmental Management in Saint Lucia (2005)
Legislation	
• National Utilities Regulatory Commission Act (2016) • Water and Sewerage Act (revision of 2008) Cap 9.03 as amended by the National Utilities Regulatory Commission Act No. 3 (2016) • Water and Sewerage Act (2005) • Water and Sewerage (Water Resource Management) Regulations (2009) • Waste Management Act (2004) • Pesticides and Toxic Chemicals Control Act (2001) • Environmental Management Act (2008) Revised draft (2018) • National Conservation Authority Act (1999) • Physical Development and Planning Act (2001)	• Beach Protection Act (1967 and Amendment of 1987) • Land Conservation and Improvement Act (1992) • Wildlife Protection Act (1980) • Maritime Areas Act (1984) • Fisheries Regulation No.9 (1994) • Fisheries Act No.10 (1984) • Public Health Act Chapter 11.01 (1975 revised in 2001) • Public Health Regulation Act No.22 (1978) • Tourism Incentives Act (2005) • Tourism Industry Development Act (1982) • Disaster Management Act (2006) • Disaster Preparedness and Response Act (2005) • Castries Constituency Council Act No. 1 (2012) • Saint Lucia Civil Code (2004 Amendment)
National Budget	
• Estimates of Revenue and Expenditure (2016-2017)	

* This list is indicative only

8.2. PROGRESS MADE IN THE IMPLEMENTATION OF CLIMATE CHANGE ADAPTATION ACTIVITIES

In addition to the progress made at the policy level, the GoSL has obtained international funding and technical support for the initiation and execution of a wide range of climate change adaptation projects (see box below).

In the past years, various important projects for climate change adaptation in the water sector have also taken place, with some of them still ongoing and others approved, but not started. The most relevant of these projects are listed in **Annex 2.**

The lessons learned from the initiatives implemented have been used to inform the Water SASAP formulation process.

Box 1. Most common adaptation initiatives undertaken in Saint Lucia between 2012 and 2017. Source: GoSL, 2017 [7, 8]

- Development of sectoral policies and strategies to help build climate resilience;
- Budget reform to better integrate climate considerations;
- Adoption of modern technologies;
- Availability of financing schemes and insurance to increase resilience;
- Provision of incentives that seek to modify behaviour;
- Improved research, data collection and management;
- Development of tools for improved decision making;
- Capacity building in public agencies and specific target groups;
- Improved collaboration between agencies;
- Increased public education and outreach.

9. SAINT LUCIA'S SECTORAL ADAPTATION STRATEGY AND ACTION PLAN FOR THE WATER SECTOR (WATER SASAP) 2018-2028

In the framework of Saint Lucia's NAP process, the Water SASAP offers guidance on key investments and interventions (technical, institutional, and regulatory) required between 2018 and 2028 for safeguarding water resources and services and reducing the impact of hydrometeorological events in the country under a changing climate.

The Water SASAP has been designed to support the efforts made by the GoSL to build climate resilience within and across sectors and to promote the integration of climate change considerations into existing and new development projects, programmes and policies of the water and water-related sectors. To achieve this, the Water SASAP has been formulated in alignment with, and in the framework of, the relevant national and sectoral development and climate policy; and builds on the progress made in, and the lessons learned from, the implementation of water-related adaptation programmes, projects and activities in Saint Lucia.

This Strategy and Action Plan consists of 70 adaptation measures that are deemed critical to improve water resource and service management and reduce water-mediated climate change impacts in the

country. The measures, endorsed by relevant stakeholders through consultation, offer solutions to information, technical, institutional, financial, regulatory and policy limitations hampering adaptation in the water sector. In the SASAP, the adaptation measures and their indicative outputs are grouped under 4 major outcomes and 13 strategic objectives (that contribute to the achievement of the outcomes). All measures, strategic objectives and outcomes directly respond to the key challenges identified for adaptation in the water sector. In addition, all measures correspond to one or more of the three strategic elements of the CCAP (facilitation, implementation and financing). While it is recognised that some of the adaptation measures contribute to the achievement of more than one objective and more than one outcome, for the sake of simplicity, each measure has been included only once in the SASAP (see **Section 10**).

9.1. STRATEGIC GOAL, OBJECTIVES AND OUTCOMES

The overarching goal of the Water SASAP is *to drive the implementation of effective adaptation actions across all sectors and at all levels of society for safeguarding Saint Lucia's water resources and services under a changing climate.*

To accelerate progress towards the achievement of this goal, the Water SASAP has defined 13 strategic objectives, grouped under four main outcomes, as follows:

Outcome 1. Enhanced enabling environment and improved behaviour 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. Minimise water-related climate change risks by adopting ecosystem-based adaptation solutions
3. Promote climate resilient business development

9.2. IMPLEMENTATION AND FUNDING OF THE WATER SASAP

The WRMA is charged with the responsibility of leading and overseeing the implementation of the Water SASAP, and of using it to inform and guide their activities. In their leading role, this institution is also expected to support and collaborate with WASCO, NURC, the Ministry with responsibility for Physical Planning and Development and with the agencies in charge of other water-dependent sectors in the implementation of measures that correspond to the mandates of those other agencies. This includes the Ministry with responsibility for Renewable Energy, the Ministry with responsibility for Infrastructure, the Ministry with responsibility for Agriculture, the Ministry with responsibility for Economic Planning and Development, and the Ministry with responsibility for Finance. In addition, strong communications and collaboration with the DSD, the country's climate change focal point, and NCCC, the multi-sectoral institution in charge of overseeing the implementation of the NAP, will help support and track activities conducted by other public-sector agencies that are relevant and that contribute to achieving the objectives and outcomes of this SASAP. It is the intention that further to the collaborative process undertaken to date, the document will be shared and discussed with all the partner agencies and that awareness will be raised on its objectives and planned activities to gain high level buy-in and facilitate the inclusion of the SASAP priorities in national and sectoral policy and budgets, as appropriate.

It is anticipated that the adaptation measures defined under each objective and outcome will start to be implemented during the 2018-2028 period, according to their degree of urgency (short, medium and long-term). However, it is also clear that their implementation will depend on funding, policy and other opportunities opening up during this time; opportunities will be seized for implementation as they arise, cross-sectorally or sectorally.

Given the broad scope of this SASAP, it is to be expected that the execution of most of the specific measures may occur as a consequence of their inclusion in projects and programmes funded from both national and international sources. The SASAP includes indicative outputs to facilitate the planning and design of such projects and programmes.

The execution of most actions included in the SASAP relies on the assumption that further to national budgetary efforts that are commensurate with national circumstances, the level of international

support that Saint Lucia has received for development of projects and programmes in its water and water-dependent sectors will be maintained and that additional climate finance for adaptation in these sectors will be attracted, for example, through the Green Climate Fund (GCF), Adaptation Fund and multilateral and bilateral arrangements. The execution of the Water SASAP will, nonetheless, require the proactive engagement and time of GoSL staff and potentially, the allocation of new public resources. It is also assumed that over time, adaptation will become immersed in all new development projects of these sectors and that the institutions in charge of water and water-dependent sectors will be able to generate revenue from their regulatory functions (e.g. user fees, royalties, licenses, and other) that can possibly be directed to their operations to help supplement other support received.

In view of the above considerations, it is the intention, in the coming years, and to the maximum extent possible, for elements of the Water SASAP (see **Section 10**) be integrated into the existing and proposed cooperation programmes of Saint Lucia's bilateral and multilateral partners. To ease this process and facilitate funding the implementation of the SASAP, **Section 11** presents a series of stand-alone project concept notes, which are aligned with specific objectives and measures of the Water SASAP and which can be presented, either on their own or as part of programmes, to various funding sources. The indicative outputs in the SASAP (**Section 10**) can also be grouped and included in the elaboration of specific programmes and projects, as funding opportunities arise.

9.3. MONITORING AND EVALUATION

The transparent reporting, monitoring and review of adaptation action is critical to measure and steer the progress of Saint Lucia's NAP process, of which the Water SASAP is a building block. It is necessary to design and put in place a monitoring plan for the implementation of the Water SASAP, to ensure that the activities conducted are completed and contribute to the achievement of the established objectives and outcomes. The monitoring and evaluation (M&E) plan will also help to determine corrective actions when changes, due to existing and new circumstances, occur, and will ease reporting. This M&E plan is a supplement of Saint Lucia's overarching NAP, which was developed in parallel with the SASAPs for the Water, Agriculture and Fisheries sectors.

It is expected that on a yearly basis, the lead agencies will report to the NCCC on the progress and revisions made to the implementation of the Water SASAP, for inclusion of the relevant information in the NAP M&E system.

10. ADAPTATION MEASURES

This section presents Saint Lucia's Water SASAP. It has been structured according to main outcomes and strategic objectives and suggests the period of execution, or at least initiation, of each adaptation measure (short, medium and long-term) according to the level of urgency established by the stakeholders consulted, with short-term being the most urgent. The SASAP also indicates the element(s) of the CCAP that most accurately correspond to each measure (i.e. facilitation, implementation or finance).* It is suggested that the past, present and approved projects relevant to adaptation in the sector (in **Annex 2**) are consulted when planning projects and programmes and activities to implement the adaptation measures contemplated in this SASAP, for them to build on previous outputs and outcomes and to facilitate synergy building.

* Saint Lucia CCAP is supported by three types of adaptation processes (facilitation, implementation and finance).

Facilitation encompasses activities that provide the enabling environment and enhance adaptive capacity; for example in awareness- and capacity-building, institutional and governance structures, policies and legislative frameworks, fiscal and economic incentives, knowledge management and dissemination and others, thereby improving conditions for the capacities and awareness at all levels of society.

Implementation encompasses activities geared towards building the resilience of households, communities, vulnerable groups, enterprises, sectors and, ultimately, the nation. Implementation measures will therefore be identified at the national and community levels, with regional and international support and backstopping provided through agreed modalities.

Financing options are linked to one or more of the following five categories: 1. Affordable climate change-related loan financing for civil society and the general public; 2. Economic Incentives; 3. Private Sector Financing; 4. International Funding; 5. Mechanisms to realise sustainable financing for climate change adaptation. These options will be supported by an enabling fiscal regime.

OUTCOME 1. ENHANCED ENABLING ENVIRONMENT AND IMPROVED BEHAVIOUR FOR WATER-RELATED CLIMATE ADAPTATION ACTION

STRATEGIC OBJECTIVE 1. IMPROVE THE NATIONAL POLICY, LEGAL AND REGULATORY FRAMEWORK TO FACILITATE CLIMATE ADAPTATION IN THE WATER AND WATER-DEPENDENT SECTORS

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
1	Develop a new 20-year Integrated Water Resources Management Strategy for Saint Lucia (incorporating water conservation and allocation strategies and climate change and other priorities in the Water SASAP).	Short-term (2018-2021)	New 20-year Water Resources Management Strategy for Saint Lucia formulated, integrating climate change considerations and including water conservation and allocation strategies as defined in the Water SASAP).	Facilitation
2	Revise development standards / guidelines and integrate climate adaptation considerations for the water sector ("make them climate-smart" e.g. river/ravine buffers; requirements for open spaces and conservation reserves).	Short-term (2018-2021)	Development standards/guidelines revised and including climate change adaptation considerations.	Facilitation
3	Revise the current water, land and other policies to address climate change challenges and integrate coherently climate adaptation considerations.	Short-term (2018-2021)	Water, land and other policies (which may affect water resources or their management) revised and addressing both, climate change challenges and climate adaptation considerations.	Facilitation
4	Revise government policy on water conservation incentives and water price controls to increase water use efficiency.	Short-term (2018-2021)	Government policy on water conservation incentives and water price controls to increase water use efficiency revised, approved and enforced.	Facilitation

STRATEGIC OBJECTIVE 2. SCALE-UP NATIONAL HUMAN CAPACITY FOR THE DESIGN AND IMPLEMENTATION OF WATER-RELATED CLIMATE ADAPTATION PROJECTS

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
5	Establish human resource and training expertise in NGOs and CBOs to support natural resource management and water quality monitoring.	Medium-term (2021-2024)	Training workshops, courses and hands-on learning activities for NGOs and CSOs to support government-led and other water resource management and water monitoring activities.	Facilitation

STRATEGIC OBJECTIVE 3. INCREASE PUBLIC AWARENESS TO INTEGRATED WATER RESOURCE MANAGEMENT

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
6	Design and implement a communications strategy for raising awareness and sparking action on integrated water resource management under a changing climate at all levels of the Saint Lucian society.	Short-term (2018-2021)	Communications and awareness raising strategy to raise public awareness on integrated water resource management, including integrated watershed management, water efficiency, wastewater management and other relevant thematic areas designed, in alignment with the Climate Change Communications Strategy (2018), funded, implemented and reaching all levels of the Saint Lucian society.	Facilitation and implementation

OUTCOME 2. INCREASED WATER ACCESS, AVAILABILITY AND QUALITY

STRATEGIC OBJECTIVE 1. STRENGTHEN INTEGRATED WATERSHED MANAGEMENT TO BUILD CLIMATE RESILIENCE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
7	Conduct a feasibility study to establish river usage zoning to reduce water use conflicts and secure the integrity of river water quality.	Short-term (2018-2021)	Feasibility study establishing river usage zoning.	Facilitation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
8	Undertake a comprehensive study of the 37 watersheds and all water resources in Saint Lucia to develop a comprehensive water resources database, hydrological models and a reporting system.	Short-term (2018-2021)	- Study report of Saint Lucia's water resources including all relevant information on the country's watersheds. - Water resources database. - Reporting system.	Facilitation and implementation
9	Improve river bank management and water quality by introducing and maintaining riparian buffer zones/strips and/or selectively re-introducing river reserves.	Medium-term (2021-2024)	- Riparian buffer zones introduced and maintained. - River reserves introduced.	Implementation
10	State acquisition and maintenance of private water catchments and intact natural forests.	Medium-term (2021-2024)	- Plan for State acquisition of private water catchments and intact natural forests formulated, including funding mechanisms for its implementation. - Plan implementation initiated. - Private water catchments and natural forests purchased by the state and maintained.	Implementation
11	Expand reforestation programmes, prioritising the reforestation of critical watersheds (with selection of appropriate mixes of species for reforestation/ afforestation where needed).	Short-term (2018-2021)	New or expanded existing reforestation programmes in critical watersheds implemented and or planned.	Implementation
12	Adopt forest management plans to reduce and control soil erosion, sedimentation of water sources and to minimise the risk of landslides.	Short-term (2018-2021)	Forest management plans in place and implemented.	Facilitation and Implementation
13	Identify new and expand sustainable forest-based livelihood opportunities for securing forest cover and ecosystem health.	Short-term (2018-2021)	- Study on sustainable forest livelihoods for Saint Lucia, identifying marketable products (including non-timber forest products) and services (e.g. eco-tourism), value chain and market analyses. - Training on the identified sustainable forest livelihoods for beneficiaries.	Facilitation and Implementation
14	Activate or reactivate Community-based Organisations for integrated watershed / natural resource management.	Short-term (2018-2021)	- CBOs mobilised, informed and trained on sustainable natural resource management practices (including sustainable land management practices).	Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
15	Phase out inappropriate activities (for example agricultural, commercial, industrial, domestic, etc.) which compromise water quality and take place adjacent to water sources.	Medium-term (2021-2024)	- Mechanisms to phase out activities which compromise water quality and take place next to water sources identified and agreed with CBOs and communities. - Mobilised CBOs actively participate in designing and planning natural resource management and sustainable land use projects in their watersheds. - CBOs mobilise watershed communities to implement sustainable natural resource management projects and to adopt sustainable land management practices in water catchments.	Facilitation and implementation
16	Mobilise communities to implement sustainable land use practices in water catchments.	Short-term (2018-2021)		Implementation
17	Continue/accelerate the selective relocation of water intakes.	Medium-term (2021-2024)	Water intakes relocated to suitable areas, taking into consideration climate change and land/agricultural use (pollution)-related risks.	Implementation
18	Use engineering measures for river bank and channel protection, where necessary.	Short-term (2018-2021)	- Technical feasibility study identifying priority areas for engineering solutions to flooding along river banks and channels. - Implementation of engineering solutions in identified priority areas.	Facilitation and Implementation
19	Review the National Land Use Plan to ensure that it: a) addresses watershed degradation, saline intrusion, sea level rise and groundwater use and, b) encourages a well-planned intensive use of land vs. the lateral spread of development, to secure increased land availability for conservation purposes.	Short-term (2018-2021)	- National Land Use Plan reviewed and addressing watershed degradation, saline intrusion, sea level rise and groundwater and providing guidance on the intensive use of land for development. - Execution of the Revised National Land Use Plan.	Facilitation

STRATEGIC OBJECTIVE 2. PROMOTE THE SUSTAINABLE USE OF ALTERNATIVE WATER SOURCES TO ENSURE WATER AVAILABILITY UNDER A CHANGING CLIMATE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
20	Promote the use of communal Rain Water Harvesting (RWH) and storage systems for non-potable uses and the retrofitting of private homes and	Short-term (2018-2021)	- Public campaigns to raise awareness of the benefits of RWH systems.	Facilitation and Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
	domestic/commercial buildings to include rain water harvesting and storage.		- Training on RWH system construction and maintenance delivered to CBOs and other interested community representatives. - Public buildings retrofitted (including RWH and water storage systems) and used as demonstration projects/sites.	
21	Expand storage capacity through the strategic placement of bulk water storage tanks (rainwater and potable water).	Short-term (2018-2021)	- Strategic locations for the installation of bulk water storage tanks across the island identified. - Installation of bulk water storage tanks initiated.	Implementation
22	Raise awareness and develop/extend training on the correct maintenance of private water storage.	Short-term (2018-2021)	Training delivered to technical officers, local government officials, CBOs and suppliers on the correct maintenance of private water storage.	Facilitation and Implementation
23	Test and implement approaches for enhancing water availability, such as dam and reservoir establishment/construction in the south (Troumassee River), desalination plants, micro-dams and the establishment of satellite water storage tanks within the forest reserve to feed rural communities	Medium-term (2021-2024)	Pilot projects to test alternative water sources, storm water management and re-use systems designed, funded, implemented and evaluated in terms of effectiveness, applicability, cost-effectiveness and scalability.	Implementation
24	Test and implement storm water management and re-use systems.	Medium-term (2021-2024)		Implementation
25	Continue groundwater resource mapping and exploration for use.	Long-term (2024-2028)	New groundwater exploration for use project designed and funded.	Implementation

STRATEGIC OBJECTIVE 3. IMPROVE WASTEWATER MANAGEMENT TO REDUCE POLLUTION AND INCREASE WATER AVAILABILITY UNDER A CHANGING CLIMATE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
26	Extend Public Sanitation Programmes and improve/upgrade sanitation facilities in vulnerable communities/poor households.	Medium-term (2021-2024)	Sanitation facilities in vulnerable communities upgraded.	Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
27	Revise current regulations to ensure that connections are made to the central sewer where possible and that the construction and maintenance of private septic tanks is appropriate. Develop mechanisms for the enforcement of regulations and establish training sessions (in conjunction with the Police) for the training of enforcement officers.	Short-term (2018-2021)	- Regulations revised, and enforcement mechanisms formulated and approved. - Training sessions on the regulations and their enforcement mechanisms delivered to enforcement officers.	Facilitation
28	Conduct a Feasibility Study to determine the infrastructural requirements for tertiary level municipal sewage treatment facilities to cover the island's needs.	Short-term (2018-2021)	Feasibility study conducted to determine the infrastructural requirements for tertiary level municipal sewage treatment facilities to cover the island's needs.	Facilitation and Implementation
29	Raise awareness and develop training on the correct use of grey water.	Short-term (2018-2021)	Training sessions on the correct use of greywater delivered to local government officials, CBOs, community leaders and industry representatives.	Facilitation and Implementation
30	Install new, upgrade and extend existing waste water treatment facilities.	Medium-term (2021-2024)	- Plan for installing new and upgrading existing wastewater treatment facilities. - Feasibility studies and Environmental Impact Assessments (EIAs) for the installation of new wastewater treatment facilities. - Existing wastewater treatment facilities upgraded. - New wastewater treatment facilities designed.	Implementation
31	Upgrade EIA for tourism waste water plants to include hazard risk assessments and vulnerability analyses.	Short-term (2018-2021)	EIAs updated and integrating hazard risk assessments and vulnerability assessments (including climate change risk and vulnerability considerations).	Facilitation
32	Promote and implement wastewater re-use programmes, including the recycling of grey water and sludge management at hotels and other large institutions.	Medium-term (2021-2024)	Training session on wastewater and reuse treatments for the recycling of wastewater and sludge management (including regulations and benefits under a changing climate) delivered to members of the Saint Lucia Hotel and Tourism Association and other commercial institutions.	Facilitation and Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
33	Regulate the use of grey water and grey water products.	Medium-term (2021-2024)	- Regulations for the use of greywater and greywater products. - Regulation enforcement mechanisms formulated and set-up. - Training on the regulations for enforcement officers conducted.	Facilitation

STRATEGIC OBJECTIVE 4. SET AND SCALE-UP WATER QUALITY AND POLLUTION CONTROL IN A CHANGING CLIMATE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
34	Develop and enforce potable water quality standards.	Short-term (2018-2021)	- Potable water quality standards developed and approved. - Standard enforcement mechanisms formulated and implemented.	Facilitation
35	Build capacity for water quality monitoring by improving and staffing the Water Resources Monitoring Programme to identify yield and water quality issues in each supply area and by re-establishing the Water Testing Laboratory.	Short-term (2018-2021)	- Plan for strengthening water resource monitoring in Saint Lucia formulated and including: a) an analysis of existing technical, financial, infrastructural (equipment) and logistical and limitations in the Water Resource Monitoring Program. b) an analysis of the cost-effectiveness of re-establishing the Water Testing Laboratory vs. other alternatives and, c) implementation mechanisms (including funding sources) and timeline for action. - Capacity building activities to strengthen the identified technical weaknesses in water monitoring delivered.	Facilitation
36	Implement waste-to energy projects to increase the availability of non-polluted water (though reduction in water pollution/contamination by liquid/organic waste) and to reduce the compounded effects of flooding by solid waste.	Medium-term (2021-2024)	- Proposal for implementing waste-to energy pilot projects designed and submitted for funding. - Pilot projects undertaken.	Implementation
37	Develop guidelines for the handling, transportation and storage of chemicals and chemical waste; managing accidents and spills; and the use and disposal of chemicals in order to safeguard water resources.	Short-term (2018-2021)	Guidelines for the handling, transportation and storage of chemicals and chemical waste; managing accidents and spills; and the use and disposal of chemicals.	Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
38	Conduct an assessment of hazardous chemical storage facilities of the Saint Lucia Air and Sea Ports Authority (SLASPA) with options for improvement of storage infrastructure	Short-term (2018-2021)	Assessment conducted, taking into consideration climate change concerns and report produced, including a plan for enhancing climate resilience and improving inadequate storage infrastructure.	Facilitation and Implementation
39	Review and update the classification of pesticides and chemical products of concern in the legislation.	Short-term (2018-2028)	Legislation related to the classification of pesticides and chemical products of concern reviewed and updated, including an effective mechanism for the continuous updating and including (in the relevant legislation) chemicals and chemical products of concern.	Facilitation
40	Implement red-flagging of pesticides and chemical products in the Automated System for Customs Data (ASYCUDA) World. Red flags are to be triggered every time the HS codes for banned products are entered into ASYCUDA World by a Customs Officer or Broker to activate a secondary inspection.	Short-term (2018-2021)	- Red-flagging of pesticides and chemical products in the ASYCUDA World implemented. - Training on the system and procedures after banned products are flagged delivered to Customs Officers and Brokers.	Implementation

OUTCOME 3. INCREASED WATER EFFICIENCY AND CONSERVATION

STRATEGIC OBJECTIVE 1. IMPROVE WATER INFRASTRUCTURE TO BUILD CLIMATE RESILIENCE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
41	Facilitate investment and invest in major water system infrastructural upgrades, including the construction of new pipelines to reduce water loss.	Medium-term (2021-2024)	- A comprehensive assessment of all water system infrastructure upgrades and extension required across Saint Lucia conducted. The assessment should: a) analyse current and projected future demand and place emphasis on interventions required in areas lacking individual connections and in areas with significant leaks, b) integrate climate change considerations and recommendations based on climate change projections (climate proofing of existing and new water infrastructure), c) include a Plan of Action (including water infrastructure improvements and extension, leak control measures - meter installation and capacity building for leak detection- and improvement of WASCO's operational plans), d) provide a budget and potential (national and international) funding sources for the Plan's (full or partial) execution. - The assessment report and Plan of action is considered in national budgets, and additional funding is secured to start and advance the Plan's implementation. - Priority infrastructural interventions undertaken. - WASCO's Operational Plans updated and under execution. - Meters purchased and installed. - Capacity building activities for reducing leaks undertaken. - Customer base with individual connection increased. - Standpipes and communal supplies reduced. - Leaks reduced.	Facilitation and implementation
42	Increase customer base with individual connection and reduce standpipes and communal supplies.	Short-term (2018-2021)		Implementation
43	Improve leak detection and alleviation to reduce losses including an improvement of WASCO's operational plans and institutional capacity to reduce line losses.	Medium-term (2021-2024)		Implementation
44	Purchase meters and install along water distribution network to quantify total losses and assess leakage within the network/ reservoirs. Address areas that show high leakages.	Medium-term (2021-2024)		Implementation
45	Install water meters for all consumers (bulk and low volume).	Short-term (2018-2021)		Implementation

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
46	Conduct water audit of government buildings and government-occupied buildings to determine where there are high leakages/wastage.	Medium-term (2021-2024)	- Audit performed. - Key public and community buildings retrofitted and used as demonstration sites.	Implementation
47	Retrofit public and key community buildings for climate change resilience and for demonstration/replication of climate-appropriate design re – rainwater harvesting and hurricane resilience	Short-term (2018-2021)		Implementation
48	Facilitate the development of renewable energy infrastructure to reduce current water pumping costs.	Short-term (2018-2021)	- Projects for the development of renewable energy infrastructure for reducing the costs of water pumping designed and submitted for funding.	Implementation

STRATEGIC OBJECTIVE 2. ENCOURAGE WATER EFFICIENCY UNDER A CHANGING CLIMATE BY IMPROVING WATER PRICING, WATER UTILITY REVENUE AND WATER CONSERVATION INCENTIVES

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
49	Design and implement an adequate water and wastewater tariff system (adjusting rates to accurately reflect costs of water supply).	Medium-term (2021-2024)	- Study analysing Saint Lucia's water service tariff and revenue collection system. The study should consider current and forecasted demand and water supply and treatment costs (including climate change-related variation in demand and costs). The study should propose adequate adjustments to the water and wastewater tariff system, including the potential adjustment of dry season charges and provide recommendations on a more effective revenue collection system. - Adjusted water and wastewater tariff and revenue collection systems approved and implemented.	Facilitation and Implementation
50	Implement dry season premium water charge for excessive use of water	Medium-term (2021-2024)		Facilitation and Finance
51	Improve the efficiency of water revenue collection.	Short-term (2018-2021)		Facilitation and Finance

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
52	Establish water conservation incentives for private and community-based water conservation programmes.	Medium-term (2021-2024)	- Most effective water conservation incentives for private and community-based conservation programmes identified and approved. - Incentive system established and implemented.	Facilitation
53	Promote the adoption of low flow water technologies for domestic use (e.g. toilets and faucets).	Short-term (2018-2021)	- Market assessment of domestic water conservation products conducted, presented to and discussed with importers/suppliers. - Price caps discussed to ensure affordability and adoption of the technologies. - Incentives approved for motivating the adoption of water conservations systems at the domestic and commercial level. - Public awareness raising campaigns on the benefits of water conservation systems under current and future climate, including the use of low flow technologies designed and conducted (these campaigns could be linked to the NAP communications strategy). - Availability, purchase and installation of domestic water conservation devices increase.	Facilitation
54	Encourage the private sector to increase the availability of domestic water conservation products for purchase by the public in Saint Lucia.	Short-term (2018-2021)		Facilitation and implementation
55	Create/increase awareness-raising campaigns to promote the efficient and effective use of water (including water conservation practices) for climate change adaptation amongst landowners, farmers and the public in general.	Short-term (2018-2021)		Facilitation and Implementation

STRATEGIC OBJECTIVE 3. PROMOTE CLIMATE SMART AGRICULTURE

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
56	Document best practices in dryland agriculture in the Caribbean.	Short-term (2018-2021)	Comprehensive document on Caribbean dryland and climate-smart agriculture prepared. The document reviews soil and water conservation measures, includes case studies and offers crop production recommendations for Saint Lucia, considering climate change projections.	Implementation
57	Change management practices such as planting dates to compensate for crop /water cycle modifications.	Short-term (2018-2021)	Climate-smart agricultural practices tested and adopted.	Implementation
58	Improve farm drainage infrastructure, cultivation and harvesting practices to reduce impacts of soil water stress during heavy precipitation periods.	Short-term (2018-2021)	- A programme for improving farm drainage infrastructure and developing climate-smart irrigation systems (allowing for the recycling of wastewater) is designed and submitted for funding. - Pilot testing of soil and water conservation and water-efficient agricultural practices in demonstration plots takes place. - Farmer field schools design and offer training on climate-smart-agricultural practices to farmers, using the demonstration plots and in an ongoing basis.	Implementation
59	Extend drip irrigation use and develop irrigation networks that allow for the recycling of waste water.	Medium-term (2021-2024)		Implementation
60	Extend the use of soil and water conservation measures (mulching, appropriate terracing, etc.) to reduce water losses and erosion.	Short-term (2018-2021)		Implementation
61	Set up demonstration plots showcasing climate-smart farming techniques. Facilitate farmers training on climate smart agriculture through farmer field schools.	Short-term (2018-2021)		Implementation
62	Review agricultural support mechanisms and policies to promote water efficient production methods and techniques.	Short-term (2018-2021)	Review conducted.	Facilitation

OUTCOME 4. STRENGTHENED PREPAREDNESS TO CLIMATE VARIABILITY AND EXTREMES

STRATEGIC OBJECTIVE 1. IMPROVE HYDROMETEOROLOGICAL MONITORING, EMERGENCY PLANNING AND DECISION MAKING

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
63	Undertake country-wide hazard mapping (flooding, drought, wildfires, landslides, digital elevation modelling) to inform land use and infrastructure development planning.	Short-term (2018-2021)	Multi-hazard risk maps for Saint Lucia developed and in use.	Implementation
64	Enhance existing monitoring/alert networks on sea level rise through effective training and outreach mechanisms.	Short-term (2018-2021)	-Capacity building programme for improving sea-level rise monitoring and alert networks designed and delivered.	Implementation
65	Continue expanding the network of automatic rainfall stations and stream gauges with data loggers to remotely transmit readings to a central office and improve early warning systems.	Short-term (2018-2021)	- Automatic rainfall stations and stream gauges with data loggers installed and transmitting readings to a central office. - Existing early warning systems adjusted accordingly.	Implementation
66	Identify and acquire appropriate predictive rainfall and flood (coastal and inland) models and provide in-depth training and capacity building on their use and analysis complementary to, and beyond, the Hydromet Rehabilitation component of the Disaster Vulnerability Reduction Project (DVRP).	Short-term (2018-2021)	- Adequate flood and rainfall predictive models for Saint Lucia acquired. - Training on the use of the models and the analysis of derived data delivered to Meteorology Office staff.	Facilitation and Implementation
67	Train staff in GIS, satellite image analysis, meteorological data analysis, predictive analysis, and use of satellite and remote sensed data and systems.	Short-term (2018-2021)	- Comprehensive capacity building programme designed for technical officers of relevant ministries and departments. - Capacity building programme delivered.	Facilitation and Implementation

STRATEGIC OBJECTIVE 2. MINIMISE WATER-RELATED CLIMATE CHANGE RISKS BY ADOPTING ECOSYSTEM-BASED ADAPTATION SOLUTIONS

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
68	Maintain existing vegetative buffers – mangroves, coastal vegetation, river banks - through regulations and enforcement.	Medium-term (2021-2024)	Wetlands and main vegetative buffers along riverbanks and coasts are protected and restored through regulations and enforcement.	Facilitation
69	Protect wetland ecosystems, most of which are coastal and have been targeted as landfill sites or earmarked for development.	Medium-term (2021-2024)		Facilitation

STRATEGIC OBJECTIVE 3. PROMOTE CLIMATE RESILIENT BUSINESS DEVELOPMENT

	Prioritised adaptation measures	Period	Outputs	Alignment with the CCAP
70f	Encourage the development of business continuity plans (including water supply considerations) for dealing with the impacts of climate change through the creation of certification schemes for businesses that have implemented business continuity measures.	Medium-term (2021-2024)	- Certification schemes designed and implemented. - Meetings held with private sector associations and leaders to inform them about the schemes.	Facilitation

11. CONCEPT NOTES FOR CLIMATE CHANGE ADAPTATION PROJECTS IN SAINT LUCIA'S WATER SECTOR

The project concept notes outlined here are a reflection of the prioritised measures contained in Saint Lucia's NAP and Water SASAP. These are also represented, for ease of reference, in *Saint Lucia's Portfolio of Project Concept Notes for the Water Sector 2018-2028.* The project concepts notes are not presented in order of priority. Implementation of these projects will be based partially on funder interest and partially on urgency-short, medium and long, as elaborated in the SASAP. Given that these documents are living or organic, it is envisaged that additional project concept notes will be added over time.

While the lead agency for *Saint Lucia's Sectoral Adaptation Strategy and Action Plan for the Water Sector (Water SASAP) 2018-2028,* is the Water Resources Management Agency, the implementation of projects and programmes would require the involvement of multiple agencies and stakeholders. In some cases, collaboration with other lead agencies would be warranted.

PROJECT CONCEPT 1. GUIDING WASTEWATER INTERVENTIONS UNDER A CHANGING CLIMATE: SAINT LUCIA'S WASTEWATER MASTER PLAN (WMP) AND GUIDELINES

PROJECT CONCEPT 1	
Project title	**Guiding Wastewater Interventions under A Changing Climate: Saint Lucia's Wastewater Master Plan (WMP) and Guidelines**
Objective	To provide guidance for future wastewater interventions in Saint Lucia

Rationale

Saint Lucia's Climate Change Adaptation Policy recognises the challenge of providing freshwater to the country's population and economic activities under a changing climate. Freshwater shortages have already started to be experienced and are expected to increase with time. This will be driven by an increasing demand brought by a growing population, while climate change induces lower annual precipitation and more erratic rainfall, higher evaporation, and saline intrusion into coastal rivers due to sea-level-rise, all of which exacerbate current pressures on the country's fragile water resources.

Safeguarding Saint Lucia's water resources and services under a changing climate requires the urgent implementation of sustainable and integrated water management practices, including the appropriate management of wastewater, recognised as a 'no regrets' adaptation option, and calls for well-structured planning mechanisms in the water sector based on ground-level information that is currently incomplete or outdated.

A WMP is a strategic long-term planning instrument to determine future demand for wastewater management. It may be combined with water supply and urban planning, and can cover a village, a town or the entire island of Saint Lucia. After the Saint Lucia Wastewater Management Policy and Strategic Plan, completed in 2017, the national WMP is the next step in the hierarchy of strategic documents required to develop the sector and match technical proposals with geographic, climatic and other parameters.

Development of guidelines for the different sub-sectors (e.g. greywater management, on-site sanitation facilities, marinas) should be part of, or be done in parallel with, the development of the WMP. The guidelines will raise public awareness and promote discussion about specific issues on wastewater management.

Scope

Domestic wastewater, including faecal sludge from households, hotels, restaurants, commercial areas, car-wash areas, gas stations, ports and marinas.
The town of Castries can be included in the national WMP, but due to its specific situation (no Wastewater Treatment Plan, WWTP) a separate WMP and feasibility study could be elaborated.

Activities and Tasks

1. Elaborate a WMP for Saint Lucia that includes, *inter alia*:

- An inventory and description of existing water and wastewater systems (e.g. Beausejour WWTP, Castries City Council faecal sludge treatment plant, sewer networks of Castries and Gros-Islet/Beausejour, communal septic tank in Vieux Fort);
- The description of geographic, topographic, geotechnical and other environmental conditions for wastewater management and risk mapping (e.g. landslide risk, low-lying and coastal areas);

PROJECT CONCEPT 1	
Project title	**Guiding Wastewater Interventions under A Changing Climate: Saint Lucia's Wastewater Master Plan (WMP) and Guidelines**

- Projections: water supply quantity and quality projections, population projections, service area projections, present and planned land use, water and wastewater demand projections, future water quality demand and wastewater standards;
- An analysis of socio-economic conditions, affordability and willingness-to-pay and impact of wastewater service improvements on rental levels;
- A description of improvements needed to meet future water and wastewater demand based on hydraulic modelling approaches to estimate long-term needs with documentation of each option;
- The justification for the selection of particular centralised, decentralised or individual system improvements or greenfield options (based on needs, cost effectiveness, constructability, reliability, operation, maintenance, stakeholder preferences, etc.);
- Recommendations on system improvements or greenfield options;
- Maps showing improvement components and service areas;
- An institutional set-up and public service model and tariff structure;
- Documentation and description of costs and benefits of system improvements, including a financial feasibility study;
- An implementation plan (establishing priorities, i.e. short-term solutions and others to be implemented in the long-term.).

2. Guidelines

- Elaborate guidelines for on-site and small wastewater facilities, and greywater management for all sectors (e.g. households, small communities, restaurants, hotels, businesses, public offices). The Guidelines should provide: a) information for the design, construction, operation and maintenance of facilities, b) information for retrofitting systems for water saving, and c) contact information for the technical support unit and related services (e.g. technical support unit at the Ministry of Health and Wellness (MoH), sanitary engineers, masons, vacuum tankers).
- Elaborate guidelines for ports and marinas to implement adequate careening activities. These guidelines should include: a) technology description, b) design and costs, and c) operation and maintenance requirements. These guidelines may also consider solutions for car-wash areas and gas stations.

Implementation	
• **Leading agency:** Water Resource Management Agency (WRMA) • **Implementation entities**: WRMA • **Technical support**: Water and Sewerage Company Inc. (WASCO) and an external consultant • **Financing**: Government of Saint Lucia (GoSL) and development partners	
Indicative Cost	USD 1,000,000
Duration	1 year

PROJECT CONCEPT 1	
Project title	**Guiding Wastewater Interventions under A Changing Climate: Saint Lucia's Wastewater Master Plan (WMP) and Guidelines**
Additional information	
• This project is aligned with the Water SASAP's measures 2, 4, 26, 27, 28, and 48 and can contribute to implementing measures 30, 31, 32, 33 and 63. • The WMP and Guidelines will support national climate change adaptation efforts; their periodic evaluation and update will be included in, and monitored as part of, the Climate Adaptation Strategy and Investment Plan for the Water Sector, to ensure they keep up with changing needs, technologies and service levels. • Saint Lucia is finalising a study entitled, "Assessment of soil/geology to inform suitable sewage and liquid waste disposal methods in settlement areas". This study will provide important technical information for the WMP.	

PROJECT CONCEPT 2. DEVELOPING SEA LEVEL RISE-APPROPRIATE COASTAL WASTEWATER MANAGEMENT SYSTEMS: THE CANARIES VILLAGE PILOT PROJECT

PROJECT CONCEPT 2	
Project title	**Developing Sea Level Rise-appropriate coastal wastewater management systems: The Canaries village pilot project**
Objective	To develop and implement integrated and sustainable wastewater management solutions and technologies for all wastewater producers in Canaries village

Rationale

Saint Lucia's Climate Change Adaptation Policy recognises the challenge of providing freshwater to the country's populations and economic activities under a changing climate. Freshwater shortages have already started to be experienced and are expected to increase with time. This will be driven by an increasing demand brought by a growing population, while climate change induces lower annual precipitation and more erratic rainfall, higher evaporation, and saline intrusion into coastal rivers due to sea-level-rise, all of which exacerbate current pressures on the country's fragile water resources.

Safeguarding Saint Lucia's water resources and services with due consideration of climate change requires the urgent implementation of sustainable and integrated water management practices, including the appropriate management of wastewater, recognised as a 'no regrets' adaptation option.

Most of the coastal towns/villages (i.e. Anse la Raye, Canaries, Vieux Fort, Laborie, Choiseul, Micoud, Dennery, Soufrière) are at or partially below sea level, with serious implications for wastewater management. The hydrogeology conditions with a high-water table make these zones not suited for septic tank and soakaway absorption systems. The saturated zones may facilitate a higher rate of migration of faecal contaminants towards the near shore marine environment due to the presence of advection currents. This challenge may increase as a consequence of climate change. A rise in sea level and natural events causing flooding may lead to more infiltration/exfiltration in sanitation facilities.

Also, most of the coastal towns/villages are facing a situation where sea water enters the drains, in particular at high tide, and today, most households discharge their greywater into the drain (even black water in some cases).* This issue should be addressed by proper greywater, storm water and solid waste management.

Saint Lucia needs to develop an integrated wastewater management system for its coastal towns and villages, to reduce coastal communities' exposure to faecal contamination and other harmful chemicals and material.

Canaries, with its relatively low population and high tourism potential (namely, village tourism), offers an appropriate starting point to develop a pilot integrated system. A study financed through the Global Environment Facility (GEF), "Assessment of Wastewater infrastructure and go-forward options for the village of Canaries, Saint Lucia" was published in 2016. The study identified feasible and affordable sanitary options to address the inadequate practices and technologies used by the communities of Canaries. Strategies for both short term and long-term visions have been proposed,

* GoSL. (2017). Saint Lucia National Policy on Wastewater Management. Ministry of Agriculture, Fisheries, Physical Planning, Natural Resources and Cooperatives

PROJECT CONCEPT 2	
Project title	**Developing Sea Level Rise-appropriate coastal wastewater management systems: The Canaries village pilot project**

incorporating low-complexity, cost effective solutions as well as centralised networks to reduce health and environmental risks, and allow for improved tourism related activities.

Scope

Canaries Village, including all wastewater producers such as households, offices, businesses, restaurants, hotels, industries, gas stations, car-wash areas, harbour, etc.
If successful, the project can be replicated and adapted to suit other coastal towns and villages.

Activities and Tasks

- Review study on, "Assessment of Wastewater infrastructure and go-forward options for the village of Canaries, Saint Lucia";
- Identify recent wastewater management development activities in Canaries (if any) and existing wastewater management services in place;
- Identify all wastewater producers in Canaries (all sectors);
- Develop different scenarios for integrated wastewater management development, including climate change considerations;
- Consult with the different stakeholders (e.g. communities, local authority, tourism industry, businesses, industries) to assess their needs, willingness to pay and potential voluntary actions to be undertaken;
- Evaluate affordability, financing and cost recovery issues;
- Select the most suitable scenario;
- Implement and build integrated wastewater management infrastructure;
- Conduct awareness-raising campaigns;
- Identify gaps and opportunities for improvement.

Implementation

- **Leading agency:** Water Resource Management Agency (WRMA)
- **Implementation entity**: Canaries Village Council
- **Technical Support**: WRMA Water and Sewerage Company Inc (WASCO) and an external consultant
- **Financing:** Government of Saint Lucia supported by development agencies

Indicative Cost	USD 4,000,000
Duration	3 years

Additional information

- This project is aligned with the Water SASAP's measures 26, 27, 28, 29, 30, 32 and 33, and can contribute to implementing measures 2 and 70. Selection and implementation of technologies should also consider drainage and storm water management, as well as solid waste management.
- Solutions should consider urban development and resettlement options. Local communities should be actively consulted and strongly involved in the development and decision-making process.

PROJECT CONCEPT 3. STUDY FOR THE INTRODUCTION OF CLIMATE RESILIENT AND SUSTAINABLE DOMESTIC GREYWATER MANAGEMENT SYSTEMS

PROJECT CONCEPT 3	
Project title	**Study for the introduction of climate resilient and sustainable greywater management systems**
Objective	To develop and promote sustainable greywater management solutions for Saint Lucia
Rationale With climate change, sea-level rise, lower annual rainfall amounts but more intense rains, and tropical storms in the Caribbean, associated flooding episodes are expected to increasingly affect Saint Lucia's population, economic activities and environment in the coming decades. This could not only jeopardise development gains but exacerbate the effects of current unsustainable practices and increase the vulnerability of the country's land, freshwater and marine resources, food production and health systems, with potentially irreparable damage if no timely and effective adaptation measures are implemented. The implementation of sustainable and integrated water management practices, including the appropriate management of wastewater, has the potential to reduce pollution, environmental and health risks and is recognised as a 'no regrets' adaptation option. In Saint Lucia, most greywater is discharged untreated into open drains and ultimately enters the marine environment. The main reasons for such practice include existing separation between black and grey water at the household level, the savings on septic tank maintenance, the long-lasting (cultural) practice and to some extent inadequate sanitation education. Inhabitants seem not to link such practices to poor coastal water quality, whether using an on-site facility or connected to a sewer network. The introduction of a new approach about greywater practice is a key challenge to reduce environmental and climate-related risks. It is also a technical challenge since today, most households are still directly connected with pipes to the drains.	
Scope	All greywater producers in Saint Lucia (i.e. households, public offices, businesses, restaurants, hotels)
Activities and Tasks – Conduct a study for guiding the effective introduction of greywater management techniques in the Saint Lucian context. The study should include: • Guidelines for greywater management, including both sustainable technologies and practices (catalogue of technologies and practices). The guidelines will provide information/parameters for the design, construction, modification, operation and maintenance of facilities. The guidelines should also include the retrofitting of water-saving systems and should inform users about technical support units and services (e.g. technical support unit at the Ministry of Health and Wellness, sanitary engineers, masons, plumbers, material and equipment providers); • An analysis of the support required to facilitate the private sector to import and distribute the required new technologies and equipment; • The design of public awareness-raising and promotion campaigns for the sustainable management of wastewater and materials and recommendations for the introduction of relevant courses in the curriculum of primary and secondary schools;	

PROJECT CONCEPT 3	
Project title	**Study for the introduction of climate resilient and sustainable greywater management systems**
• The selection of a pilot area to start implementation; • An analysis and test of financial mechanisms (such as, subsidies, incentives, tax credits for early birds) and technical support to encourage the Saint Lucian population to build and adopt appropriate technologies.	
Implementation • **Leading agency:** Water Resources Management Agency (WRMA) • **Technical Support**: Ministry of Infrastructure, Port, Energy and Labour; Water and Sewerage Company Inc. (WASCO); Ministry of Economic Development, Housing, Urban Renewal, Transport and Civil Aviation; Ministry of Education, Innovation, Gender Relations and Sustainable Development • **Financing:** GoSL and development partners	
Indicative cost	USD 100,000
Duration	1 year (initial project; implementation may last 5 - 10 years, depending on enforcement capacities and political support)
Additional information • This project is aligned with the Water SASAP's measures 29, 30, 32, 33, and 52 can contribute to implementing measures 2, 6 and 53. • This study could be extended to other sources of surface water pollution such as car-wash areas, gas stations, and careening activities. • The study should consider as a first measure for implementation the reduction of pollution at the source (reduction of greywater volume generation). The study should consider the introduction of reduced flow devices and appliances and should promote the adoption of appropriate practices and behaviours. Options for rainwater collection and on-site greywater reuse should be assessed. • The guidelines shall propose solutions to move from existing greywater practice to sustainable greywater management infrastructure; specifically, how to change/modify the existing on-site piping system to move from an unimproved to an improved infrastructure.	

PROJECT CONCEPT 4. PILOTING LOW COST INDIVIDUAL CLIMATE RESILIENT SANITATION SYSTEMS IN COASTAL AREAS

PROJECT CONCEPT 4	
Project title	**Piloting low cost individual climate resilient sanitation systems in coastal areas**
Objective	To develop low-cost, on-site sanitation technologies for low-lying areas to decrease the risk of coastal water contamination by faecal matter

Rationale

Saint Lucia is highly vulnerable to the impacts of climate change and associated hazards. Poor water and sanitation infrastructure and services add to the country's vulnerability as with global warming, sea-level rise, extreme weather events and flooding episodes - linked to increasing rates of pollution and water and vector disease outbreaks - are expected to increasingly affect the island in the coming decades. Investment in climate-resilient water and sanitation infrastructure has the potential to minimise these risks and is recognised as a 'no regrets' adaptation option.

Saint Lucia's coastal towns/villages do not have sewer systems. Limited space and high-water tables hamper the construction of proper on-site sanitary facilities such as septic tanks and soakaway systems. Many inhabitants depend on public toilets. In Canaries, for example, many households do not have toilets. In some cases, the poor management and restricted opening hours of public toilets cause open defecation practices, especially during the night.

The isolated coastal towns and villages border the vulnerable marine environment. Soil is mostly clayey and saturated with a high-water table, which disrupts the absorption function of septic tank and soakaway. The areas are also prone to flooding.

A high unemployment rate and limited financial capacities within the communities make investments and cost recovery very challenging. Up to 2017, no affordable and appropriate low-cost and watertight on-site sanitation facilities had been proposed or tested in Saint Lucia.
Biofil digester and Canteiro bio-septico, developed in Ghana and Brazil, respectively, are such technologies worthy of being tested.

The Biofil Digester system operates on the principle of aerobic decomposition. The digester is a simple compact onsite organic waste treatment system. The three principles of this system are: 1) Rapid separation of solid and liquid, 2) Aerobic decomposition of solid, and 3) Bio-filtration of wastewater.

The system is easy to install, its space requirement is low, usually operates without odour and is feasible in areas with a high-water table. The system requires minimum maintenance; since the system does not produce faecal sludge, it does not need to be de-sludged. The digester gets full after 10 years of operation and the top soil can be removed easily (no truck needed).

The Canteiro bio-septico works with a flush toilet system. It can also receive domestic greywater. It is a single chamber where organics are decomposed by microorganisms through both aerobic and anaerobic digestion. Plants are planted on top of the structure. The water is absorbed by the roots then eliminated through evapo-transpiration. Some organics are also consumed by the plants. There is no effluent or sludge to be emptied.

Scope	Low-lying areas and coast towns/villages: Vieux Fort, Anse la Raye, Canaries, Soufrière, Laborie, Choiseul, Micoud and Dennery Use of new technologies can be extended to other areas of the island.

PROJECT CONCEPT 4	
Project title	**Piloting low cost individual climate resilient sanitation systems in coastal areas**
Activities and Tasks • Identify and select technologies to be imported and piloted (study tours to Brazil and Ghana); • Identify and select households in coastal towns/villages for building, operating and maintaining the facilities (at least 10 households, is recommended); • Conduct a workshop with the household owners and the technical unit to share information about the objectives of the project, the rules and behaviour, to operate the facilities; • Conduct regular field visits for sampling and data collection (effluent quality, solids decomposition, infrastructure conditions); • Identify issues, gaps and improvement measures.	
Implementation • **Leading agency:** Water Resource Management Agency (WRMA) • **Implementation entities:** Town Councils and selected households • **Technical Support**: Technical unit from Water and Sewerage Company Inc. or WRMA • **Financing**: GoSL and development partners	
Indicative cost	USD 100,000
Duration	1 year
Additional information • This project is aligned with the Water SASAP's measures 26 and 30 and can contribute to implementing measures 2 and 28. • Special attention should be given to the material used to build the facilities. Saturated soil and seawater may accelerate erosion of the superstructure. • Special attention should also be given to building the climate resilience of the structures. • If the pilot is successful, the new technologies should be added to the on-site sanitation guidelines and widely disseminated.	

PROJECT CONCEPT 5. PIG FARMS' WASTEWATER AND MANURE MANAGEMENT: PILOTING SOLUTIONS TO REDUCE WATER POLLUTION UNDER A CHANGING CLIMATE

PROJECT CONCEPT 5	
Project title	**Pig farms' wastewater and manure management: Piloting solutions to reduce water pollution under a changing climate**
Objective To develop and test technologies for the safe treatment of pig farm wastewater and manure in the Saint Lucian context to prevent coastal, surface and groundwater contamination	
Rationale Saint Lucia's Climate Change Adaptation Policy recognises the challenge of providing freshwater to the country's populations and economic activities under a changing climate. Freshwater shortages have already started to be experienced and are expected to increase with time. This will be driven by an increasing demand brought by a growing population, while climate change induces lower annual precipitation and more erratic rainfall, higher evaporation, and saline intrusion into coastal rivers due to sea-level-rise, all of which exacerbate the effects of current pressures on the country's fragile water resources. Untreated pig-farm waste is a major source of pollution and a cause of concern for Saint Lucia's water systems, particularly when swine farms are located close to river banks and above water intakes. Making use of simple and well-tested waste and wastewater treatment technologies to eliminate this form of pollution is a valid adaptation measure and key to securing the quality of freshwater resources under a changing climate. The manure production from swine farms is the result of a mix of urine, faeces, water used for cleaning activities and wasted potable water. The wastewater (manure slurry) contains a high organic load, high nitrogen content and can be highly pathogenic. Saint Lucia has a significant number of registered pig farms with a few equipped with biogas digesters; thus, wastewater from swine farms still remains largely untreated in Saint Lucia, causing contamination of the watershed. The volume of manure and wastewater is estimated to be close to the overall production of domestic Faecal Sludge (FS) of the island. The poor management of the manure and liquid waste and the location of a few farms above Water and Sewerage Company Inc.'s drinking water intakes make this sector a key challenge to be addressed by the Government of Saint Lucia. If properly managed, wastewater and manure generated by pig farms can also result in highly valuable products. Thus, pig farm wastewater management shall focus on resource recovery of waste. Different (low-cost) technologies are available for effective waste management such as composting, vermicomposting, bio digesters, waste stabilisation ponds/lagoons and constructed wetlands. It is recommended that the Beausejour Agricultural Station initiate a pilot project to optimise the recovery of biogas from pig waste with different sizes of digesters (fixed-dome, tubular digesters). The Centre shall support some committed farmers to test composting and vermicomposting systems under Saint Lucia's climatic conditions.	
Scope	Wastewater and manure generated by small, medium and large-scale pig farms in Saint Lucia

PROJECT CONCEPT 5	
Project title	**Pig farms' wastewater and manure management: Piloting solutions to reduce water pollution under a changing climate**

Activities and Tasks

- Identify and select the technologies to be imported and piloted (study tours in Korea or Vietnam for bio-digesters, in Cuba for vermicomposting);
- Preliminary study to determine the design and capacity of the systems that will be constructed;
- Construct the bio digesters on the Beausejour Agricultural Station site;
- Select farmers to host the composting and vermicomposting pilot projects (at least 5 farms for each system);
- Design of on-site data collection, sampling and analysis procedures (identification of key parameters);
- Recommendation for improvements and scaling up.

Implementation

- **Leading agency**: Government agency with responsibility for Agriculture
- **Implementation entities**: Beausejour Agricultural Station
- **Financing**: Government of Saint Lucia and development partners

Indicative cost	USD 100,000
Duration	1 year

Additional information

- This project is aligned with the Water SASAP's measures 30 and 32 can contribute to implementing measure 36. Given that pig farming is one of the major agricultural activities in Saint Lucia and today's management of manure and wastewater is poor, it is recommended that Saint Lucia develops an Agricultural Competence/Reference Centre to support and enforce the sector (mainly individual farmers) to implement appropriate technical, cost-effective solutions to reduce water and environmental contamination, and create secondary revenue sources from the production of valuable by-products (soil amendment, biogas). The Beausejour Agricultural Station is an ideal location to host such reference activity.
- Saint Lucian personnel could seek training in Cuba. Cuba is a specialist in vermicomposting for waste from farming. Vermicomposting centres are numerous in Cuba and vermicomposting has been the largest single input used to replace commercial fertiliser. In 2003, an estimated one million tons of vermicomposting were produced in Cuba.

PROJECT CONCEPT 6. IMPROVEMENT OF EXISTING AND DEVELOPMENT OF NEW FAECAL SLUDGE TREATMENT PLANTS TO REDUCE CLIMATE-RELATED HEALTH AND ENVIRONMENTAL RISKS

PROJECT CONCEPT 6	
Project title	**Improvement of existing and development of new Faecal Sludge Treatment Plants (FSTPs) to reduce climate-related health and environmental risks**
Objective	To provide safe treatment and disposal of Faecal Sludge (FS)
Rationale With climate change, sea-level rise, lower annual rainfall amounts but more intense rains, and tropical storms in the Caribbean, associated flooding episodes are expected to increasingly affect Saint Lucia's population, economic activities, and environment in the coming decades. This could not only jeopardise development gains but exacerbate the effects of current unsustainable practices and increase the vulnerability of the country's land, freshwater and marine resources, food production, and health systems, with potentially irreparable damage if no timely and effective adaptation measures are implemented. The implementation of sustainable and integrated water and waste management practices, including the appropriate management of wastewater, has the potential to reduce pollution, environmental and health risks and is recognised as a 'no regrets' adaptation option. The disposal and treatment of FS is critical in Saint Lucia. 81% of FS is collected, but only partially treated (Beausejour and Union FS Treatment Plants) and probably 19% is dumped directly onto open land, causing environmental and human health risks, which will only increase with climate change-induced, more frequent weather extremes. Since most of the population relies on on-site sanitation facilities, safe FS treatment and disposal services should be provided and enforced for all areas of Saint Lucia. To optimise the use of existing installations, an upgrading of the existing installation to treat the effluent from FS drying beds should be assessed (e.g. the waste stabilisation ponds from Hewanorra International Airport). Beausejour Wastewater Treatment Plant (WWTP) offers an ideal location to build a state-of-the-art Faecal Sludge Treatment Plant (FSTP). Land is available and the existing waste stabilisation ponds in operation could be used for secondary treatment of the effluent from faecal sludge drying beds. Given Saint Lucia's climate (temperature, air moisture, rainfall and tropical storms), planted drying beds for FS treatment may be the most appropriate technology. Local climate is ideal for the growth of macrophytes, and even if the operation of such a plant requires qualified staff, it provides better treatment than unplanted drying beds. This technology requires very little operation and maintenance. The products are potentially highly valuable if culturally accepted.	
Scope • Island wide; all sectors relying on on-site sanitation systems (households, public offices, businesses, industries/factories, restaurants, hotels); • Small scale WWTP mainly operated by hotels; • Existing large-scale WWTP.	
Activities and Tasks • Conduct a study to determine the FS volume to be treated annually and determine the peak flow production if any (e.g. rainy season); • Conduct a FS quantification study (annual volume to be emptied and treated in the Northern	

PROJECT CONCEPT 6	
Project title	**Improvement of existing and development of new Faecal Sludge Treatment Plants (FSTPs) to reduce climate-related health and environmental risks**
and Southern parts of the island, seasonal peak flow); • Conduct a FS characterisation study (FS sampling and analysis of total solids, total suspended solids, chemical oxygen demand); • Assess the feasibility to connect the sludge drying beds to Beausejour and Hewanorra International Airport WWTPs for secondary treatment of the effluent; • Identify and select the most appropriate technology for FS treatment for Saint Lucia specific context (planted or unplanted drying beds with or without settling tank); • Design the FSTPs; • Conduct a study on affordability, cost structure and recovery; • Contract a local construction company to construct the FSTPs. • Conduct staff training on FSTPs.	
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Implementation entities**: Construction sector • **Technical Support**: External consultant • **Financing**: GoSL and development partners	
Indicative cost	USD 400,000
Duration	1.5 years
Additional information • This project is aligned with the Water SASAP's measures 28, 30 and 31, and can contribute to implementing measures 26, 27 and 32. A market assessment study should be conducted to evaluate the potential demand for dried FS (e.g. agriculture, farming, greenery). The market assessment should include a cultural assessment component to address public acceptance in using products from planted drying beds. • The World Health Organization requires at least 6 months of storage duration of dried sludge from unplanted drying bed. For both planted and unplanted drying beds, the dried sludge should be analysed to ensure they are pathogen-free and thus safe for reuse. • Possibility of discharging the sludge from the WWTP (Beausejour WWTP, WWTPs from private hotels) on the planted drying beds should be assessed. • The FSTPs will be built for climate resilience from the design stage. • The FSTPs can be operated by WASCO, the town/village councils or operation can be delegated to private companies through a PPP scheme. It is recommended that workshops/consultations be held with FS emptying service providers to agree upon, among other things, the FS discharge tariffs and the opening hours to decrease uncontrolled FS discharge into the environment. • BOD5 concentration is often required to design a FSTP, but results from analyses are often inaccurate and unreliable with heterogeneous substrate such as FS.	

PROJECT CONCEPT 7. STRENGTHENING WASTEWATER MANAGEMENT AND HEALTH UNDER A CHANGING CLIMATE: THE DEVELOPMENT OF AN INDUSTRIAL WASTEWATER ORDINANCE (IWO) FOR SAINT LUCIA

PROJECT CONCEPT 7	
Project title	**Strengthening wastewater management and health under a changing climate: The development of an Industrial Wastewater Ordinance (IWO) for Saint Lucia**
Objective	To develop a legal instrument to regulate and enforce industrial wastewater management in Saint Lucia to protect the environment and public health from industrial contamination
Rationale Saint Lucia's Climate Change Adaptation Policy recognises the challenge of providing freshwater to the country's populations and economic activities under a changing climate. Freshwater shortages have already started to be experienced and are expected to increase with time. This will be driven by an increasing demand brought by a growing population, while climate change induces lower annual precipitation and more erratic rainfall, higher evaporation, and saline intrusion into coastal rivers due to sea-level-rise, all of which exacerbate current pressures on the country's fragile water resources. Safeguarding Saint Lucia's water resources and services under a changing climate requires the urgent implementation of sustainable and integrated water management practices, including the appropriate management of wastewater, recognised as a 'no regrets' adaptation option. Among the 122 industries/manufacturers registered in Saint Lucia, only one operates a wastewater treatment plant package. The absence of technical support and the lack of legal and regulatory framework for industrial wastewater management (e.g. no standards in terms of effluent quality discharge for industries), is a key challenge. The results are large quantities of industrial wastewater entering untreated into water courses. The sector needs to develop an IWO, taking into consideration the new international trend, such as the cleaner production approach. The IWO shall require every business that intends to discharge industrial wastewater into a public sewerage system or the receiving environment to first obtain an Industrial Wastewater Discharge Permit. The issuing Authority shall agree on the proposed measures to minimise the impact of the industrial wastewater discharge (e.g. waste minimisation procedures, requirements for on-site wastewater (pre-) treatment and safe disposal for wastewater sludge). Because of the increasing evidence of the environmental and economic benefits associated with reducing waste at the source, rather than managing such waste after it is produced, industrial companies/factories should be required to submit a Waste Minimisation Plan with every demand for a new permit or extension, to be combined, for example, with the operational/occupation permit. As a condition for approval of an Industrial Wastewater Discharge Permit, an applicant may be subject to participation in the Self-Monitoring Programme. This Programme shall require a company to provide chemical and biological analyses of its industrial wastewater to the enforcement Authority on a regular basis.	
Scope	New and actual industries (manufacturing) on the island
Activities and Tasks • Consult with the industrial sector representatives (industry representatives, Saint Lucia	

PROJECT CONCEPT 7	
Project title	**Strengthening wastewater management and health under a changing climate: The development of an Industrial Wastewater Ordinance (IWO) for Saint Lucia**
Chamber of Commerce, Industry and Agriculture, Manufacturers' Association) to identify the issues and challenges; • Draft the IWO (requirements for obtaining a Discharge Permit, Waste Minimisation Plan); • Draft the Self-Regulation Plan; • Validate the IWO through a national workshop with key stakeholders; • Establish effluent standards for discharging industrial wastewater either into a public sewer system or directly into the environment. It should differentiate the categories of industries according to the wastewater strength and characteristics; • Introduce specific and affordable wastewater treatment technologies for the different industrial sectors.	
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Implementation entity**: Government agency with responsibility for Environmental Health • **Technical Support**: Saint Lucia Bureau of Standards, National Conservation Authority, Saint Lucia Chamber of Commerce and Industry, and Manufacturers' Association • **Financing**: GoSL, development partners and industries	
Indicative cost	USD 30,000
Duration	6 months
Additional information • This project is aligned with the Water SASAP's measures 2 and 27 and can contribute to implementing measures 3, 15 and 37. • The development of IWO should be done by using a participatory approach with the industries. It will facilitate cooperation between public authority and industries and ultimately encourage compliance. • Explicit climate change adaptation considerations should be integrated in the IWO. • The IWO must be realistic and should consider that high standards lead to high treatment costs that can jeopardise or stymie the economic viability of industries. Development of incentives mechanisms, and long adaptation periods may be investigated. • Standards may be adjusted for small businesses (for example implementation of standards proposed over a certain time frame such as 5 years), to facilitate progressive investments and improvements. • Industries will need technical support to apply a cleaner production approach as well as to choose, build and operate adequate sanitation systems. The approach may need qualified international consultants to provide technical support to specific industries. • Industrial wastewater regulation may be linked to regulations for safe management of hazardous material.	

PROJECT CONCEPT 8. CHARACTERISATION OF RIVER WATER-QUALITY ZONES IN SAINT LUCIA: LAYING THE FOUNDATION FOR THE SUSTAINABLE USE OF WATERSHEDS AND RIVER WATERS UNDER A CHANGING CLIMATE

PROJECT CONCEPT 8	
Project title	**Characterisation of river water-quality zones in Saint Lucia: Laying the foundation for the sustainable use of watersheds and river waters under a changing climate**
Objectives	• To set the basis for establishing usage zones along rivers for improving management of abstraction, discharge and other activities which may impact water quantity and quality • To minimise negative impacts of users on each other • To zone the activities that can take place along watersheds by their minimum water quality requirements
Rationale This project will lay the foundation for the establishment of a river use policy by clearly demarcating cross sections of rivers and identifying the type of activities which could be undertaken within each cross section. The objective of this classification exercise would be to harmonise the water quality within each cross section with the activities within the area. This will help resolve water-related conflicts by facilitating stakeholder activities being managed in such a way that they have minimal negative impacts on each other. The demarcation and implementation of water usage zones along river basins of key watersheds will optimise the use of raw water resulting in reduced treatment costs for public utilities and bottling companies and will reduce their risk of contamination of water supplies during extreme weather events (floods) which are expected to more frequently affect Saint Lucia under a changing climate.	
Beneficiaries: River water users	
Activities and Tasks • Identify river water monitoring points within watersheds to establish water quality baseline values (BOD, Bacterial, pH, suspended solids, etc.); • Characterise the river basins according to water quality (determined in monitoring points); • Establish usage zones based on characterisations; • Identify appropriate uses and activities for each usage zone; • Monitor water quality at transition points between zones; • Survey each zone to identify impacting activities to the water quality within the cross section; • Where necessary, act to ensure that activities within zones are congruous with the zoning requirements.	
Main outputs/products • Establishment of water quality zones along the river. • Periodic aerial images of zones.	
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Financing:** Government of Saint Lucia and development partners	
Indicative cost	USD $300,000.00 per watershed

PROJECT CONCEPT 8	
Project title	**Characterisation of river water-quality zones in Saint Lucia: Laying the foundation for the sustainable use of watersheds and river waters under a changing climate**
	One-time cost of USD $70,000.00 for purchase of a monitoring drone.
Duration	24 months
Additional information • This project is aligned with the Water SASAP's measures 2 and 7 can contribute to implementing measures 5, 8, 9,10, 15, 16, 18, 19 and 68. This is a multi-thematic initiative having elements of watershed management and land use planning.	

PROJECT CONCEPT 9. INCREASING WATER AVAILABILITY DURING DRY PERIODS: PILOT PROJECT FOR RAINWATER HARVESTING (RWH) SYSTEMS FOR FARMS (POULTRY FARMS, SMALL CROP FARM HOLDINGS).

PROJECT CONCEPT 9	
Project title	**Increasing water availability during dry periods: Pilot project for Rainwater Harvesting (RWH) systems for farms (poultry farms, small crop farm holdings).**
Objective	To pilot the effectiveness of RWH and storage systems in ensuring the availability of water to small livestock and crop holdings especially during dry periods or droughts

Rationale

Climate change in Saint Lucia is expected to reduce the total annual precipitation and induce more intense and unpredictable rainfall events. Along with higher temperatures, longer and more frequent dry periods and recurrent drought will lead to water stress, which will decrease crop and livestock production in areas with no alternative water sources, affecting food security and farming livelihoods in the island. RWH has been proposed as a 'no regrets', simple and effective adaptation measure to enhance water availability during dry periods.

Currently, the main water utility company in Saint Lucia rations water during the dry season and as a result, farmers who rely heavily on this resource for maintaining crop and animal production are significantly impacted. This project proposes the installation of pilot RWH systems in key areas of small-scale crop and livestock farms which rely on raw and potable water for production. The project is set to showcase the effectiveness of RWH technologies in sustaining production during water-related emergencies, including periods of drought when the intermittency of water supply increases.

This initiative would assist in maintaining agricultural production levels during the dry season; or in drought conditions, reduce reliance on the water utilities company for supplying water to farms; and directly support food security.

Beneficiaries	Livestock and small crop farmers

Activities and Tasks

- Identify areas vulnerable to low water supply for agriculture production and number of persons affected;
- Retrofit existing or construct new RWH infrastructure, including water storage tanks;
- Perform an assessment of farming infrastructure such as farm houses and greenhouses;
- Identify suitable location for water storage area per farm;
- Perform an assessment of the water supply and potential demand per farm;
- Identify the mean rainfall total for the location;
- Create a maintenance plan and sustainability of the system project.

Main outputs/products

- RWH systems installed and used in key farming areas of five (pilot) livestock and small crop holdings. Reduced water stress on crop and animal production during water-related emergencies and droughts, hence maintaining production yields.

PROJECT CONCEPT 9	
Project title	**Increasing water availability during dry periods: Pilot project for Rainwater Harvesting (RWH) systems for farms (poultry farms, small crop farm holdings).**
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Financing**: GoSL and development partners	
Indicative cost Water tanks: 25 x 1000 gallon water tanks = USD 20,000 Plumbing materials: 25 X USD 500 = USD 12,500 Labour: 5 HRS X 25 = USD 500 X 15 = USD 12,500 Transportation: USD 963 Consultancy/Contractor's fee per site/farm = USD 1,851.85 x 5 = USD 9,259.25 Indicative total cost: USD 55,222.25	
Duration	6 months per project site
Additional information • This project is aligned with the Water SASAP's measures 20, 22 and 55 and can contribute to implementing measures 24, 58, 62 and 70. The project is proposed as a pilot in five farms. It is expected that the successful trials can be replicated and scaled-up by farmers in areas with similar conditions.	

PROJECT CONCEPT 10. ENHANCEMENT OF SAINT LUCIA'S EARLY WARNING SYSTEMS AND FLOOD EMERGENCY RESPONSE THROUGH FLOOD HOTSPOT ANALYSIS, GUIDELINES, TRAINING PLAN, PROCUREMENT AND INSTALLATION OF FLOOD LEVEL GAUGES

PROJECT CONCEPT 10	
Project title	**Enhancement of Saint Lucia's early warning systems and flood emergency response through flood hotspot analysis, guidelines, training plan, procurement and installation of flood level gauges**
Objective	To improve strategic flood response measures and early warning systems by enhancing flood event data collection and analysis
Rationale With climate change, sea-level rise, lower annual rainfall amounts but more intense rains and tropical storms in the Caribbean, associated flooding episodes are expected to increasingly affect Saint Lucia's population, economic activities and environment in the coming decades. This could not only jeopardise development gains, but exacerbate the effects of current unsustainable practices and increase the vulnerability of the country's land, freshwater and marine resources, infrastructure, food production and health systems, with potentially irreparable damage if no timely and effective adaptation measures are implemented. Saint Lucia's Climate Change Adaptation Policy calls for the set-up and promotion of integrated early warning and response systems as a climate change adaptation measure required to reduce risks and losses associated with flooding and landslide episodes. This includes those experienced in the country with the impact of Hurricane Thomas in 2010, which amounted to 43.4% of the island's Gross Domestic Product, or of the 2013 unseasonal low-level trough system which crossed the island and produced greater than 224 mm of rainfall in a matter of two to three hours, impacting 2,600 persons directly, killing 6, and causing USD 89.2 million in damages. Developing flood prediction models to set up the integrated early warning systems requires the systematic and consistent collection of a broad range of quality data, with the appropriate geographical coverage in Saint Lucia. Currently, there is an island-wide flood early warning system that requires improving, as data limitations do not allow for the calculation of the magnitude of flooding, hampering the prioritisation of areas of intervention during emergencies. This project will improve the existing early warning system and hence, inform the adjustment of emergency response measures by enabling (in terms of infrastructure, modelling, and training in data collection and analysis) the National Emergency Management Organisation (NEMO) to correlate rainfall quantity to flood levels and thus monitor the magnitude of flooding in flood-prone community zones. Proposed location/site(s) for installing flood level gauges and collecting data for the hotspot analysis: Anse La Raye Village, Castries (central business district), Canaries Village, Dennery Village, Bois D'Orange, Soufrière (New Development), Cul De Sac and Bexon	
Beneficiaries	Community members and households exposed to flooding
Activities and Tasks • National flood hotspot analysis; • Installation of flood level indicators for reporting and emergency response.	
Main outputs/products • Mapped flood hotspots. • Improved community flood emergency response (improved early warning system).	

PROJECT CONCEPT 10	
Project title	**Enhancement of Saint Lucia's early warning systems and flood emergency response through flood hotspot analysis, guidelines, training plan, procurement and installation of flood level gauges**
Implementation • **Leading agencies:** National Emergency Management Organisation (NEMO), Met Office, Water Resources Management Agency (WRMA) • **Financing:** Government of Saint Lucia and development partners	
Indicative cost Consultancy fees (Flood hotspot analysis, guidelines, training plan): USD 200,000 Procurement of flood gauges: USD 10,000 Installation of gauges: USD 400 Training of community members of reading gauges: USD 3,000 Total: USD 215,000	
Duration	3 months
Additional information • This project is aligned with the Water SASAP's measures 14, 63, 64, 65 and 66.	

PROJECT CONCEPT 11. ENHANCEMENT OF EARLY WARNING SYSTEMS AND FLOOD EMERGENCY RESPONSE THROUGH THE CONSTRUCTION OF FIVE CONTROLLED STRUCTURES IN KEY WATERSHEDS AND THE INSTALLATION OF STAFF GAUGES AT STREAM GAUGING SITES

PROJECT CONCEPT 11	
Project title	**Enhancement of early warning systems and flood emergency response through the construction of five controlled structures in key watersheds and the installation of gauges at stream gauging sites**
Objective	To create a conducive data collection environment for flood prediction through the installation of required river structures
Rationale With climate change, sea-level rise, lower annual rainfall amounts but more intense rains and tropical storms in the Caribbean, associated flooding episodes are expected to increasingly affect Saint Lucia's population, economic activities and environment in the coming decades. This could not only jeopardise development gains but exacerbate the effects of current unsustainable practices and increase the vulnerability of the country's land, freshwater and marine resources, infrastructure, food production, and health systems, with potentially irreparable damage if no timely and effective adaptation measures are implemented. Saint Lucia's Climate Change Adaptation Policy calls for the promotion of integrated early warning and response systems as a climate change adaptation measure required to reduce risks and losses associated with flooding and landslide episodes. This includes those experienced in the country with the impact of Hurricane Thomas in 2010, which had a total cost of 43.4% of the island's GDP, or of the 2013 unseasonal low-level trough system which crossed the island and produced greater than 224 mm of rainfall in a matter of two to three hours, impacting 2,600 persons directly, killing 6, and causing USD 89.2 million in damages. However, developing flood prediction models for setting up the integrated early warning systems requires the systematic and consistent collection of a broad range of quality data, with the appropriate geographical coverage in Saint Lucia and appropriate predictive models. This initiative would allow for the placement of controlled structures within rivers which would facilitate the calculation of river rating / stage discharge curves, demarcating floodplain areas and providing necessary data for establishing hydrologic models. The collection of hydrologic data currently provides a huge challenge because of the unpredictable pathing behaviour of rivers in Saint Lucia. This initiative would seek to facilitate consistent and accurate automatic data capturing of water levels. The data captured via this initiative would be used to support the Flood Early Warning Systems (FEWS) as well as develop informational resources for the Flood and Drought Management Committee, the Water and Sewerage Company Inc. (WASCO) and other stakeholders. Proposed location/site(s): Near existing bridges, intakes and John Compton Dam	
Direct Beneficiaries	Hydrological data users, Water Resources Management Agency (WRMA)

PROJECT CONCEPT 11	
Project title	**Enhancement of early warning systems and flood emergency response through the construction of five controlled structures in key watersheds and the installation of gauges at stream gauging sites**
Activities and Tasks • Discuss with the Ministry with responsibility for Infrastructure and the Water and Sewage Company (WASCO) to incorporate the design of weirs during their construction of bridges and intakes.; • Find suitable location where weirs can be erected; • Procure staff plates; • Conduct civil works to create controlled structures where they are needed; • Undertake installation of staff plates using levelling technique.	
Main outputs/products • Creation of hydrograph and rating curves which can be used in the design of bridges, culvert and other critical infrastructure. This will also aid in flood modelling for predicting floods/flash floods based on rainfall intensities.	
Implementation • **Leading agencies**: Water Resources Management Agency (WRMA) • **Technical Support**: National Emergency Management Organisation (NEMO), Met Office • **Financing**: Government of Saint Lucia and development partners	
Indicative cost Five controlled structures: USD 150,000 Procurement of staff plates: USD 2,000 Installation of staff plates: USD 1,000 Indicative total cost: USD 153,000	
Duration	9 months
Additional information • This project is aligned with the Water SASAP's measures 18 and 65 and can contribute to implementing measures 1, 2, 8, 63 and 66. The initiative is proposed as a collaboration among Ministries.	

PROJECT CONCEPT 12. LAND ACQUISITION AND PUBLIC-PRIVATE PARTNERSHIPS (PPPS) FOR WATERSHED MANAGEMENT, PROTECTION AND INFRASTRUCTURE UPGRADE IN A CHANGING CLIMATE

PROJECT CONCEPT 12	
Project title	**Land acquisition and Public-Private Partnerships (PPPs) for watershed management, protection and infrastructure upgrade in a changing climate**
Objectives	• To protect and restore lands in critical watersheds (especially privately-owned lands) • To obtain lands for the installation of requisite water infrastructure (water tanks, intakes, wastewater treatment facilities etc.) • To establish a registry of lands available for water resource management/administration
Rationale Deforestation and unsustainable land use are diminishing the capacity of Saint Lucia's watershed ecosystems to deliver fundamental water provision and regulation services. These processes lead to increased runoff, landslides and the siltation and pollution of freshwater resources. The loss of these services is of particular concern as it is expected that in the coming decades, a growing country population will increase the demand for freshwater, while climate change reduces annual rainfall amounts but intensifies rainfall events, which could lead not only to more prolonged dry periods and drought -and consequent water shortages- but also to more frequent and potentially devastating floods. To safeguard Saint Lucia's water resources and reduce disaster risks in a changing climate, it is imperative to immediately reduce human pressures on, and restore key forested watershed areas (e.g. deterring the encroachment of agriculture and other unsustainable practices into forest reserves and water intake areas and reducing unplanned residential development along river/ravine buffer zones). However, many of the environmentally critical areas in watersheds are privately owned. The acquisition of these lands by the state would facilitate their sustainable management. Failing to reserve them early means they may be compromised, or difficult to obtain them later. This project would seek the identification and subsequent acquisition of private lands for watershed management and protection and installation of water infrastructure (intakes, storage tanks, wastewater treatment facilities etc.). This will create the requisite land resource to secure the allocation of areas for these necessary resources and contribute to strengthening the country's water sector under a changing climate. **Proposed location/site(s):** As identified by the relevant stakeholders (i.e. the Water Resources Management Agency (WRMA), the Forestry Department, the Water and Sewerage Company Inc. (WASCO) and others)	
Beneficiaries	Private residences and businesses in the areas fed by the water watershed and infrastructure
Activities and Tasks • Identify suitable lands (both through preliminary desktop and technical studies); • Determine ownership; • Explore PPP options for ecosystem restoration, reforestation and other activities; • Request Cabinet approval to acquire;	

PROJECT CONCEPT 12	
Project title	**Land acquisition and Public-Private Partnerships (PPPs) for watershed management, protection and infrastructure upgrade in a changing climate**
• Conduct Surveys (land and valuation); • Carry out acquisitions of lands; • Generate a land register.	
Main outputs/products • Registration of lands for watershed management/protection and infrastructure improvement. • Land bank (to ensure that lands are available for the use before the need arises).	
Implementation • **Leading agencies:** WRMA, Forestry Department, Physical Planning (Development Control Authority, Surveys, Valuation, Crown Lands) • **Financing:** GoSL and development partners	
Indicative cost	Intakes (10): Land per watershed/intake: USD 1,000,000 Protection (fences): USD 50,000 Indicative total cost: USD 10,500,000
Duration 2 years	
Additional information • This project is aligned with the Water SASAP's measures 10, 15 and 68 and can contribute to implementing measures 8, 9, 11, 12, 19, 25 and 69. The initiative is proposed as a collaboration among Ministries.	

PROJECT CONCEPT 13. LAYING THE GROUND FOR THE SUSTAINABLE MANAGEMENT OF GROUNDWATER RESOURCES UNDER A CHANGING CLIMATE: THE DEVELOPMENT OF A HYDROGEOLOGICAL MAP FOR SAINT LUCIA

PROJECT CONCEPT 13	
Project title	**Laying the ground for the sustainable management of groundwater resources under a changing climate: The development of a hydrogeological map for Saint Lucia**
Objectives	• To develop a hydrogeological map for Saint Lucia • To identify groundwater abstraction points • To identify groundwater resources • To populate a database of groundwater sources
Rationale Saint Lucia suffered the worst drought in forty years in 2009-2010 and has experienced drought conditions each year since 2012. Water stress has affected crop and livestock production and the living conditions of all Saint Lucians, as the entire island has been periodically placed on water rationing. The levels of the country's largest freshwater reservoir, the John Compton Dam, have fallen critically during these drought events and the dam's storage capacity has been severely compromised by sedimentation, delivered by landslides and triggered by hurricanes and heavy storms. Exploring alternative water sources and planning their sustainable management and use is critical for securing availability and supply of freshwater in Saint Lucia under a changing climate. Climate projections for the country indicate that in the coming decades, Saint Lucia will see an overall reduction in annual precipitation, more frequent and intense dry spells and more intense and unpredictable rainfall events, all detrimental to the availability, quality and supply of water from current surface water sources. In view of the above considerations, Saint Lucia has started to explore and use, to a limited extent, its groundwater resources. However, data and financial limitations still hamper the planning process for the sustainable exploitation of groundwater on the island. One major gap is the absence of a hydrogeological map. This instrument is key for identifying abstraction points, selecting sites for groundwater exploration and establishing site-specific groundwater protection zones (and associated land use regulation) to prevent groundwater contamination. Proposed location/site(s): Island-wide	
Beneficiaries	The entire Saint Lucian population
Activities and Tasks • Consult stakeholders; • Conduct an accurate ground field survey at several scales; • Collect and review water related documents (policy, legislation, regulation); • Collect, review and update existing geographical information (soils, topography, land use, etc.); • Collect and review historical information on existing groundwater wells; • Conduct a public notification campaign of the project (print and digital media); • Collect historical meteorological and hydrological data and information;	

PROJECT CONCEPT 13	
Project title	**Laying the ground for the sustainable management of groundwater resources under a changing climate: The development of a hydrogeological map for Saint Lucia**
• Geotag confirmed groundwater abstraction points; • Generate groundwater database; • Generate maps; • Inform policy; • Conduct training.	
Main outputs/products • Hydrogeological map • Geophysical map • Land use regulation and policy • Legislation • Procedures and standards for sustainable groundwater exploration and use	
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Financing**: GoSL and development partners	
Indicative cost USD 3 million	
Duration 36 months	
Additional information • This project is aligned with the Water SASAP's measures 19 and 25 and can contribute to implementing measures 1, 17 and 67.	

PROJECT CONCEPT 14. PUBLIC SENSITISATION TOWARDS IMPROVING THE MANAGEMENT, CONSERVATION AND PROTECTION OF WATER RESOURCES UNDER A CHANGING CLIMATE

PROJECT CONCEPT 14	
Project title	**Public sensitisation towards improving the management, conservation and protection of water resources under a changing climate**
Objectives	• To increase public awareness of the role played by each individual in causing and solving water resource management problems • To increase public participation in improving water resource management • To jump-start the public education/sensitisation activities within the water sector and establish a product which would be able to draw corporate sponsorship
Rationale Saint Lucia relies heavily on the abstraction of surface water to meet water consumption demands. However, poor land use and conservation practices have exacerbated soil erosion and increased the risk of landslides, which result in large sediment loads reaching the country's rivers, particularly during heavy rain events and tropical storms preceded by dry periods. This affects river water quality, reduces the capacity of freshwater reservoirs and ultimately compromises water supply in the island. This situation could worsen in the future if no action to improve farming and other land-use practices is undertaken, as with climate change, Saint Lucia is expected to experience an overall reduction in annual precipitation, more frequent and intense dry spells and more intense and unpredictable rainfall events in the coming decades. In view of the above considerations, it is crucial to raise public awareness on the role farmers and citizens in general play in securing the quality and provision of water in the future and to spark changes in the attitudes and unsustainable practices that currently compromise land and surface water resources. This project focuses on exposing Saint Lucians to sustainable land use and water conservation practices and encouraging to adopt them, in order to reduce river sedimentation and to better manage water supplies during periods of water scarcity. Proposed location/site(s): Island-wide	
Beneficiaries	The entire Saint Lucian population
Activities and Tasks • Organise an annual exhibition during the week of World Water Day; • Conduct water-themed school competitions, including quizzes; • Design and conduct conservation activities (tree planting, river/wetland clean ups) • Conduct panel discussions; • Develop animated public service announcements for broadcast on radio and television (English and Creole); • Consider an annual award for communities illustrating best water management practices.	
Main outputs/products • Quarterly news bulletin (electronic publication) highlighting local actions (success stories) • Informational video productions • Jingles and animated comic series	

PROJECT CONCEPT 14	
Project title	**Public sensitisation towards improving the management, conservation and protection of water resources under a changing climate**
• Population behavioural change	
Implementation • **Leading agency**: Water Resources Management Agency (WRMA) • **Financing**: GoSL and development partners	
Indicative cost USD 120,000	
Duration 36 months	
Additional information • This project is aligned with the Water SASAP's measures 6, 20, 22, 29, 54 and 55 and can contribute to implementing measures 16 and 32. The project is also aligned with and contributes to the implementation of Saint Lucia's Climate Change Communications Strategy (2018). • This project is also of relevance for the Agriculture SASAP and thus, this concept note is also included in it.	

PROJECT CONCEPT 15. BUILDING CLIMATE RESILIENCE IN SAINT LUCIA THROUGH THE DOCUMENTATION OF EFFECTIVE INDIGENOUS SOIL AND WATER CONSERVATION MEASURES FOR REPLICATION AND PROMOTION

PROJECT CONCEPT 15	
Project title	**Building climate resilience in Saint Lucia through the documentation of effective indigenous soil and water conservation measures for replication and promotion**
Objectives	• To identify and document soil and water conservation measures used in Dennery and Mabouya Valley • To assess the effectiveness of indigenous soil and water conservation measures under current and expected future climate conditions
Rationale The Saint Lucia Climate Change Adaptation Policy (2015) calls for close attention to be paid to the traditional technologies and skills that have allowed the country's communities to cope successfully with climate variability in the past and to combine these with modern knowledge and technologies, where appropriate. While there are several examples of indigenous adaptation and coping strategies in the country's agricultural sector, these have not been rigorously documented or assessed, missing the opportunity of utilising the local knowledge in planning and implementing adaptation responses for the sector at the national level. This project seeks to identify and assess the effectiveness of local and traditional soil and water conservation practices applied in some areas of the Dennery Mabouya valley, an area inhabited by many small-scale farmers and where agriculture often takes place over the surrounding steep slopes. In this region, soil erosion has become a very serious problem, triggered by the recent shift in cultivation from bananas to cash crops not suitable for local conditions. Documenting effective local strategies to address this problem is highly relevant now and not only for this area, but also for all agricultural regions in the country as with climate change, more frequent and extended dry periods and more intense rainfall events are projected. These are expected to exacerbate land degradation processes and to reduce water availability for agriculture. This initiative is proposed as the first of a series of projects to document and map local effective strategies to respond to environmental and climate change in Saint Lucia. Proposed location/site(s): Pilot in the Dennery Mabouya valley area and application island-wide	
Beneficiaries	• Farming community (hillside farmers) • Extension officers
Activities and Tasks • Select sites for information collection; • Collect local information and farmers' perspectives; • Collect socio-economic information; • Document measures; • Establish database of traditional and effective land and water conservation measures.	
Main outputs/products • Description of measures	

PROJECT CONCEPT 15	
Project title	**Building climate resilience in Saint Lucia through the documentation of effective indigenous soil and water conservation measures for replication and promotion**
• Identification of soil and water conservation measures • Description of the environmental conditions where the measures have been applied • Assessment of indigenous soil and water conservation measures	
Implementation: • **Leading agency**: Government agency with responsibility for Agriculture (Extension Department) • **Technical Support**: Engineering Department, Research Department • **Financing**: Government of Saint Lucia and development partners	
Indicative cost USD 60,000	
Duration: 2 years	
Additional information • This project is aligned with the Water SASAP's measures 16 and 60 and can contribute to implementing measures 2, 3. 6, 12, 13, 14 and 15. This project is also of relevance for the Agriculture SASAP and thus, this concept note is also included in it.	

PROJECT CONCEPT 16. BUILDING CAPACITIES FOR NATIONAL MONITORING, SURVEILLANCE AND ENFORCEMENT OF CONTROL MEASURES FOR SOUND CHEMICALS AND HAZARDOUS WASTES TO PREVENT THE CONTAMINATION OF CRITICAL WATER RESOURCES UNDER A CHANGING CLIMATE

PROJECT CONCEPT 16	
Project title	**Building capacities for national monitoring, surveillance and enforcement of control measures for sound chemicals and hazardous wastes to prevent the contamination of critical water resources under a changing climate**
Objective	To strengthen/develop capacity for monitoring, surveillance and enforcement of regulatory measures related to sound chemicals and hazardous waste management
Rationale Saint Lucia's population, economic activities and environment will be increasingly affected by climate change in the coming decades. Climate projections indicate that the country will experience the effects of sea-level rise, lower annual precipitation, recurrent drought, stronger and more erratic rainfall events and more intense tropical storms (and associated flooding episodes). These effects are also expected to exacerbate current land degradation processes and, along with higher temperatures, reduce the availability and quality of freshwater resources. This will occur while water demands for all activities in the island increase with population growth. In view of the above considerations, reducing potential sources of water pollution is clearly a priority for safeguarding the quality and availability of freshwater in Saint Lucia under a changing climate. This includes reducing risks associated with *inter alia*: • Agro-chemical contamination of water sources from increased runoff and erosion of farming areas. • Poor operational performance of inundated municipal and household septic systems contaminating drainage and water supplies. At present, an assessment of the existing institutional and regulatory environment for the sound management of chemicals and hazardous wastes is underway with the aim of making recommendations for strengthening national regulatory capacity. Weak enforcement of existing legislation has emerged as one of the main barriers to implementing a national programme for chemicals management and safety and in particular, the reduced ability of the Customs and Excise Department to effectively monitor the import of chemicals and chemical products of global and national concern. The proposed project is expected to support the enforcement of existing and planned regulatory control measures, resulting in improved capability to detect and monitor imports of chemicals/chemical products subject to regulation. The detection of illegal imports and implementation of pollution monitoring and surveillance programmes are key elements for ensuring that the risk of exposing residents and sensitive ecosystems to hazardous substances is minimised. The Customs and Excise Department, the Ministry of Health, Department of Agriculture, Fisheries and Natural Resources, and the Department of Sustainable Development are proposed as the main project partners.	
Beneficiaries	• Direct beneficiaries: Government agencies with responsibility for the control and life-cycle management of chemicals and products with chemicals of concern (Pesticides and Toxic Chemicals Control Board/Government agency with responsibility for Agriculture, Ministry of

PROJECT CONCEPT 16	
Project title	**Building capacities for national monitoring, surveillance and enforcement of control measures for sound chemicals and hazardous wastes to prevent the contamination of critical water resources under a changing climate**
	Health and Wellness, Customs and Excise Department, Saint Lucia Bureau of Standards) • Indirect beneficiaries: community members and households exposed to contaminated drinking water and recreational water bodies
Activities and Tasks • Develop and establish an effective mechanism for updating and including chemicals and/or chemical products of global and national concern into existing national legislation and/or enacting new legislation where appropriate; • Undertake the revision/strengthening of existing legislation (External Trade Act, Pesticides and Toxic Chemicals Control Act, Public Health Act); • Conduct the identification and provision of resource and training needs.	
Main outputs/products • Mechanism/system established for updating and including chemicals and/or chemical products of concern into existing legislation • Capacity to implement the Globally Harmonised System of Classification and Labelling of Chemicals (GHS) assessed and developed • Equipment to support monitoring and surveillance efforts (for imports and pollution control) and requisite training	
Implementation • **Responsible institutions**: Government agency with responsibility for Agriculture, Customs and Excise; Department of Sustainable Development; Ministry of Health	
Indicative cost 300,000USD	
Duration 18 months	
Additional information • This project is aligned with the Water SASAP's measures 39 and 40 and can contribute to implementing measures 37 and 38.	

PROJECT CONCEPT 17. DIGITISATION OF HISTORICAL HYDRO-METEOROLOGICAL DATA FOR IMPROVING CLIMATE CHANGE MODELLING AND ADAPTATION PLANNING IN SAINT LUCIA

PROJECT CONCEPT 17	
Project title	**Digitisation of historical hydro-meteorological data for improving climate change modelling and adaptation planning in Saint Lucia**
Objective	To rescue hydro-meteorological data from risk of being lost due to deterioration and store the recovered data To have the historic rainfall, watershed and river evaluations digitised and stored on media into computer compatible form for easy access
Rationale Historical climate data is fundamental for improving the climate change projections and for producing models at a scale that is useful for making decisions on adaptation options at the subnational level. The Water Resources Management Agency (WRMA) is the local authority charged with the responsibility of collecting, monitoring, analysing and storing of hydrological data. Before the existence of the WRMA however, the responsibility for collecting hydro meteorological data fell upon the agricultural engineering division's irrigation unit. Thus, a lot of historic hydro meteorological data resides within the Department of Agriculture as printed reports. To avoid the potential loss of such valuable data and increase its accessibility, it was concluded that the like should be digitally preserved. WRMA maintains a network of 17 conventional and automatic weather stations spread across the country, two soil moisture probes, four water level sensors and conducts stream flow and water quality data collection at 21 sites on a monthly basis. Data collected from these field stations and data collection activities are essential to the resultant information that is provided to the public and other key stakeholders within the water sector. These include but are not limited to Agriculture, Tourism, Civil Engineers, Public Utilities, Physical Planning Agencies, Environmental Agencies, Researchers and the National Emergency Management Office. Additionally, climate data is useful to analyse current and projected trends in surface water availability. This information is crucial to identify climate impacts and vulnerability for effective adaptation strategies in various climate-sensitive sectors. Apart from having a good observation network for hydrology, steps must be taken to ensure that the vast amount of hydrological data collected are properly preserved in an easily accessible useful form. Two of the components of the Global Framework for Climate Services (GFCS) of the World Meteorological Organization (WMO) include: i. **Climate Services Information System:** the mechanism through which information about climate (past, present and future) will be routinely **collected, stored** and processed to generate and deliver products and services that inform often complex decision-making across a wide range of climate-sensitive activities and enterprises; ii. **Observations and Monitoring:** to ensure that climate observations and other data, including metadata, required to meet the needs of end users are **collected, managed**, disseminated and its utility assessed.	
Beneficiaries	The public and other key stakeholders within the water sector
Activities and Tasks • This project will be executed with WRMA staff or other qualified personnel on their off hours/days;	

PROJECT CONCEPT 17	
Project title	**Digitisation of historical hydro-meteorological data for improving climate change modelling and adaptation planning in Saint Lucia**
• Search and locate the data; • Inventory of data in one central location; • Preservation and storage of data; • Validating the imaged files; • Key entry of the climate data; • Quality check of the climate data; • Analysis and climate products; • All metadata and relevant station information will also be collected and documented.	
Implementation	
• **Leading agency**: Water Resources Management Agency (WRMA)	
Indicative cost	USD 24,000
Duration	6 months
Additional information • This project can contribute to implementing Water SASAP's measures 8, 63, 66 and 67.	

PROJECT CONCEPT 18. IMPROVING CLIMATE OBSERVATIONS AND MONITORING SYSTEMS TO INFORM ADAPTATION PLANNING AND STRENGTHEN EARLY WARNING SYSTEMS

PROJECT CONCEPT 18	
Project title	**Improving climate observations and monitoring systems to inform adaptation planning and strengthen early warning systems**
Objective	To improve the hydro-meteorological monitoring capacity of the Water Resources Management Agency (WRMA) through the use of Automated Local Evaluation in Real-Time (ALERT) rainfall stations, acoustic doppler technology, water level sensors and environmental monitoring drones

Rationale

Climate change projections indicate that with climate change, Saint Lucia will experience lower annual rainfall amounts, higher intensity of rainfall events, more unpredictable weather patterns and more frequent flooding and drought episodes. In this context, the generation and use of reliable climate information, drought and flood models as well as their application in early warning systems and other climate services is fundamental to transmit to all sectors and regions of the country. This will provide relevant parties with the information they need to prepare for weather extremes in a timely and reliable manner.

Automated Local Evaluation in Real-Time (ALERT) was developed by the United States National Weather Service in the 1970's. It is intended to be a local flood warning system for local agencies. ALERT systems are fairly low cost and provide important real-time rainfall and flow/stage information to evaluate the potential for flooding. Although the intended application was for local flood warning systems, the Water Resources Management Agency (WRMA) recognises that this type of data network is an ideal tool for gathering the data it requires to fulfil its mandate. The Meteorological Services currently has 17 weather stations deployed on an ALERT network. The WRMA is very familiar with both the weather stations and the software package that are utilised in the Meteorological Services ALERT network, particularly since officers within the Agency have assisted in the installation of these stations, and under the AusAid project, WRMA facilitated the upgrading of the software package and the addition of two stations to this network.

The WRMA currently collects data from 17 rainfall stations (seven inoperable for three months), and four soil probes. Data from these stations are collected by monthly station visits. Upgrading the WRMA stations so that they could integrate into the ALERT network would allow for real time access to data as well as real time monitoring of each station. This real time monitoring will enable the WRMA to identify and respond more quickly to stations that become inoperable, since identifying issues at a given station currently takes up to one month. Additionally, the WRMA intends to expand the data collection capacity of the rainfall stations so that additional variables such as temperature, sunlight, humidity, atmospheric pressure, wind speed, soil saturation and in some cases, water levels in rivers would also be captured. This will allow for the creation of more accurate water availability, flood, and drought models that leverage more meteorological and environmental data variables. The ALERT data network is also a more resilient data network than the current WRMA rainfall and water level stations since, barring physical damage to the stations, data will continue to be transmitted irrespective of the conditions of the road network or telecommunications service providers.

The use of acoustic Doppler velocimeters will improve the efficiency of field data collection by reducing the need for manpower without compromising data quality. It would also allow river flows to be assessed in real time while in the field (hence improving on-site decision making).
Drones equipped with sensors specific to water resources management needs will serve as a vital

PROJECT CONCEPT 18	
Project title	**Improving climate observations and monitoring systems to inform adaptation planning and strengthen early warning systems**

tool to allow the Agency to undertake difficult tasks such as monitoring soil erosion, water balance, flood, drought, water quality, runoff, soil moisture, wetlands and reservoir content. Specialised drone sensors (RGB, IR, Multispectral and Thermal sensors) which are attached to these drones would assist the Agency in acquiring imagery more conveniently and at a finer geographic scale than more costly satellite and conventional aerial photography.

Data collected from water level stations when correlated with rainfall and stream flow data can assist in developing baselines specific to a watershed which could be used as thresholds for flood warnings. Additionally, abnormal changes in water level data can be an indication of upstream changes that the WRMA may need to investigate. Collecting such data thus enhances the Agency's ability to improve the accuracy of early warning systems as well as identify potential issues within a given watershed.

It is recommended that under the project, officers within the WRMA are fully trained in the configuration, maintenance and repair of the associated data loggers and ultra-high frequency (UHF) radios within the stations. Training on the use and maintenance of the acoustic doppler velocimeters and drones would also be required as well as training in image processing and analysis. This will ensure that moving forward, the WRMA can sustainably support these new technologies, thereby reducing data gaps. With the implementation of the proposed technologies and the appropriate training of officers in their configuration and upkeep, the environment to collect and provide quality data in a timely fashion will be enhanced. These datasets can then be leveraged for decision making, preparation of risk\hazard maps, and design of flood early warning systems.

WRMA has monthly stakeholder meetings during the dry season where updates on water availability are presented in an attempt to predict hydrological, meteorological and agricultural droughts. This information is also used to advise the public on proper water conservation practices due to pressures on the water availability within the watersheds.

Beneficiaries Vulnerable populations in low lying flood prone areas

Activities and Tasks

- Upgrade WRMA stations;
- Integrate into the ALERT network;
- Provide real time access to data as well as real time monitoring of each station;
- Identify and respond more quickly to stations that become inoperable;
- Expand the data collection capacity;
- Monitor soil erosion, water balance, flood, drought, water quality, runoff, soil moisture, wetlands and reservoir content;
- Train on the use and maintenance of the acoustic doppler velocimeters and drones;
- Train in the configuration, maintenance and repair of the associated data loggers and UHF radios within the stations.

Main outputs/products

- Reduced occurrence of data gaps in rainfall data, to capture high level flows and improve the quality of rainfall data.
- Additional variables logged to assist in creation of hydrological models
- Built capacity within WRMA to ensure cost effective and sustainable maintenance of rainfall stations
- Improved efficiency of stream flow data collection through the use of acoustic doppler velocimeters and water level sensors

PROJECT CONCEPT 18	
Project title	**Improving climate observations and monitoring systems to inform adaptation planning and strengthen early warning systems**
• Improved capacity for watershed monitoring and river assessments using drone technology • Stronger flood and drought early warning systems • Provided data for use in updating flood and landslide hazard maps	
Implementation: **Leading agency**: Water Resource Management Agency **Indicative cost** USD 444,440	
Duration	6 months
Additional information • This project is aligned with the Water SASAP's measures 63, 65 and 66 and can contribute to implementing measures 8 and 18.	

PROJECT CONCEPT 19. IMPROVING ENERGY EFFICIENCY WITHIN THE WATER SECTOR IN SAINT LUCIA THROUGH THE INTRODUCTION OF RENEWABLE ENERGY TECHNOLOGIES INTO THE OPERATIONS OF THE WATER AND SEWERAGE COMPANY INC.

PROJECT CONCEPT 19	
Project title	**Improving energy efficiency within the water sector in Saint Lucia through the introduction of renewable energy technologies into the operations of the Water and Sewerage Company Inc.**
Objective	To improve energy efficiency within the operations of the Water and Sewerage Company Inc. by introducing appropriate renewable energy technologies into the operations of the Water and Sewerage Company Inc.
Rationale	Climate change is projected to reduce the availability and quality of freshwater, cause more frequent damage to water infrastructure and increase water management costs in Saint Lucia, thereby affecting the water security of all Saint Lucians, especially vulnerable groups. Anticipating these impacts, the Water and Sewerage Company Inc. (WASCO) is making efforts to improve its operations, strengthen its infrastructure and reduce its operational costs. WASCO is wholly owned by the Government of Saint Lucia, with responsibility for the provision of water supply and wastewater management services throughout the island. WASCO is the only company engaged in the business of supplying water services to households and businesses in Saint Lucia, and it services approximately 58,000 connections. WASCO's potable water distribution system is heavily dependent on pumps which are mostly electrically powered, with the electricity being supplied by Saint Lucia's lone electricity supplier, the St. Lucia Electricity Services Limited (LUCELEC). The cost of energy represents a significant proportion of the operating costs of WASCO, and electricity costs account for approximately 20-25% of WASCO's total operational budget. WASCO has identified improvement in energy efficiency within its operations as a priority, and in that regard, with assistance from the Caribbean Development Bank, an Energy Efficiency Audit (EEA) of WASCO's overall operations is being conducted within the first half of 2018. The EEA will, among other things, identify Energy Efficiency Opportunities (EEOs) and Renewable Energy Options (REOs) related to, but not limited to, improvements in motor drives and pumps energy efficiency, pumping system controls, power factor; lighting, ventilating and air conditioning; building envelopes; and building control systems. WASCO will wish to pursue implementation of the recommendations relating to EEOs and REOs which will come out of the EEA, and this proposed project is intended to support the implementation of these recommendations, particularly those relating to REOs. WASCO has, to date, introduced small solar panels to assist in powering selected equipment in some remote locations. However, these have not had a major impact on the company's overall energy use. It is expected that by undertaking this proposed project, new renewable energy solutions and technologies will be introduced into WASCO operations on a larger scale and in a manner that will increase the level of reliance on renewable energy sources and decrease reliance on diesel-powered electricity, thereby reducing WASCO's carbon footprint. It is also expected that in the medium to long-term, further EEAs will be conducted so that assessments could be made of the impact of the renewable energy solutions and technologies on overall energy efficiency of the company.
Beneficiaries	The Water and Sewerage Company Inc. and its customers

PROJECT CONCEPT 19	
Project title	**Improving energy efficiency within the water sector in Saint Lucia through the introduction of renewable energy technologies into the operations of the Water and Sewerage Company Inc.**
Activities and Tasks • Review recommendations of the 2018 Energy Efficiency Audit of WASCO, with a view to identifying recommendations and options for introduction of renewable energy technologies into WASCO operations; • Develop detailed designs for priority renewable energy technologies to be introduced into WASCO operations; • Procure and commission the selected renewable energy technologies; • Train WASCO staff in the operation and maintenance of the renewable energy technologies; • Report on the commissioning of the renewable energy technologies and develop recommendations for related follow-up actions; • Create detailed designs of renewable energy technologies to be introduced into WASCO operations; • Procure and commission selected renewable energy technologies; • Train WASCO staff in the operation and maintenance of the renewable energy technologies; • Report on the commissioning of the renewable energy solutions and develop recommendations for related follow-up actions.	
Implementation	
• **Leading agency**: The Water and Sewerage Company Inc. (WASCO)	
Indicative cost	Consultancy on design of renewable energy solutions and training of staff: USD 100,000 Procurement and commissioning of renewable energy solutions: USD 500,000 Total: USD 600,000
Duration	9 months
Additional information • This project is aligned with measure 48 in the Water SASAP. • This project has climate change mitigation co-benefits	

12. CONCLUSION

Saint Lucia is highly vulnerable to climate change. Securing the availability, quality and supply of freshwater, while protecting lives, livelihoods, economic activities and critical infrastructure from the impact of hydrometeorological hazards, requires urgent action. The Water SASAP, a building block of Saint Lucia's NAP process, provides a framework for guiding this action and initiating the continuous and coherent process of integrating climate change considerations into policies, programmes, projects, activities and investments in the country's water sector. The implementation of the SASAP will require a concerted effort by all stakeholders from both the private and public sectors. Financing the SASAP will require the mobilisation of national, bilateral and international resources. High level political buy-in and commitment will contribute to the SASAP's implementation success, and to the achievement of the greater adaptation goals Saint Lucia has endorsed in its CCAP and in its various water-specific or -relevant policies, strategies and plans.

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ANNEX 1. POTENTIAL CLIMATE CHANGE IMPACTS ON SAINT LUCIA'S WATER RESOURCES AND SERVICES

Impacts	Repercussions
Impacts of more frequent extreme weather events (intense rainfall events, hurricanes, high winds, storm surges)	• Reduced water availability affecting all development sectors in the country. • Increased cost of treating and supplying potable water. • Increased cost of maintaining water infrastructure. • Increased risk of conflict over the use of water resources • Declining health (and biodiversity) of freshwater and marine ecosystems, including coral reefs, with increasing water pollution. • Increased sedimentation and pollution with agrochemicals leaching during strong rainfall events; more frequent flooding and water shortages, water-borne disease outbreaks and reduced marine life could negatively affect the tourism appeal of Saint Lucia.
• Increased risk of flooding	
• Destruction or damage of water intakes, dams, reservoirs during extreme weather events, leaving settlements without water or with poor water quality.	
• Increased soil erosion and surface run off on exposed soil leading to: siltation of river systems, dams and reservoirs (resulting in reduced dam capacity).	
• Reduced effectiveness of drainage infrastructure (increasing risk of flooding in low-lying coastal areas) • Increased risk of contamination of water sources from leaching of pit latrines, septic tanks and pig farms in rural areas into flood plains increases during flooding episodes. • Increased risk of agro-chemical contamination of water sources from increased runoff -and erosion- of farming areas. • Poor operational performance of inundated municipal and household septic systems contaminating drainage and water supplies. • Freshwater and marine ecosystems and biodiversity increasingly affected by heightened sedimentation and leaching of organic matter and agro-chemical during strong rainfall events. This would increasingly affect coral reefs, mangrove systems and fisheries.	
• Increased risk of water-borne and vector-borne disease outbreaks with flooding.	
Impacts of higher temperatures, prolonged and intense dry episodes and drought	
Reduced availability of freshwater resources due to long dry periods and reduced annual precipitation	
Higher temperatures and longer heatwaves leading to: • Increased water consumption • Increased municipal demand for freshwater	
Increased evapotranspiration leading to: • Higher demand and abstraction of water for agriculture (irrigation and livestock)	
Sea level rise impacts	
• Intrusion of seawater into freshwater lenses, particularly in low-lying coastal areas, further reducing the availability and quality of freshwater. • Irrigation with increasingly brackish water reducing crop production and salinising soils, affecting food security and quality.	

ANNEX 2. FEATURES OF SIGNIFICANT PAST, PRESENT AND PLANNED PROJECTS CONTRIBUTING TO CLIMATE CHANGE ADAPTATION IN SAINT LUCIA'S WATER SECTOR

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
Flood early warning system for Corinth of the Bois d'Orange River (as part of the CADM 2 project) Regional project Period: 2009 -2012 Status: Completed:		JICA/CDEMA	NEMO/WRMA/Met Office	The communities of Corinth and Bois D' Orange (approximately 6000 persons)	The SMS system is lacking during hurricanes due to delays and lag in the network. There were interferences due to network interruptions. Spare parts were not provided. The entire target community was not incorporated into the community disaster master plan. There was a lack of preliminary data to determine flood thresholds. The national desilting programme needs to be properly scheduled and coordinated to help reduce flooding during the rainy season.
CARAIBE-HYCOS Project Regional project Period: 2010-2012 Status: Completed	USD 2,300,000 (total project cost, including the Saint Lucian component)	WMO/IRD	WRMA	3 communities	- Issues concerning the security of installed field equipment. -More public education, sensitisation and awareness were needed concerning the value of the installed equipment (to foster community ownership). -Insurance of the equipment was required to foster improved operation, maintenance and recovery due to damage or theft. -Better civil works required to improve robustness and durability of installed structures.
Early warning system and hydrological monitoring for water management and disaster risk reduction.	Component 1: XCD 652,000 (revised XCD 869,233,	Government of Australia (AUSAID)	WRMA	Residents in the Castries, Anse la Raye and Canaries	Public awareness and education concerning the project's objectives was lacking during component 1.

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
COMPONENT ONE: Establishment of a hydrological monitoring system to enhance water management and early warning against floods and droughts. COMPONENT TWO: Identification, inventory, and assessment of suitable alternative water sources (underground sources) that could be managed and made available to the public during water scarcity situations such as floods and droughts. COMPONENT THREE: Identification, assessment and inventory of waste disposal sites that must be designated and declared as Waste Control Sites in order to protect the water resources of Saint Lucia. National Project Period: 2011-2015 Status: Completed	approx. USD 321,650) Component 2: XCD 604,000 (revised XCD 401,767, approx. USD 124,560) Component 3: XCD 389,500 (revised XCD 374,500, approx. USD 138,570)			Watershed for component 1.	After component 2, funding needs to be sourced for drilling, conducting pumping and water quality testing from wells. If water is safe, it can be used during droughts and other emergencies.
Consultancy services to develop a national wastewater management strategic plan. National project Period: 2015-2016	USD 228,740	World Bank	WRMA	Entire Population	

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
Status: Completed					
Enhancing Management of the Water Network and Capacity in the use of GIS Related Technologies to Build Resilience to Climate Change and Climate Variability: Reducing the Risks to Human and Natural Assets Resulting from Climate Change (RRACC) Regional project Period: 2013-2014 Status: Completed	USD 80,000	GEF	DSD, WASCO, WRMA	Targeted beneficiaries in all districts	The equipment provided/procured must be compatible with existing network.
Multi-hazard early warning system. National Project Period: 2016-2017 Status: Completed	USD 96, 831	UNDP	NEMO	The Dennery Village	
Technical assistance for optimisation of the meteorological and hydrological monitoring network National Project Period: 2016-2017 Status: Completed	USD 40,000	World Bank	WRMA/Project Coordination Unit	Entire country	A road map for strengthening operational weather, water, and climate services was developed. This project feeds into the implementation of the following project: Optimisation of meteorological and hydrological monitoring network through procurement of hydrological and meteorological equipment.
Development of guidelines for watershed management plan preparation and development of one watershed management plan for a critical watershed.	USD 350,277	World Bank	WRMA	Entire Population	

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
National Project End date: 2017 Status: Completed					
The Denney North Water Supply Redevelopment Project (Phase 1) National Project Period: 2016 –2018 Status: Ongoing	Phase 1: XCD 17.82 million (approx. USD 6,594,000) Phase 2: XCD 27 million (approx. USD 9,991,000)	GoSL and Mexican Government UNOPS	WASCO	Dennery North and environs	
Mainstreaming water harvesting in Saint Lucia National Project Period: 2017 – 2018 Status: Ongoing	USD 22,500	World Bank	WRMA	Island-wide	
Iyanola natural resource management of North East Coast Project. National Project Period: February 2015 -2019 Status: Ongoing	Approx. USD 7,513,426	Bal Environmental Facility (GEF / GoSL	Forestry Department	Island-wide	
Optimisation of meteorological and hydrological monitoring network through procurement of hydrological and meteorological equipment.	USD 1,077,689	World Bank	WRMA	Island Wide	

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
National Project Period: 2017 – 2019 (18 months) Status: Ongoing					
Climate Change Adaptation (CCA) and Sustainable Land Management (SLM) in the Eastern Caribbean Regional project Period: 2014-2020 Status: Ongoing	Euro 149,643	EU GCCA/OECS	Forestry Department	Farmers	GCCA Mango Project for rehabilitation of degraded lands and riverbank stabilisation. Also, to re-introduce rare native species of mangoes.
Integrating water, land and ecosystems management in Caribbean Small Island Developing States (IWECO) National Project Status: Ongoing	USD 2,205,446	GEF / GoSL	Forestry Department	Soufrière	
Consultancy to develop a watershed management plan for Vieux Fort. National Project Period: March 2018 – November 2018 Status: Approved	USD 150,000	Caribbean Development Bank (CDB GoSL	WASCO	Vieux Fort and environs	
The Vieux Fort Water Supply Development Project National Project Period: 2016-2021 Status: Approved/awaiting	XCD 65.26 million (approx. USD 24,148,500)	CDB and GoSL	WASCO	Vieux Fort and environs	

Project	Total Investment Cost	Donor/ Sponsor	Responsible Institutions	Direct Beneficiaries Targeted	Lessons Learned and Key Success Factors
Strengthening of flood early warning systems and hydrological data collection systems in Saint Lucia National Project Status: Approved	USD 100,000	Korean Government	WRMA	At least 3 communities	
The John Compton Dam Rehabilitation Project. National Project Status: Approved	XCD 49.4 million (approx. USD 18,295,000)		WASCO	North of the island	