Antigua & Barbuda

NATIONAL ADAPTATION PLAN

Enhancing Adaptive Capacity, Strengthening Resilience, and Reducing Vulnerability to Climate Change in Antigua & Barbuda

CITATION: Government of Antigua and Barbuda (2024), Antigua and Barbuda National Adaptation Plan: Enhancing Adaptive Capacity, Strengthening Resilience, and Reducing Vulnerability to Climate Change in Antigua and Barbuda, St. John's, Antigua.

Produced by the Department of Environment

The Department of Environment (DOE) is a government agency within the Ministry of Health, Wellness, Social Transformation, and the Environment in the Government of Antigua and Barbuda (GoAB). Its overall mission is to provide technical advice on the environment and to design and implement projects on behalf of the Government and the people of Antigua and Barbuda. The DOE is the national focal point for the multilateral environmental agreements (MEAs) to which the country is a Party. It accomplishes its mission inter alia through an integrated environmental planning and management system, efficient implementation of programmes, projects, and technical services, provision of the accurate council on environmental management as well as effective and consistent enforcement of environmental laws and regulations, and provision of easily accessible information and technical assistance to the public.

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Technical Contributions

Stakeholder agencies that supported the review of the NAP included the Environmental Awareness Group (EAG), Antigua and Barbuda National Parks Authority, Ministry of Finance, Corporate Governance and Public Private Partnerships, and Ministry of Tourism, Investment and Economic Development.

Partner Organisations

The Centre for Environment, Fisheries and Aquaculture Science (CEFAS) is an Executive Agency of Defra (the UK Government's Department of Environment, Food and Rural Affairs). CEFAS provided support for the collection of baseline adaptation data, which included a nationwide drainage model; nationwide satellite derived bathymetry; nationwide digital elevation models; nationwide benthic habitat and geomorphology maps; and nationwide orthophotos.

The NAP Global Network provided support for the development of Antigua and Barbuda's Adaptation Communications (ADCOM), a key product of the national adaptation planning process. Data and information from the ADCOM were integrated into the NAP Report. This product was also developed with funding support from the Government of the United Kingdom of Great Britain and Northern Ireland through the International Institute for Sustainable Development (IISD).

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We are delighted to present the National Adaptation Plan (NAP) for Antigua and Barbuda, a crucial milestone in our nation's ongoing efforts to address and adapt to the impacts of climate change. This comprehensive plan has been made possible through generous support and funding from the Green Climate Fund (GCF). As we celebrate the completion of this vital initiative, we extend our deepest gratitude to all those who have contributed to its fruition.

We would also like to extend our heartfelt thanks to the dedicated team of experts, consultants, and researchers who tirelessly worked on the formulation of this NAP. Their expertise, dedication, and passion for sustainability have been invaluable in shaping a plan that reflects the unique vulnerabilities and opportunities of Antigua and Barbuda.

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Furthermore, we extend our thanks to our international partners who have collaborated with us throughout this journey. Your continued support and collaboration have not only strengthened our NAP but also fostered meaningful partnerships for the effective implementation of adaptation strategies.

To our international partners and donors who have collaborated with us throughout this journey, we thank you. Your continued support and collaboration have not only strengthened our NAP but also fostered meaningful partnerships for the effective implementation of adaptation strategies.

As we move forward with the implementation of the National Adaptation Plan, we remain committed to working hand in hand with all stakeholders, building on the strong foundations laid through this collaborative process.

Together, we can forge a more climate-resilient future for Antigua and Barbuda, safeguarding our natural heritage and securing the well-being of our economic sectors and people for generations to come.

This National Adaptation Plan (NAP) for Antigua and Barbuda is being submitted to the United Nations Framework Convention on Climate Change (UNFCCC) by the Department of Environment, the national agency with responsibility for environmental management, including climate change issues. Antigua and Barbuda's NAP was developed with funding from the Green Climate Fund (GCF) through the Readiness Support Project: *National Adaptation Planning support for Antigua and Barbuda through Ministry of Health and Environment.*

GREEN CLIMATE FUND

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AC - Adaption Communication
A&B - Antigua and Barbuda
APUA – Antigua Public Utilities Authority
BEPAMU – Biodiversity, Ecosystems, and Protected Areas Management Unit
CARICOM – Caribbean Community
CCA – Climate Change Adaptation
CCORAL – Caribbean Climate Online Risk and Adaptation Tool
COVID – Coronavirus Disease
CAN – Competent National Authority
CO2 – Carbon Dioxide
DOE - Department of Environment
EIA – Environmental Impact Assessment
EIMAS – Environmental Impact Monitoring and Assessment System
EPMA - Environmental Protection and Management Act
GCF - Green Climate Fund
GDP – Gross Domestic Product
GEF – Global Environment Facility
GHG - Greenhouse Gases
GoAB - Government of Antigua and Barbuda
GGA – Global Goal on Adaptation
Ha – Hectare
I&H – Infrastructure and Housing
IPCC – Intergovernmental Panel on Climate Change
IP – Investment Programme
LAAP - Local Area Adaptation Plan
M&E - Monitoring and Evaluation
MCA – multi-criteria Analysis
MW – Megawatt
MOF – Ministry of Finance
MTDS – Medium Term Development Strategy
NAP - National Adaptation Plan
NDC - Nationally Determined Contributions
NGO – Non-Governmental Organization
OECS – Organization of Eastern Caribbean States
PAHO – Pan American Health Organization
PDNA – Post-Disaster Needs Assessment
PMC – Project Management Committee
PMU – Project Management Unit
PPA – Physical Planning Act
PV – Photovoltaic
RCP - Representative Concentration Pathway
RO – Reverse Osmosis
SAP - Sectoral Adaptation Plan
SLR – Sea Level Rise
SIDS – Small Island Developing States
SIRF – Sustainable Island Resources Framework
SIRMM – Sustainable Island Resource Management Mechanism
TAC - Technical Advisory Committee
UNDP – United Nations Development Programme
UNESCO – United Nations Educational, Scientific and Cultural Organization
UNFCCC - United Nations Framework Convention on Climate Change
UNICEF – United Nations Children's Fund
VSLA – Village Savings and Loans Associations
NRDC – Natural Resources Defense Council
USD – United States Dollar
UNFAO – United Nations Food and Agriculture Organization
W&R – Wholesale and Retail
WRI – World Resources Institute
XCD – Eastern Caribbean Dollar

Foreword

Climate change poses an existential threat to Small Island Developing States like Antigua and Barbuda. Rising sea levels, more frequent and intense hurricanes, and changes in rainfall patterns are already impacting our communities, our economy, and our environment. This National Adaptation Plan (NAP) represents a crucial step in our efforts to address these challenges and build a more resilient future for our nation.

This plan is the result of extensive research, stakeholder consultations, and expert analysis. It outlines a comprehensive framework for climate action, addressing key vulnerabilities and outlining concrete adaptation measures across various sectors. From strengthening our early warning systems to investing in climate-resilient infrastructure and promoting sustainable development practices, this NAP provides a roadmap for building a more resilient and sustainable future for Antigua and Barbuda.

The successful implementation of this plan will require the concerted efforts of government agencies, civil society organizations, the private sector, and the international community. I urge all stakeholders to work together to ensure the effective and timely implementation of the actions outlined in this NAP.

I am confident that through collective action and unwavering commitment, we can overcome the challenges posed by climate change and build a more prosperous and sustainable future for generations to come.

Sincerely,

Hon. Molwyn Joseph

Minister of Health, Wellness and Environment

Executive Summary

This National Adaptation Plan (NAP) outlines Antigua and Barbuda's comprehensive strategy to address the escalating challenges posed by climate change. As a Small Island Developing State (SIDS), we are acutely vulnerable to the impacts of climate change, including rising sea levels, extreme weather events, and increased temperatures. This plan aims to enhance our resilience by identifying and prioritizing adaptation actions across key sectors, including agriculture, tourism, infrastructure and housing, finance, wholesale and retail, as well as for cultural and historical resources.

The NAP is informed by extensive stakeholder consultations, scientific assessments, and climate projections. It outlines a vision for a climate-resilient future, where our communities, ecosystems, and economy can thrive despite the challenges posed by climate change. Key strategies include:

- **Strengthening Early Warning Systems:** Enhancing our capacity to predict and respond to extreme weather events through improved data collection, advanced forecasting models, and effective communication systems.
- **Investing in Climate-Smart Infrastructure:** Developing and implementing resilient infrastructure, such as seawalls, coastal defenses, and climate-proof buildings, to minimize the impacts of sea-level rise and extreme weather events.
- **Promoting Sustainable Land Use Practices:** Implementing sustainable land use planning strategies to protect critical ecosystems, such as mangroves and coral reefs, and reduce vulnerability to coastal erosion.
- **Diversifying the Economy:** Promoting economic diversification to reduce reliance on climate-sensitive sectors and enhance economic resilience.
- **Building Human and Institutional Capacity:** Strengthening the capacity of government agencies, communities, and individuals to plan for, adapt to, and respond to climate change.

The successful implementation of this NAP will require strong political will, inter-sectoral collaboration, and continued support from the international community. By working together, we can build a more resilient and sustainable future for Antigua and Barbuda.

I. Introduction

I.1. Scope

The formulation phase of the national adaptation planning process commenced in 2017[1] and was completed in 2024, supported by a budget of USD 3,000,000 from the Green Climate Fund (GCF) Readiness Grant. This project assumes a critical role in providing an evidence-based adaptation planning approach to mainstream climate change adaptation into Antigua and Barbuda's public and private sector operations to support the country's capacity to withstand the effects of climate change and promote enduring sustainable development. The plan is also set to address critical gaps that hinder effective adaptation efforts, and it will be implemented through a sector-driven and area-specific approach. These gaps are related to:

1. **Data collection**: to collect and store high resolution topographical data in Geographic Information System (GIS) format for Antigua and Barbuda; improve the quality of downscaled climatic projections; and engage in data exchange among agencies. While there is a large amount of baseline data, there are significant errors that expose the Government to liability issues if adaptation planning decisions are legislated. The NAP will fill these gaps.

2. **Planning mandates**: to establish sectoral plans that build on the actions identified in the Medium-Term Development Strategy (2015) and are prioritized based on financial and technical criteria; high-level (Cabinet) endorsement and buy-in; and proof of concepts for innovative financing models.

3. **Monitoring and Evaluation**: adaptation indicators exist but need to be aligned with the Sustainable Development Goals (SDGs) and national development frameworks to manage requirements for meeting M&E obligations.

Ultimately, the National Adaptation Plan (NAP) focuses on the development of climate adaptation strategies, guidelines, and action plans. Activities involve comprehensive vulnerability assessments across key sectors, the translation of findings into practical adaptation measures, and the creation of guidelines to seamlessly integrate climate resilience into development and sectoral endeavours.

Furthermore, this NAP will be implemented in collaboration with Government ministries, local authorities, non-governmental organisations (NGOs), international development partners, and community representatives.

[1] GCF National Adaptation Planning and Process Readiness Proposal with Ministry of Health and the Environment for Antigua and Barbuda. https://www.greenclimate.fund/sites/default/files/document/readiness-proposals-antigua-and-barbuda-ministry-health-and-environment-adaptation-planning.pdf

This plan also focuses on public awareness and capacity building, public awareness campaigns and capacity-building workshops/ training, which are integral to promoting understanding of climate change adaptation and resilience and is quite critical in the development of the NAP. However, the NAP does not encompass the direct implementation of physical adaptation measures.

I.2. Methodology for NAP Formulation (Principle and Approach)

The formulation of a NAP for Antigua and Barbuda involves a meticulous methodology grounded in principles and approaches tailored to the unique environmental and socio-economic context of these twin island state. In keeping in alignment with the vision of the NAP to enhance adaptive capacity, strengthen resilience, and reduce vulnerability to the adverse effects of climate change, the core of this process is a commitment to integrate climate change adaptation into national policies and development planning. The principle of inclusivity guides the formulation, ensuring that diverse stakeholders, including government agencies, local communities, and non-governmental organizations, actively participate in identifying vulnerabilities and proposing adaptive strategies. Furthermore, the approach is multifaceted, encompassing comprehensive vulnerability assessments, rigorous climate science, and an understanding of the islands' socio-economic dynamics. By aligning the NAP with existing national development frameworks, the methodology seeks to create a seamless integration of climate adaptation measures into broader policy agendas.

The Adaptation Communication (ADCOM) of Antigua and Barbuda played a crucial role in the formulation of the NAP for the twin-island nation. This milestone achievement marked the initiation of a strategic and comprehensive approach to address the impacts of climate change.

The ADCOM serves as a foundational document, established to adhere to the reporting requirements outlined in the Paris Agreement and its Enhanced Transparency Framework (ETF). By aligning with these international standards, Antigua and Barbuda demonstrated its commitment to transparent and accountable climate action.

One of the key contributions of the ADCOM was its role as a repository of information. It systematically introduced and outlined the primary climatic drivers affecting Antigua and Barbuda, providing a comprehensive understanding of the environmental challenges the nation faces. This knowledge base was essential for informed decision-making and prioritization in the development of the NAP. Furthermore, the ADCOM went beyond merely identifying challenges; it delved into the consequences of these climatic drivers. The document also demonstrated the nation's commitment to addressing climate change by presenting a detailed overview of both ongoing and planned initiatives.

Importantly, the ADCOM contributed to the understanding of the adaptation framework within the context of Antigua and Barbuda. By elucidating the intricacies of the nation's responses to climate change, it offered valuable insights into the overall landscape in which these adaptation measures were situated. This contextual understanding was crucial for the formulation of the

NAP as it ensured that the strategies proposed were not only effective but also tailored to the specific needs and challenges of Antigua and Barbuda. Furthermore, the executing of the NAP process for Antigua and Barbuda epitomized a dedicated commitment to a consultative and cooperative approach, marked by comprehensive stakeholder engagement. This process was characterized by the active participation of an expansive array of stakeholders, comprising both local and international actors from the public and private sectors. At the core of this initiative was a purposeful drive to bring together representatives from various sectors, including government agencies, private enterprises, non-governmental organizations, and community leaders. This comprehensive engagement approach aimed to capture a wide range of perspectives and insights, fostering a deep understanding of the unique challenges and opportunities, and priorities associated with climate adaptation in the context of Antigua and Barbuda.

Furthermore, inclusion of international stakeholders also played a pivotal role in facilitating the exchange of best practices, the infusion of specialized expertise, and the potential for financial support.

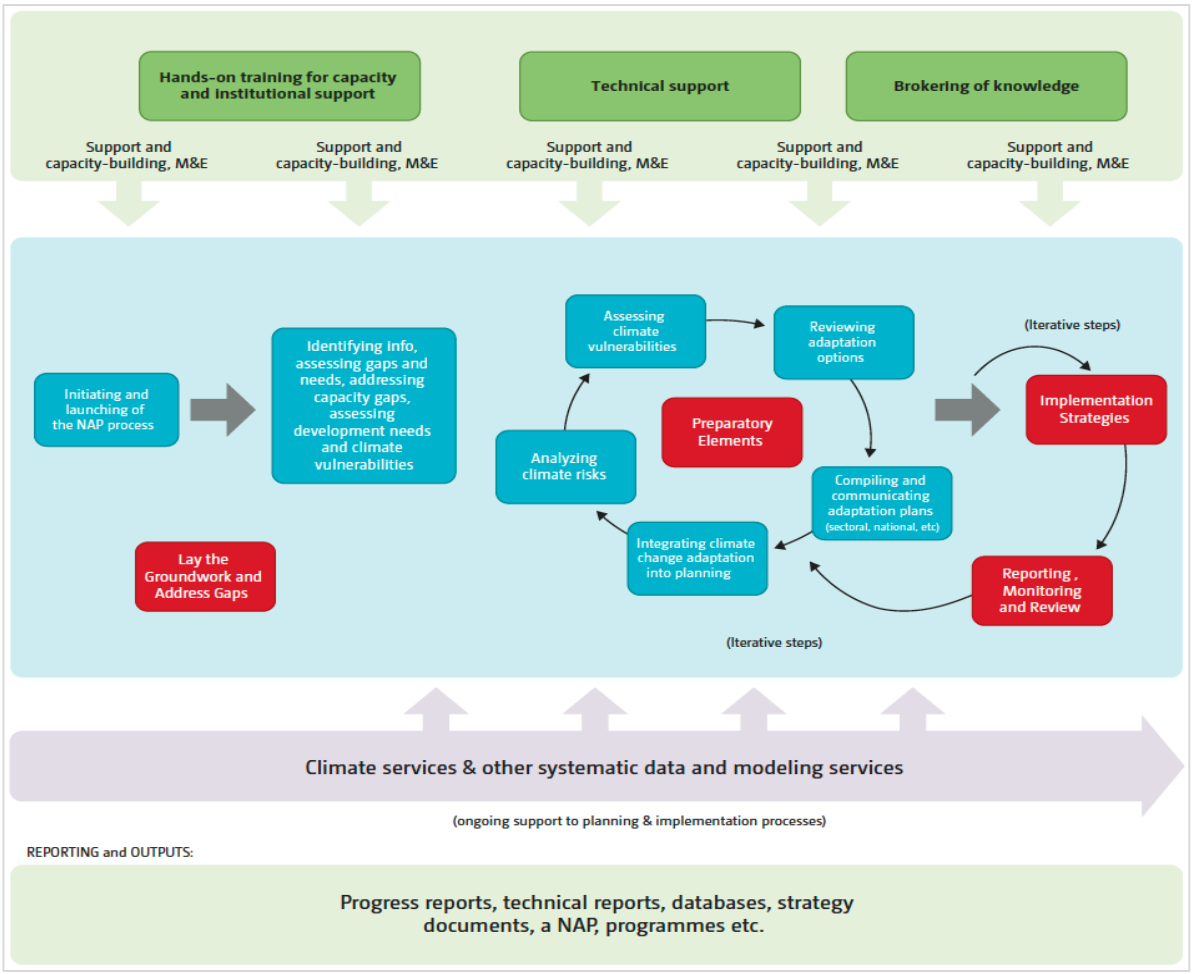

Figure 1: The National Adaptation Plan Process for the National Adaptation Plan Development for Antigua and Barbuda (UNFCCC, 2012)

ELEMENT A. LAY THE GROUNDWORK AND ADDRESS GAPS
1. Initiating and launching of the NAP process
2. Stocktaking: identifying available information on climate change impacts, vulnerability and adaptation and assessing gaps and needs of the enabling environment for the NAP process
3. Addressing capacity gaps and weaknesses in undertaking the NAP process
4. Comprehensively and iteratively assessing development needs and climate vulnerabilities
ELEMENT B. PREPARATORY ELEMENTS
1. Analyzing current climate and future climate change scenarios
2. Assessing climate vulnerabilities and identifying adaptation options at the sector, subnational, national and other appropriate levels
3. Reviewing and appraising adaptation options
4. Compiling and communicating national adaptation plans
5. Integrating climate change adaptation into national and subnational development and sectoral planning
ELEMENT C. IMPLEMENTATION STRATEGIES
1. Prioritizing climate change adaptation in national planning
2. Developing a (long-term) national adaptation implementation strategy
3. Enhancing capacity for planning and implementation of adaptation
4. Promoting coordination and synergy at the regional level and with other multilateral environmental agreements
ELEMENT D. REPORTING MONITORING AND REVIEW
1. Monitoring the NAP process
2. Reviewing the NAP process to assess progress, effectiveness and gaps
3. Iteratively updating the national adaptation plans
4. Outreach on the NAP process and reporting on progress and effectiveness

Table 1: Steps under each of the Elements of the Formulation of the National Adaptation Plans (Source: UNFCCC, 2012)

I.3. Legal Basis

The 2015 version of the Environmental Protection and Management Act[2] (EPMA) brought about a significant transformation by transitioning the Division of Environment into the Department of Environment (DOE) while also expanding its role. This expansion included the incorporation of the Sustainable Island Resources Framework Fund[3] (SIRF Fund) within its mandate. Subsequently, the 2019 version of the EPMA replaced the previous Act, entrusting the DOE with vital responsibilities such as overseeing the coordination and execution of cross-border environmental agreements, establishment, and administration of a viable financial mechanism

[2] An Act to provide for long-term environmental protection and management, to establish effective administrative responsibilities for environmental management, to undertake and coordinate environmental management and related activities, and to incorporate international environmental treaty obligations into national and legal matters.

[3] A national environmental funding facility initially set up as a Special Fund through the Finance Administration Act of 2006, Section 42 (1) (a) to support environmental management and climate adaptation and mitigation.

to support environmental stewardship, and management of governmental initiatives pertaining to climate change, sustainable development, as well as environment and natural resource management.

Building upon this foundation, the year 2021 saw the introduction of the Paris Agreement Regulations[4], designed to complement, and reinforce the provisions of the 2019 version of the EPMA. These regulations exhibit a specific focus on enhancing adaptability in the face of climate change. This focus is especially evident in sections that pertain to the proficient management of greenhouse gases[5] (GHGs) and other pollutants that impact both human and ecosystem resilience. Moreover, the regulations extend their purview to encompass climate change risk management and adaptation, emphasizing a comprehensive approach to addressing the challenges posed by a changing climate.

Additionally, vital to the development of the NAP, were various key policies, regulations, and plans. These include the 2015 Government of Antigua and Barbuda (GoAB) Medium Term Development Strategy (MTDS)[6], the National Physical Development Plan of 2015, the draft Building Code for the Organization of Eastern Caribbean States (OECS), the Coastal Management Plan of 2016, the Policy Framework for Integrated Adaptation Planning and Management of 2002, the National Comprehensive Disaster Management Policy and Strategy, and nonetheless, the EPMA of 2015.

[4] A legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015.

[5] A type of gas, such as carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), that can trap heat in the Earth's atmosphere.

[6] Ministry of Finance and Corporate Governance. 2015. Medium-Term Development Strategy 2016 to 2020. https://www.oneplanetnetwork.org/sites/default/files/antigua_barbuda_medium_term_development_strategy.pdf

I.4. National Circumstances

Geographic Context

The nation of Antigua and Barbuda, consists of two islands with a combined area of 170 square miles (108 mi² for Antigua and 62 mi² for Barbuda), is highly susceptible to the effects of climate change due to its geographical location at 17.1 degrees North and 61.5 degrees West, which causes the nation to be prone to the effects of climate change that can adversely impact the public and private sectors. The climate of these islands is moderately arid and tropical maritime, characterized by a dry season spanning from January to June and a wet season from July to December. Over the period from 1995 to 2021, the region has encountered 15 hurricanes and 14 tropical storms, making these weather events the primary climatic risks. Following closely are droughts, with 14 instances occurring between 2000 and 2020, categorized as severe, serious, moderate, and slight.

The Small Island Developing State (SIDS) of Antigua and Barbuda has also suffered from the adverse impacts of rising sea levels and elevated land and sea surface temperatures. Historical data shows an average annual temperature of 25.3°C from 1901 to 2016, along with an average annual precipitation of 2,468.2 mm. Due to the islands' low-lying topography, it is projected that by 2060, approximately 20 km² of land in Antigua and 15 km² of land in Barbuda will be lost due to rising sea levels, according to the Representative Concentration Pathway (RCP) 4.5 scenario outlined by the Intergovernmental Panel on Climate Change (IPCC). Under various RCP scenarios, sea surface temperatures are anticipated to increase by a maximum of 2.7°C.

Furthermore, General Circulation Models (GCMs) predict an 18% rise in the intensity of category 4 and 5 hurricanes for Antigua and Barbuda, compared to the intensity observed over the past three decades. Specifically considering the RCP 4.5 scenario, it is forecasted that between 2040 and 2069, there will be nine years of drought, signifying an 8% escalation[7] in the severity of droughts. However, a multi-model scenario indicates a potential increase of up to 23% in drought severity.

[7] DOE. 2022. Adaptation Communication for Antigua and Barbuda. https://unfccc.int/sites/default/files/ACR/2022-07/ATG%20-%20UNFCCC%20Adaptation%20Communication%20-%202022-06-29%20-%20Final.pdf

Additionally, Antigua's terrain is a combination of coral and ancient volcanic formations, characterized by its relatively flat landscape, except for the hilly southwest region, which includes the Shekerley mountains. The highest point on the island is known as Boggy Peak. Along its coastline, one can observe a jagged shoreline punctuated by numerous bays and rocky headlands, surrounded by vibrant coral reefs.

Geologically, Antigua can be divided into three distinct zones, running in a northwest to southeast direction. These zones encompass the southwest volcanic region, which coincides with the island's only significant topographical feature—the central alluvial plain—and the northeast limestone area. In contrast, Barbuda, located 40 kilometers due north of Antigua, is a low-lying limestone island. The Barbuda highlands present a distinctive landscape, marked by cavernous formations and sinkholes that add to the island's unique geological character. The Barbuda highlands present a distinctive landscape, marked by cavernous formations and sinkholes that add to the island's unique geological character. Notably, the island hosts the Codrington Lagoon on its western edge, which is surrounded by coral, shelly, and semi-crystalline limestone formations. Although, it has been affected by breaches due to events like hurricane Irma, it remains the largest lagoon in the Eastern Caribbean and holds the status of a Ramsar Wetland of International Importance. It is also home to the largest frigate bird sanctuary in the entire Eastern Caribbean region.

Antigua, Barbuda, and the nearby Redonda Island are interconnected by the Barbuda bank, an extensive underwater platform spanning an area of approximately 3,500 square kilometers. This geographical linkage further contributes to the rich natural diversity and ecological significance of the region.

Economic Context

Antigua and Barbuda have a dynamic and diversified economy with tourism and financial services at its core. The nation's economic landscape centers on tourism, a vital contributor to both its GDP and employment. With its pristine beaches, cultural attractions, and favourable climate year-round, the country draws tourists from around the globe, particularly through cruise ship arrivals and upscale resorts. With tourism, Antigua and Barbuda has developed a financial services sector, encompassing offshore banking and international business corporations, which generates substantial revenue through fees, licenses, and taxes. However, the economy faces vulnerabilities, including susceptibility to external shocks such as hurricanes and its reliance on international tourism, making it sensitive to global economic fluctuations.

Social Context

Antigua and Barbuda is characterized by a unique social context shaped by its historical, cultural, and economic influences. The country, with a population of approximately 97,000 as of 2021 has made significant strides in various social aspects, including gender issues. However, like many nations, it continues to grapple with certain social challenges.

Gender issues and context in Antigua and Barbuda are multifaceted. The nation has witnessed substantial progress in promoting gender equality, with women actively participating in various spheres of life, including politics, education, and the workforce. This progress can be attributed to legal frameworks and policies that promote gender equity. For instance, the 2015 Gender Equality Act seeks to eliminate discrimination on the grounds of gender in both the public and private sectors.

Despite these advancements, gender disparities persist, particularly in the economic sphere. Women continue to face challenges in accessing equal opportunities for leadership positions and equal pay for equal work. The traditional gender roles that have shaped Antiguan and Barbudan society for generations are still prevalent in some segments, affecting women's empowerment and economic independence.

Furthermore, issues related to gender-based violence remain a concern in the country. Initiatives have been undertaken to combat this problem, including the establishment of the Directorate of Gender Affairs, which aims to address gender-based violence, promote women's rights, and engage men and boys in gender equality efforts. However, challenges in enforcing existing legislation and providing adequate support services for survivors persist.

In the broader social context, Antigua and Barbuda are known for their rich cultural heritage and vibrant traditions. The country celebrates its African, European, and indigenous Amerindian roots through music, dance, and various cultural festivals. Tourism is a major economic driver, and the hospitality industry plays a crucial role in shaping the social fabric of the nation, bringing together people from diverse backgrounds.

Additionally, the country's history of British colonialism has left an imprint on its social dynamics. English remains the official language, and elements of British culture are evident in governance, education, and the legal system. However, the nation has also forged its own identity, blending these influences with its Afro-Caribbean heritage.

I.5. Vision and Goals

The vision of the NAP for the twin-island nation of Antigua and Barbuda is to support the global efforts on adaptation described in the Paris Agreement by **enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to the adverse effects of climate change**, specifically among both the local public and private sectors, and areas. To achieve this, four (4) key outcomes were formulated, each tailored to meet the critical requirements of climate adaptation for the twin-island nation. These outcomes and their associated deliverables have been substantiated through a validation process involving rigorous stakeholder consultations and thorough desk reviews.

Outcome 1: Adaptation baselines are established through data collection, compilation, and comprehensive climate change risk mapping.

Outcome 2: Stakeholders are engaged in the consultative adaptation planning process.

Outcome 3: Vulnerability Risk Assessment and Adaptation Plans are developed for the Public Sector and Private Sectors using a learning-doing capacity-building approach.

Outcome 4: Sustainable financing and workforce training strategies are developed to facilitate NAP implementation in the Public, NGO, and Private sectors.

Upon the fulfilment of these key outcomes, there will be:

Data Mapping for Adaptation

The Environmental Impact Monitoring and Assessment System (EIMAS) will undertake an extensive mapping of the data collected throughout the National Adaptation Plan (NAP) Process. This data mapping initiative will cater to the needs of various stakeholders, including planning agencies and financial institutions. By providing a detailed overview of climate-related data, this effort will permit key sectors to gain further understanding of climate risks. They will be equipped to identify and implement suitable measures for adaptation planning.

Enhanced Recognition of Adaptation Requirements

The private sector and non-governmental organizations (NGOs) will be enabled to recognize the adaptation requirements outlined in the Antigua and Barbuda Paris Agreement Regulations. This recognition will facilitate the development of skills necessary for conceptualizing and executing projects. It will also result in tangible proof of concepts that exemplify the successful implementation of NAPs, thus resulting in the growth of adaptation initiatives.

Updated Workforce Training for Climate Change

Antigua and Barbuda will make important changes to how they train their workforce about dealing with climate change. This transformation will involve the integration of training modules tailored for adaptation.

Knowledge Sharing and Supportive Mentorship

Antigua and Barbuda will provide mentorship and support to other small islands within the Organization of Eastern Caribbean States (OECS) sub-region. These mentoring efforts will be particularly valuable as these islands embark on their respective National Adaptation Plan (NAP) journeys.

Adherence to Reporting Obligations under the Paris Agreement:

The approved NAP will be communicated to the UNFCCC as Antigua and Barbuda's Adaptation Communication per the Paris Agreement Article 7.10.

I.6. Defining Sectoral Boundaries

Through the process to develop the Antigua and Barbuda NAP, the activities were surrounded around addressing the adaptation needs of Antigua and Barbuda, which are centered around: i.) coastal areas strengthening; ii.) water conservation; ii.) food, water, and energy security; iv.) populating baseline data; and v.) financial resources, and to ultimately contribute to the Global Goal on Adaptation (GGA)[8]. In alignment with these needs, the NAP was strategically designed to focus on those needs and engage in adaptation planning processes and supporting implementation by developing national climate assessments with climate resilient sector plans for six (6) sectors, along with critical cross-cutting issues, such as women, youth, persons with disabilities, the elderly, ethnic communities, and other marginalized groups – to identify appropriate strategies, incorporating priority actions into the NAP, and conducting technical studies in preparation for implementation of new climate regulations, along three (3) local area adaptation plans tailored to specific areas within Antigua and Barbuda. These plans specifically targeted key sectors and local areas that have been identified as particularly vulnerable to the adverse impacts of climate change and were used to support the development of the NAP.

The sectors and areas are as follows:

The Culture and Historical Sites Sector

This sector is responsible for preserving, promoting, and celebrating the rich cultural heritage and historical landmarks of the country. This includes maintaining and showcasing traditional practices, art, music, and festivals, as well as managing and conserving important historical sites, monuments, and artifacts that hold significance to the nation's history and identity.

Food Security

The food security sector focuses on ensuring a consistent and reliable supply of safe, nutritious, and affordable food for the population. This involves promoting sustainable agriculture, improving distribution networks, enhancing local food production, and implementing policies to reduce food vulnerabilities and ensure access to food for all residents.

Infrastructure and Housing

The infrastructure and housing sector covers the developing and maintaining essential public facilities, transportation systems, utilities, and housing infrastructure. This includes constructing

[8]UNFCC.2021. The Adaptation Committee Considers Methods to Review the Global Goal on Adaptation. https://unfccc.int/news/the-adaptation-committee-considers-methods-to-review-the-global-goal-on-adaptation?gclid=CjwKCAjwo9unBhBTEiwAipC117ZJTD_qf2d9_ev4OolfGuw8xoxE1dwkNA7-qoQA0lXE3nMu-ezP_hoCwAgQAvD_BwE

and improving roads, bridges and/ or culverts, water supply systems, energy networks, and ensuring the availability of adequate and quality housing for the population.

Water

The water sector in Antigua and Barbuda encompasses the management, distribution, and conservation of water resources, including both freshwater and wastewater systems. This sector involves collaboration among government agencies, utility providers, and stakeholders to ensure reliable access to clean water for domestic, agricultural, and industrial purposes. However, the country faces challenges such as water scarcity, infrastructure maintenance, and the impact of climate change on water availability. To address these issues, the country is implementing strategies to enhance resilience, such as those posited within the Sectoral Adaptation Plan (SAP) for the water sector. This includes improved water resource management, the development of infrastructure for storage and distribution, and the adoption of sustainable practices. By taking proactive measures to adapt to climate-related changes, Antigua and Barbuda aims to ensure the long-term sustainability and reliability of its water sector.

Tourism

The tourism sector addresses the promotion and management of the country's tourism industry. This includes marketing the destination, maintaining tourism infrastructure, managing accommodations, organizing events, and creating experiences that showcase the natural beauty and cultural heritage of the islands. The sector plays a crucial role in the economy by generating revenue, creating jobs, and contributing to development.

Finance

The finance sector prioritizes the managing financial services, institutions, and activities within the country. This includes banking, insurance, investment, asset management, and other financial services. The finance sector plays a vital role in facilitating economic growth, supporting businesses and individuals with financial needs, and contributing to the overall stability of the economy.

Wholesale and Retail

The wholesale and retail sector emphasizes the sustainable distribution, sale, and trade of goods to consumers. This sector involves purchasing products from manufacturers or suppliers in bulk (wholesale) and then selling them to individual customers (retail) through various outlets such as shops, supermarkets, markets, and online platforms. The sector plays a crucial role in ensuring

the availability of a wide range of goods to meet consumer needs and preferences, contributing to economic activity and employment within the country.

Local Area Adaptation Plans

Local Area Adaptation Plans in Antigua and Barbuda are responsible for outlining strategies and actions to address climate change impacts at the community level. These plans focus on enhancing resilience, managing risks, and promoting sustainable development within specific local areas of the country. The areas of interest are i.) Airport and Fitches Creek, ii.) Jolly Harbour to Johnsons Point, iii.) St. John's City.

CHAPTER 1: CLIMATE HAZARDS, RISKS AND VULNERABILITIES

1. Climate Hazards, Risks, and Vulnerabilities

1.1. Historical and Present Climate Trends

Historic Climate Trends

Throughout the 20th century, increase in mean surface temperatures in the Caribbean approached 1°C, largely driven by an increase in daily minimum (night-time) temperatures and a decrease in the range of mean daily temperature.[9,10] The rate of change of 20th century surface temperatures in the Caribbean reached a maximum of 0.3°C per decade in the 1990s. In the first decade of the 21st century, temperature increase in the Caribbean accelerated to 0.7°C per decade.

Over the same period, sea level rise in the Caribbean ranged from 10 to 20 cm, contrasted with the global average of 10 cm. Increased evaporation from the ocean surface was also observed in the global tropical regions and parts of the tropical north Atlantic.[11]
During the latter part of the 20th century, there was notable increase in the total annual precipitation. Consequently, this led to higher daily rainfall intensity, an increase in the maximum number of consecutive dry days, and a rise in the frequency of heavy rainfall events.

Given the inherent vulnerability to climate change, it often becomes challenging to detect significant changes until well after they occur. Nevertheless, examining historical changes can provide valuable insights into what may be expected in the future.

Present Climate Trends

The average daily atmospheric temperature in Antigua is 26.9°C. There is little variation in daily temperatures between summer and winter months; the warmest and coolest months are August and February, with average daily temperatures of 28.3°C and 25.2°C, respectively. Daytime temperatures above 33°C and below 22°C are seldom recorded.[12] The average sea surface temperatures in Antigua and Barbuda's coastal waters is 27.6°C. Like air temperature, there is little yearly variation; the months with warmest and coolest sea surface temperatures are September and February, with average sea surface temperatures of 28.9°C and 26.2°C, respectively. SST in the Caribbean spanning the years from 1982 to 2016 reveals a consistent warming trend, with SST increasing at an annual rate ranging from 0.01°C to 0.04°C. Notably, the warming trend is more pronounced in specific areas, particularly in the eastern Caribbean, extending into the eastern tropical Atlantic. This information underscores the region's

[9] Climate changes in the greater and southern Caribbean by B. Singh, 1992
[10] Observed climate variability and change by Folland, 1992 (IPCC)

[12] http://www.antiguamet.com/Climate/Our_Climate.html and https://www.weather-atlas.com/en/antigua-and-barbuda-climate#climate_text_1

vulnerability to rising temperatures and highlights the need for climate resilience strategies and adaptation measures.[13]

Rainfall in Antigua and Barbuda follows a unimodal distribution pattern in line with the general patterns observed across the Caribbean region. The wet season, which correlates with the Atlantic Hurricane Season, spans June to December and accounts for approximately 2/3 of the total yearly precipitation. Antigua receives approximately 1100 mm of rainfall in the low-lying areas each year, and up to 1300 mm in the hilly south-west. Average yearly rainfall in Barbuda is slightly less, at approximately 900 mm. The wettest and driest months are typically October and March, respectively.

Drought is a recurring circumstance in Antigua and Barbuda; at least one serious or severe drought has a 28.9% probability of occurrence in one year, an 81.8% probability of occurrence over 5 years, and is a near certainty (96.7% probability of occurrence) in a 10-year period.[14] The nation's depleted groundwater reserves and the absence of naturally occurring surface water creates critical water shortages when compounded by consecutive low-rainfall years.

The trade winds blow from the east/northeast with varying strength and consistency throughout the year. The trade winds are steadiest and slowest in the summer months and have an average surface speed of 8 to 10 kph. In the winter months the trade winds are stronger but intermittent, with variable speeds reaching up to 25 kph.

Strong trade winds are associated with a lack of precipitation while weak trade winds can transport moisture and rain and develop into tropical storms under the right conditions. Trade winds also carry particles of dust and sand long distances. Tropical dust storms during the Atlantic Hurricane Season are often associated with dry, low-pressure areas and an absence of tropical storms.[15] Throughout the year, average wind speeds in Antigua and Barbuda are approximately 20 kph. The interannual variation in the trade winds is strongly influenced by the North Atlantic Oscillation and the El Nino Southern Oscillation (ENSO).

Since the 1950s, Antigua and Barbuda have experienced a gradual sea-level rise of 1.6 to 2.0 millimeters (approximately 0.06 to 0.08 inches). It is important to note that this phenomenon is part of a broader global trend. Over the last two decades, the pace of global sea-level rise has quickened significantly, averaging approximately 3.3 millimeters (about 0.13 inches) annually from 1993 to 2008.[16]

Hurricane Season and Ocean Warming

In the Atlantic Basin, the past two decades have witnessed a notable increase in hurricane activity, resulting in a higher frequency of named storms and hurricanes impacting countries across the

[13] https://repositorio.cepal.org/server/api/core/bitstreams/c94d4b38-7867-4049-b500-e2ca09f21e1e/content
[14] http://antiguamet.com/Climate/STATS/anu_drought.html
[15] https://www.nationalgeographic.org/encyclopedia/wind/
[16] https://www.climatehotmap.org/global-warming-locations/antigua-and-barbuda.html

region, including Antigua and Barbuda. These hurricane seasons have displayed variability in terms of both intensity and the number of storms. Some seasons have seen more powerful hurricanes, while others have witnessed fewer or weaker storms. Notably, the 2021 Atlantic hurricane season stood out as the third most active on record, ranking behind only the seasons of 2017 and 2005. Remarkably, this marked the sixth consecutive year of above-average hurricane activity in the Atlantic. The 2021 season even commenced ahead of schedule in May, marking the seventh consecutive year in which a storm formed before the official start date of the season on June 1st. Such heightened activity led to the unique occurrence of two consecutive hurricane seasons fully exhausting the list of 21 storm names designated for the year.

1.2. Future Climate Scenarios

Global Climate Models (GCMs) serve as fundamental tools for assessing the impact of greenhouse gases on the Earth's climate, which were chosen from the 5th Phase of the Coupled Model Intercomparison Project (CIMP5). Global climate change projections from the CIMP5 unanimously predict that climates will continue to change through to the end of the current century.

While valuable for broad-scale analyses, the inherent coarse spatial resolution of GCMs limits their ability to accurately depict regional climate conditions on smaller landmasses, such as Antigua and Barbuda. Consequently, GCMs are less suitable for informing localized adaptation strategies and conducting precise risk assessments at a regional level. Regional Climate Models (RCMs) can offer improvements over GCMs by applying similar methodologies as GCMs but over a limited region of the Earth.

Based on these models, it is unanimously suggested that mean global surface temperature will increase anywhere between 1.1°C to 2.6°C under RCP4.5 and 2.6°C to 4.8°C under RCP8.5. It is "virtually certain" that there will be more frequent hot extremes and fewer cold extremes, and that heat waves will occur at a higher frequency and longer duration. These temperature increases will likely be accompanied by an increase of intensity and frequency of extreme precipitation events over tropical regions, and significant changes to seasonal precipitation patterns.

Sea levels are expected to continue rising due to melting polar ice and seawater thermal expansion. Ocean warming through the end of the century is a near certainty. It is suggested that ocean acidification will increase anywhere between 38 to 41% in an RCP4.5 future, and 100 to 109% for an RCP8.5 future. These impacts are expected to disproportionately impact tropical regions.

Downscaling

High resolution RCM simulations, at approximately 12km, were modelled from three (3) GCMs in the CIMP5 experiment, over the Caribbean, and were procured to inform the National Adaptation Planning Process. The *HadGEM-ES* (Hadley Centre Global Environmental Model – Earth System*),*

MPI-ESM-LR (Max Planck Institute Earth System Model – Low Resolution) and *MRI-CGCM3* (Meteorological Research Institute Climate Global Climate Model version 3) models were selected for their ability to capture the full range of future responses, including low and high temperature responses and wet and dry precipitation biases. Thus, enabling the stakeholders of Antigua and Barbuda to prepare for a multitude of future climates at all possible futures. The models were produced under two Representative Concentration Pathways (RCPs) scenarios, RCP4.5 and RCP8.5.

Downscaled projections for Antigua and Barbuda predict increases of 1.4°C to 2.0°C to the average daily minimum temperature by the end of the century under RCP4.5 and increases of 2.9°C to 3.4°C by the end of the century in an RCP8.5 scenario. Heat wave days are projected to increase from the historical average of 18 per year to 100 to 135 by mid-century and 120 to 200 nearing the end of century in an RCP4.5 future. An RCP8.5 future projects that more than 2/3 of the year will qualify as heat wave days nearing the end of the century.[17] Daily temperatures could rise an additional 3°C to 4°C during heat spells in an RPC8.5 future. In all downscaled models, up to 10% fewer heatwave days are predicted in Antigua's hilly southwest region.

The three downscaled models differ in their precipitation response under future climate. The HadGEM2-ES and MPI-ESM-LR RCMs both forecast overall reductions in precipitation of up to 2mm/day by the end of the century in an RCP 8.5 future. The MRI-CGCM3 RCM indicates a slight increase in overall precipitation under future climate, driven by increases in wet-season precipitation. Independent of their individual biases, all three regional models predict an increase in the number of consecutive dry days and a shift in the seasonality patterns of precipitation across the region under future climates.[18]

Sea levels are expected to continue rising due to melting polar ice and seawater thermal expansion. Ocean warming through the end of the century is a near certainty. It is suggested that ocean acidification will increase anywhere between 38 to 41% in an RCP4.5 future, and 100 to 109% for an RCP8.5 future. These impacts are expected to disproportionately impact tropical regions.

[17] ImageCat Heat Waves netCDF
[18] CEFAS Final Report V1_1

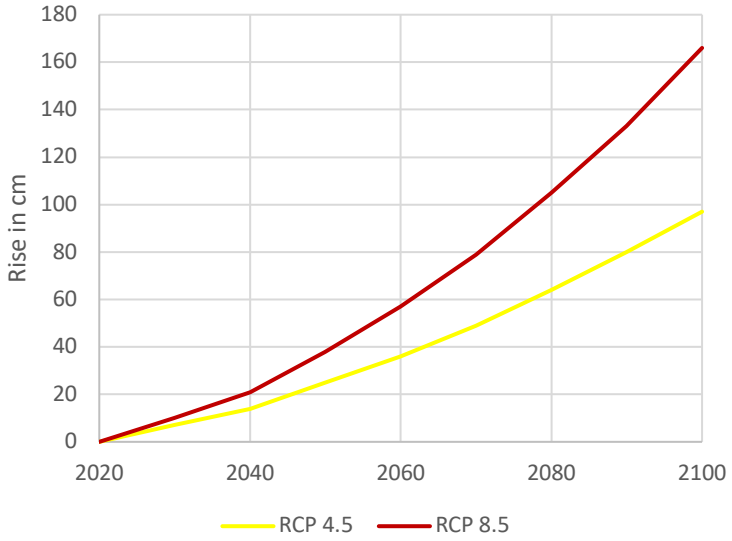

Figure 2: Predicted rise in sea level in Antigua area

(a) (b)

Figure 3: Antigua's coastline changes under 0.13 m Sea Level Rise (SLR) scenario (a), and 1.45 m Sea Level Rise (SLR) scenario (b)

The HadGEM2-ES and MPI-ESM-LR RCMs suggest a decrease in the number of consecutive wet days, and an increase in frequency of future droughts in both modelled futures. The HadGEM2-ES model predicts drought years will be 28% (RCP4.5) or 42% (RCP8.5) drier by the end of the century, whereas the MPI-ESM-LR model predicts drought years to be 4 to 6% wetter over the mid-century before drying by up to 20% approaching the end of the century. In contrast, the MRI-CGCM3 RCM shows little change in precipitation totals but an increase in year-to-year variability.

Drought frequency and magnitude projections from each of the downscaled models are summarized in Tables 1 and 2, respectively.

Table 1:Projected change in frequency of drought, expressed as the number of drought years within the 30-year mid-century (2040-2069) and end-century (2070-2099) intervals. Results are presented by RCM to showcase the extreme variability in precipitation projects among climate models.

MODEL	RCM	MID CENTURY	END OF CENTURY
HadGEM2-ES	4.5	+7	+7
	8.5	+6	+17
MPI-ESM-LR	4.5	+3	+2
	8.5	+2	+16
MRI-CGCM3	4.5	0	+10
	8.5	+6	+2

Table 2: Projected change in magnitude of drought, expressed as a percentage change within the 30-year mid-century (2040 – 2069) and end-century (2070-2099) intervals. Results are presented by RCP to showcase the extreme variability in precipitation projections among climate models.

MODEL	RCM	MID CENTURY	END OF CENTURY
HadGEM2-ES	4.5	+29%	+28%
	8.5	+11%	+42%
MPI-ESM-LR	4.5	-4%	+20%
	8.5	-6%	+10%
MRI-CGCM3	4.5	+15%	+2%
	8.5	+3%	0

The intensity of hurricanes in the categories 4 and 5 range for Antigua and Barbuda is projected to rise by 18%, according to General Circulation Models (GCMs), when compared to the intensity observed over the past 30 years. This forecast is linked to an anticipated increase in sea surface temperatures, with a maximum rise of 2.7°C under various Representative Concentration Pathway (RCP) scenarios. Higher sea surface temperatures directly contribute to the escalation of hurricane intensity. The heightened temperatures in the sea play a crucial role in amplifying hurricanes, especially those classified as more severe. This occurrence is attributed to the augmented energy input from warmer waters, facilitating the formation and persistence of potent storms.

1.3. Climate Risks and Hazards

Climate change poses a significant threat to countries of varying sizes, with Small Island Developing States (SIDS) being particularly vulnerable. It is therefore crucial to understand the potential climate-related risks and hazards affecting their habitats, populations, critical infrastructure, and economies. Decisions related to adaptation, mitigation, and infrastructural development depend on assumptions about the future under the influence of climate change.

Extreme Temperatures

Antigua and Barbuda generally experience a warm tropical climate, but extreme temperatures can lead to prolonged periods of excessive heat, increasing the risk of heat-related illnesses. These temperature extremes can have far-reaching consequences, affecting agriculture by reducing crop yields and causing food shortages due to disrupted growing seasons. Additionally, extreme heatwaves pose health risks, particularly for vulnerable populations. Moreover, extended periods of extreme heat, combined with reduced rainfall, can contribute to drought conditions. The heightened demand for electricity during extreme heat can strain the power grid, leading to potential power outages during peak periods.

Drought

Antigua and Barbuda face ongoing challenges related to drought, primarily driven by decreased precipitation and rising temperatures. The risk of drought is notably higher during El Nino Southern Oscillation (ENSO) events. The islands rely on small reservoirs and surface water resources, but overextraction has led to saltwater intrusion in groundwater sources.

The impact of drought has been historically significant, with events like the 1983 – 1985 drought prompting the purchase of the Crabbs desalination plant in 1987. Another severe drought occurred in 1993 – 1994. Notably, the pan-Caribbean drought from 2013 – 2016, as documented by Dale Destin's Blog, was the worst drought on record for Antigua and Barbuda, with 2015 standing out as the driest year ever recorded.

The probability of experiencing at least one moderate, serious, or severe drought each year is 45.1%, increasing to 95.0% over a five-year period. For severe droughts alone, the probability is 15.1% in a single year and 56.0% over five years.

Rainfall Variability

Inter-annual variability in Caribbean climate is influenced strongly by the El Nino Southern Oscillation. El Nino episodes usher in warmer and drier conditions during the late wet season, while La Nina episodes bring colder and wetter conditions. These patterns align with the islands' distinct wet and dry seasons, with the wet season spanning from June to November, coinciding with the Atlantic hurricane season. During this period, frequent rainfall is often intensified by tropical storms and hurricanes, which can result in flooding and landslides. Additionally, non-tropical cyclone rainfall events, characterized by their extremity, can exacerbate flood impacts, especially in areas with development choices favouring impervious surfaces and inadequate drainage infrastructure. These challenges highlight the importance of climate adaptation measures in the face of global concerns about changing temperatures and their potential to disrupt rainfall patterns and intensify precipitation events.

Sea Level Rise

Antigua and Barbuda, like many Caribbean SIDS, confront yet another pressing threat in the form of sea level rise. Numerous coastal areas have been reclaimed to accommodate essential infrastructure, seaports, hotels, and road networks. The escalation of sea levels amplifies the vulnerability of these vital installations, heightening the risk of damage and disruption.

In the past, Barbuda residents primarily depended on shallow groundwater as their main source of drinking water. However, in recent times, a significant shift has occurred, with many residents now allocating a substantial portion of their monthly income to purchasing bottled water. This transition is largely driven by diminishing trust in the quality of the groundwater supply.

Storm Surge and Hurricane Season

Like many Caribbean countries, Antigua and Barbuda is prone to hurricanes, especially during the Atlantic hurricane season, which spans from July 1st to November 30th. This vulnerability stems from the country's location within the heart of the Atlantic hurricane belt, where cyclones and hurricanes mostly occur throughout August and September. Historically, these months have seen approximately 79% of the storms. From 1851 to 2011, the nation has experienced 93 storm systems, with 44 of them intensifying into hurricanes.[19] The occurrence of hurricanes is strongly linked to the ENSO, with more frequent hurricane activity associated with La Nina events and less frequent events in El Nino years.

In recent years, Antigua and Barbuda have experienced the impact of several notable storms, resulting in heavy rainfall, flooding, and substantial damage to buildings, infrastructure, and the natural landscape. Among these storms, Hurricane Irma stands out as one of the most formidable Atlantic hurricanes ever recorded. In September 2017, it passed just north of Barbuda as a devastating Category 5 hurricane, causing catastrophic destruction on the island and significant damage to Antigua. Additionally, a particularly unusual event occurred just before the turn of the century when Hurricane Lenny, a late-season phenomenon in November 1999, made a lasting impact as it traversed westward across the Caribbean, leaving a trail of significant consequences for the islands.[20]

Table 3 : Recent Hurricanes that affected Antigua and Barbuda. Direct hit indicates the cyclone's center passed over land or at the most 15 nautical miles from land; Hit indicates the cyclone centre passed between 15 & 65 nautical miles from land; Brushed indicated the centre passed between 65 & 105 nautical miles from land.

Year	Hurricane names	Wind Speed (mph)	Status
2017	*Maria*	*161*	*Brushed*
2017	*Jose*	*150*	*Hit*

[19] http://country-profiles.geog.ox.ac.uk
[20] Antigua and Barbuda Health and Climate Change Profile 2020.pdf

2017	*Irma*	*178*	*Hit*
2014	*Gonzalo*	*77*	*Direct Hit*
2010	*Earl*	*104*	*Hit*
2000	*Debby*	*80*	*Hit*
1999	*Lenny*	*127*	*Direct hit*
1999	*Jose*	*96*	*Direct hit*
1998	*Georges*	*115*	*Direct Hit*

The impact of climate change on tropical cyclone characteristics is uncertain and varies by basin. However, there is a consensus that future climate changes could modify the nature of tropical cyclones, potentially leading to increased intensity and altered behaviours such as stalling over land[21]. Based on global climate models, there is a predicted shift in hurricane characteristics, with a potential decrease in the overall number of hurricanes but an increase in their intensity. This suggests a higher likelihood of encountering category 4 and category 5 hurricanes in the future. Over time, the impact of these storms has been notable, leading to significant loss of coastal mangroves, particularly following the events of the 1980s. This loss of mangroves has resulted in reduced storm surge protection.

Ocean Acidification and Sea Surface Temperature

The oceans play a crucial role as vast carbon sinks, absorbing approximately one-third of the carbon dioxide emissions generated by anthropogenic activities. Ocean acidification, a consequence of increased carbon dioxide levels, poses a significant threat to marine life. It directly impairs the ability of calcifying organisms to construct their shells and skeletons, impacting crucial species like corals and shellfish. Over the past two decades, the Caribbean region has witnessed a troubling trend of decreasing pH levels in its waters, exacerbating the challenges faced by these vital marine organisms in building and maintaining their skeletal structures.

Antigua and Barbuda are characterized by an impressive variety of ecosystems including terrestrial forests, scrublands and grasslands, mangrove forests, herbaceous swamps, and salt ponds, sandy. These ecosystems are increasingly at risk from chronic pressures, such as ocean warming. The projected rise in ocean temperatures is expected to amplify the scale, duration, and frequency of ocean heatwave events in the future [22]. The Caribbean is identified as one of the regions likely to experience the consequences of a rising heatwave hazard, posing risks to coral reef ecosystems, including those around Antigua and Barbuda. According to ecosystem impact modelling, the nation is projected to witness a notable shift in the annual likelihood of severe bleaching events, moving from the current approximately 10% to around 60% over the 2020-2055 period under a moderate emissions scenario23. Under a high emissions scenario, the latter half of the of the 2020-2055 period is expected to have nearly a 100% likelihood of annual severe bleaching, with an average probability of around 65% across the entire period.

[21] https://news.sciencebrief.org/cyclones-mar2021/
[22] https://www.nature.com/articles/d41586-021-01142-4

Ecosystem impact modelling indicates that coral damage rates could potentially rise by 47% to 84% by the close of the century under a moderate emissions scenario. In a high emissions scenario, the increase could be even more substantial, engaging between 136% and 270% (Figure 1).23

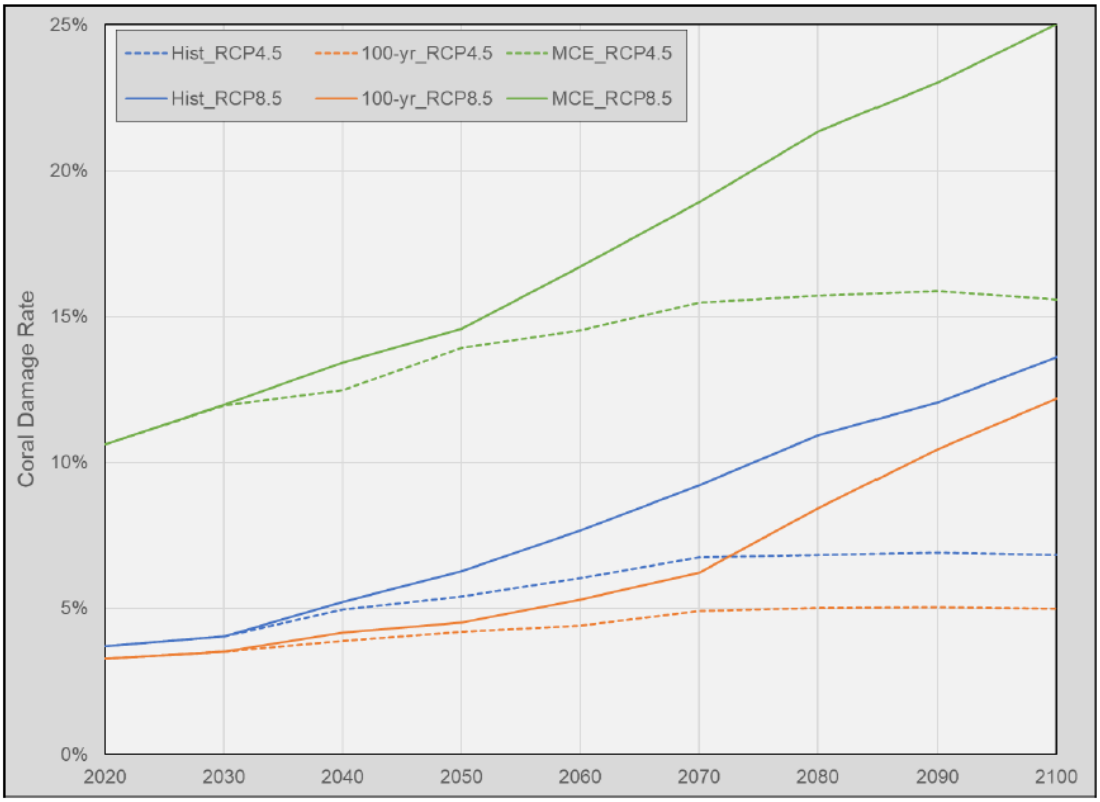

Figure 4 & 5: Coral damage risk from hurricanes for different climate scenarios (RCP 4.5 & 8.5) and events (MCE, Historical, 100-year)Figure 5: Coral damage risk from hurricanes for different climate scenarios (RCP 4.5 & 8.5) and events (MCE, Historical, 100-year)

1.4. Climate Change Risk Modelling

Five hazards; hurricane wind, storm surge, sea level rise, extreme temperatures, and extreme rainfall; can be considered when estimating losses and assessing various impacts related to climate change. These hazards contribute to four types of losses associated with specific events: the Maximum Credible Event (MCE), a "1% chance event", a historic event, and the Average Annualized Loss (AAL)[23]. The MCE is the largest event in the Kinetic Analysis Corporation (KAC) event set to affect Antigua and Barbuda, the "1% event" is a 1% probability of occurrence in a year or a 100-year Return Period event (which means that it is expected to occur on average once in 100 years), the historic event was modelled after Hurricane Irma and the AAL represents averages from 930 events that affected the islands, or overall, the average loss per year from the Kinetic library of 14,204 events, over 1,500 years23. Each loss was calculated on a decadal basis from 2020 to 2100, and for the period of 2030 to 2100, the value of the building exposure data has been

[23] National Adaptation Plan Climate Change Risk Modelling Project, 2021

modified to account for the rising sea and frequent (10-year) coastal flooding, which can be considered a fifth type of loss. These were modelled under two climate scenarios, Representative Concentration Pathways (RCPs) 4.5 (Stabilize) and 8.5 (High Emissions). Table 4 summarizes the results of the modelled losses by decade for the high emissions (RCP 8.5) and stabilization (RCP 4.5) climate scenarios for the general building stock. The values indicate physical damage to buildings (direct losses) and are expresses in millions of U.S. dollars. Table 5 provides the value of buildings modelled to be exposed to sea level rise and frequent (10% annual probability, 10-year event) coastal flooding.

Table 4: Direct Building Losses ($M USD) by decade for the high emissions (RCP8.5) and stabilization (RCP4.5) climate scenarios)

Event Type	Climate	Hazard	2020	2030	2040	2050	2060	2070	2080	2090	2100
Historic	High Emissions	Surge	$292	$292	$292	$292	$292	$292	$292	$292	$292
		Wind	$182	$205	$247	$287	$376	$498	$662	$791	$976
		TOTAL	$473	$451	$516	$573	$710	$909	$1,160	$1,342	$1,626
	Stabilize	Surge	$292	$245	$257	$276	$286	$312	$313	$328	$336
		Wind	$182	$205	$226	$257	$277	$313	$315	$313	$297
		TOTAL	$473	$451	$483	$534	$563	$624	$628	$642	$633
1 in 100 Year	High Emissions	Surge	$466	$461	$550	$628	$752	$900	$1,107	$1,228	$1,351
		Wind	$3,335	$3,571	$3,939	$4,203	$4,614	$4,984	$5,314	$5,493	$5,711
		TOTAL	$3,801	$4,032	$4,490	$4,831	$5,366	$5,885	$6,420	$6,721	$7,062
	Stabilize	Surge	$466	$449	$498	$571	$616	$687	$717	$759	$796
		Wind	$3,335	$3,566	$3,771	$4,029	$4,167	$4,360	$4,367	$4,358	$4,263
		TOTAL	$3,801	$4,015	$4,269	$4,600	$4,783	$5,047	$5,084	$5,117	$5,059
MCE	High Emissions	Surge	$1,278	$1,306	$1,442	$1,547	$1,712	$1,897	$2,094	$2,180	$2,276
		Wind	$8,090	$8,116	$8,183	$8,203	$8,225	$8,196	$8,088	$7,963	$7,846
		TOTAL	$9,368	$9,422	$9,626	$9,750	$9,936	$10,093	$10,182	$10,143	$10,122
	Stabilize	Surge	$1,278	$1,290	$1,367	$1,472	$1,533	$1,624	$1,659	$1,700	$1,729
		Wind	$8,090	$8,132	$8,166	$8,200	$8,196	$8,194	$8,131	$8,057	$7,974
		TOTAL	$9,368	$9,422	$9,534	$9,672	$9,728	$9,818	$9,790	$9,756	$9,703
AAL	High Emissions	Surge	$34	$27	$34	$40	$51	$68	$91	$102	$129
		Wind	$104	$113	$126	$136	$155	$176	$200	$216	$236
		TOTAL	$138	$139	$160	$176	$206	$244	$291	$317	$365
	Stabilize	Surge	$34	$26	$30	$36	$39	$47	$47	$51	$55
		Wind	$104	$112	$120	$129	$135	$143	$143	$143	$139
		TOTAL	$138	$138	$149	$165	$174	$190	$190	$194	$194

Table 5: Building stock ($M USD) exposed to Sea Level Rise and nuisance flooding by decade for the high emissions (RCP8.5) and stabilization (RCP4.5) climate scenarios.

Event Type	Climate	Hazard	2020	2030	2040	2050	2060	2070	2080	2090	2100
SLR	High Emissions	Sea level rise and frequent flooding	-	$108	$128	$184	$251	$320	$415	$561	$689
	Stabilize		-	$95	$108	$129	$165	$203	$262	$314	$366

To represent each loss type in Table 4, a series of charts were created to depict the modelled changes in losses overtime. Additionally, a series of maps were developed to visualize how the modelled losses, across the islands, vary spatially. Figure 3 and Figure 4 present examples of these results for which are provided in a website hosted at http://climateriskmap.environment.gov.ag.

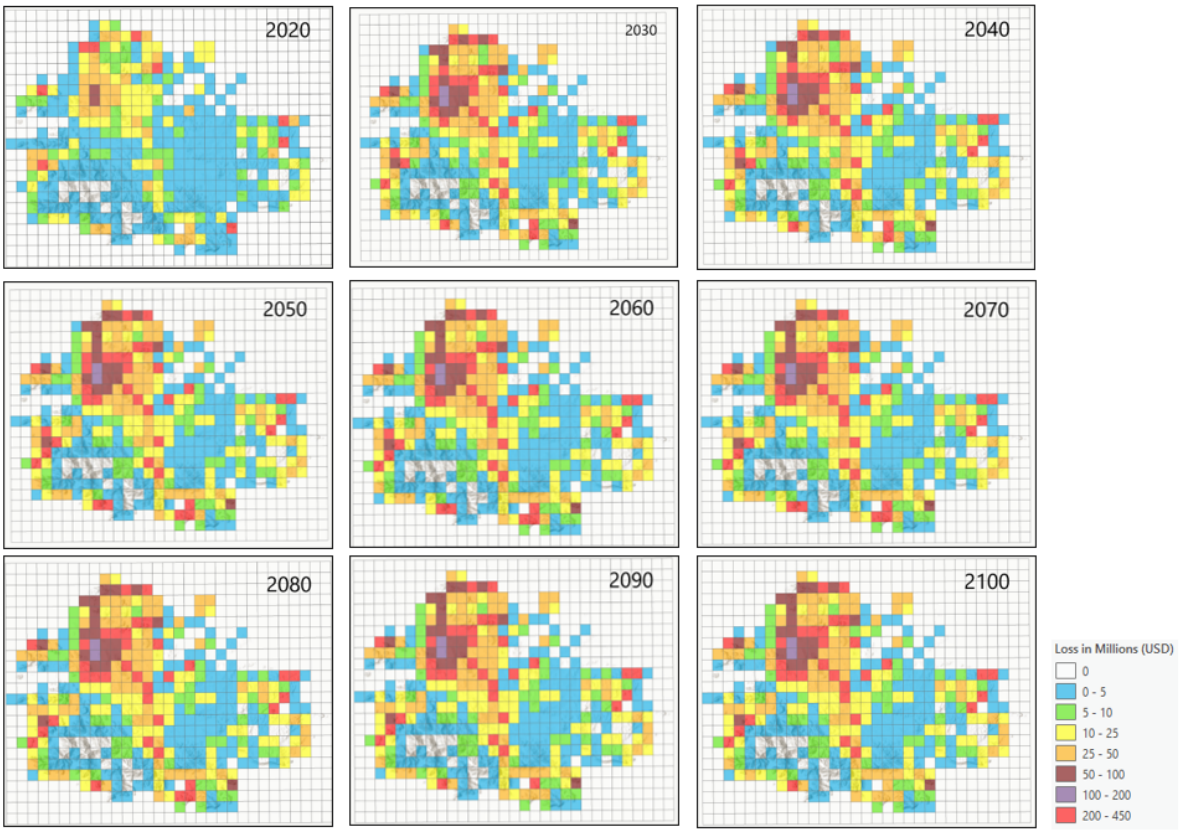

Figure 6: Total losses (Millions USD) for the Maximum Credible Event (MCE) for the stabilization climate scenario (RCP4.5)

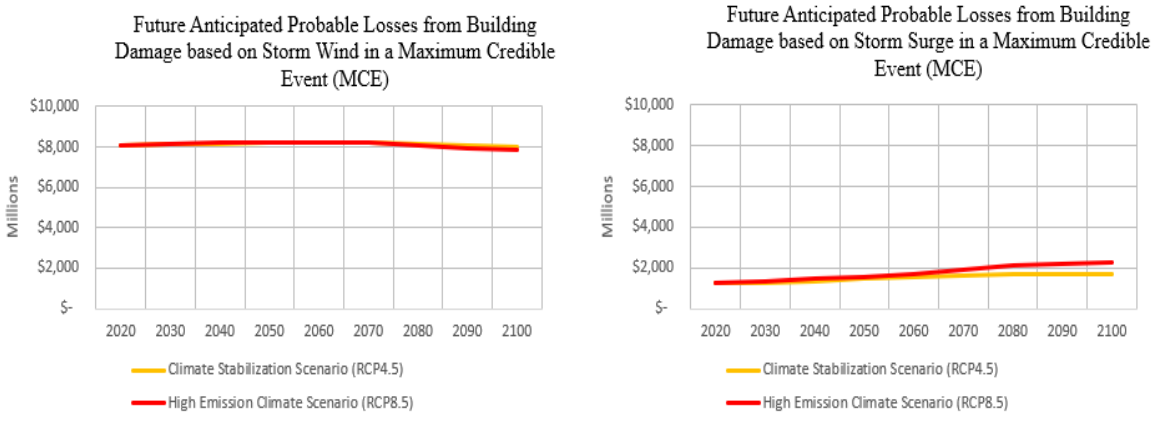

Figure 7: Future anticipated probable losses from building damage for storm wind (left) and surge (right) in a Maximum Credible Event (MCE)

Various maps and charts illustrate anticipated losses throughout the region due to storm surge, hurricane wind, and frequent coastal flooding from sea level rise. The findings reveal that, despite wind damage expected to surpass surge damage in average annualized losses, surge exposure is projected to increase with climate change.23 Additionally, the value of buildings exposed to

frequent flooding, as outlined in Table 5, is expected to significantly rise and will be concentrated in low-elevation coastal areas.

In the Caribbean, the coastal building infrastructure exhibits a dual nature, combining high value with increased vulnerability to climate change compared to internal island regions affected by high winds. The predominant exposure and risk factors lie within the islands, indicating that stringent code enforcement measures could prove highly cost-effective. Exploring potential solutions, such as the construction of buildings at elevated locations, the development of elevated structures, and the implementation of strategic land use, holds significant promise in substantially diminishing future losses.

CHAPTER 2: IMPACTS AND VULNERABILITY

2. Future Climate Vulnerabilities and Impacts

Antigua and Barbuda face an increasingly precarious future due to climate change, with profound vulnerabilities and impacts anticipated across the twin-island nation. Rising sea levels pose a significant threat to the low-lying coastal areas, exacerbating the risk of saltwater intrusion into freshwater sources; extreme weather events, including hurricanes and tropical storms, are likely to become more intense and frequent, leading to heightened risks of flooding, landslides, and infrastructure damage impacting a number of key sectors; warming climate conditions may disrupt ecosystems, and may exacerbate water scarcity issues.

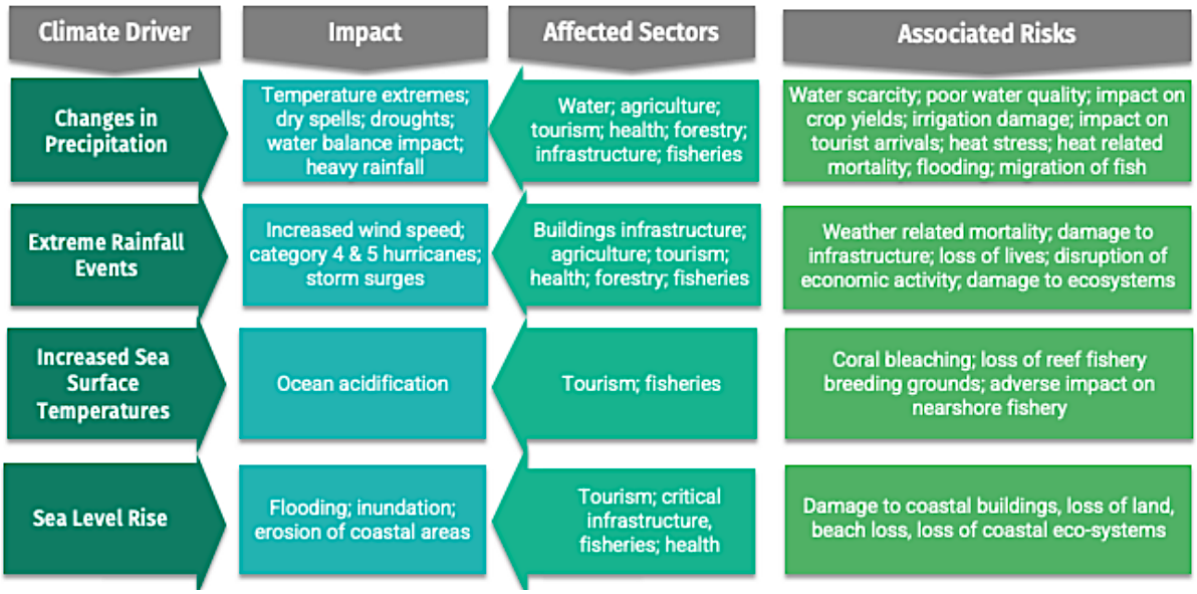

Figure 8: Climate change impacts on sectors (Source: Adaptation Communication for Antigua & Barbuda, 2022)

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2.1. Agriculture and Food Security

The Agricultural sector in Antigua and Barbuda is small, contributing ~3% to the national GDP and ~1.8% of the total employed labour force[24]. Resultingly, the national food system is heavily reliant on imports, with ~80% of food products being imported[25] [26]. The trade and planning sectors, in addition to the agricultural and fishing sectors, therefore, play a large role in the national food system and food security.

[24] Government of Antigua and Barbuda. 2021. Voluntary National Review of Antigua and Barbuda
[25] United States Department of Agriculture. 2015. Caribbean Basin. Retail foods. Eastern Caribbean Regional Report CB1526. Global Agricultural Information Network.
[26] Government of Antigua and Barbuda. 2021. Voluntary National Review of Antigua and Barbuda.

Agricultural production in Antigua is challenged by labour shortages and high material costs, limited freshwater availability, and the legacy impacts of colonization on soil quality and land degradation. Continued expansion of residential and tourism developments reduces the availability of suitable farming land, further stunting growth within the sector.

In Barbuda, shallow sandy soil coupled with limited water availability have inhibited agricultural expansion. Limited agriculture has been practiced outside of Codrington, mostly as backyard farming and grazing livestock on open ranges.

Climate models predict that Antigua and Barbuda will experience rising air and sea surface temperatures, sea level rise, changes to rainfall patterns, and increasingly intense hurricanes, each of which will likely have significant implications for the agriculture and fisheries sectors, and overall food security.

Increased temperatures will threaten food security by reducing crop performance and restricting the types of species of fruits and vegetables that can be grown locally. Rises in ocean temperature are expected to weaken the resilience of fish stocks and marine ecosystems. The projection of increasing drought conditions will place further demand on freshwater production, leading to increased costs associated with local food production.

Rises in ocean temperature are expected to weaken the resilience of fish stocks and marine ecosystems. Recent evidence has demonstrated that fishes in warmer water have a smaller maximum body size and smaller size at first maturity[27]. These fish are also likely to suffer higher natural mortality rates. Shifts in fish stock distribution are also expected with rising sea temperatures and ocean acidity as climate change pushes surface temperatures beyond temperature and salinity limits.

Drought is prevalent in Antigua and Barbuda, and agricultural production is already strained by freshwater access. Increased drought conditions will place further demand on freshwater production, leading to increased costs associated with local food production. Correspondingly, it is expected that sea levels will rise in coming decades, leading to saltwater intrusion in low-lying land and aquifers, and high levels of salt in agricultural soil and groundwater resources. High salt content in soil and irrigation water can cause significant reduction in crop yields.

Hurricanes represent the largest risk to food security in Antigua and Barbuda. A storm can cause direct damage to crop through high winds, waterlogging, and flooding. Livestock can be at risk of drowning in high-water or injury by projectiles and collapsing infrastructure. Damaged power infrastructure can also create electrocution hazards. A single strong event has the potential to cause the loss of entire fields of produce, and damage to equipment and infrastructure that persists beyond the hurricane season. Hurricane events can also contribute significant disruptions to the fishing sector through damage incurred to supplies and materials, and disruptions to marine

[27] Cheung, William & Lam, Vicky & Pauly, Daniel & Herrick, Samuel & Sumaila, Rashid. (2011). Climate Change Impacts on the Biophysics and Economics of World Fisheries. Nature Climate Change. 1. 10.1038/nclimate1301

ecosystems. Turbulent weather can destroy coral reef habitats, redistribute sediments, and cause fish to seek refuge in deeper water, reducing the available catch.

Damage to transportation infrastructure incurred during a hurricane can result in substantial disruptions to the local and international supply chain by preventing the importation and distribution of food products and essential supplies, decreasing food availability and in turn increasing local food prices.

2.2. Health

Human health in the country is seriously threatened by climate change, which is also expected to exacerbate biological and health-related problems. Climate change is predicted to raise the average annual temperature as well as the severity and frequency of heat waves, putting more people at risk for heat-related illnesses. Heat waves can be a serious threat to the health of people, animals, and even plants. They can cause fatalities, destroy livelihoods, reduce labour productivity, increase demand for and the cost of cooling options, and worsen environmental health indicators.

The health sector is strongly impacted by climate change, which increases the risk of respiratory and vector-borne diseases, leaving Antigua and Barbuda susceptible to outbreaks of disease. The chikungunya epidemic started in Antigua and Barbuda in 2014, reaching a peak in 2015 with 1005.5 cases per 100,000 people (PAHO, 2020). In 2015 and 2016, the Zika epidemic had a significant impact on the countries of Latin America and the Caribbean. By the end of 2016, there were 509.6 Zika cases per 100,000 people in Antigua & Barbuda (PAHO, 2020). Following the chikungunya and Zika epidemics, dengue fever, which is endemic to Antigua and Barbuda, reclaimed its position as the most common mosquito-borne disease. Antigua and Barbuda had 396.1 cases per 100,000 people in January 2020 (PAHO, 2020).

The Covid-19 Pandemic's effects have shown how sensitive and exposed the sector is to medical and biological challenges. According to UNDP, UNICEF, and UN Women (2020), the pandemic led to an increase in health sector spending that is projected to be 0.5% of GDP, including the hiring of foreign disease specialists and the execution of a comprehensive quarantine and testing program. As hospitals operate around the clock, the health sector also uses a lot of energy and water, putting a strain on economic resources.

2.3. Education

Climate change has a direct impact on the educational sector in Antigua and Barbuda. The primary impacts of climate change on education arise from the effects of extreme weather events, such as heavy rains accompanied by flash floods, strong winds by storms, and increased temperatures with short to long-term consequences. Storm intensity in the Caribbean has increased due to warming conditions over the Atlantic Ocean, with Antigua and Barbuda witnessing its first Category 5 storm on record in 2017. Hurricanes are known to seriously harm infrastructure and homes, notably having a significant effect on the education sector, displacing students from the classroom for long periods at times. Schools are also used for shelter by the public during these high-intensity storms. Recovery from such disruptions frequently takes several months, if not much longer. As a result, economic output, quality of life, and opportunities for students to attend regular school are all significantly reduced.

In the past, many storms that hit the country were of modest intensity, usually tropical storms, or categories 1–3 hurricanes. Schools are not constructed to resist the effects of category 4 and 5 storms, which are anticipated to increase by 80% in the Atlantic Ocean in the next 80 years (NRDC, 2019)

Flooding from heavy rainfall tends to disrupt school operations around the island. These disruptions, albeit short-term, have a negative impact on students' development, as classes are postponed until regular activities resume. Increase temperatures have forced schools around Antigua and Barbuda to explore ways to adapt to the changing climate by introducing cooling technologies to maintain a comfortable and healthy environment for its students.

2.4. Cultural and Historical Sites

Climate change is one of the most pressing global challenges of the 21st century. Its impacts are felt in various sectors, including culture and heritage sites, which play a crucial role in preserving the historical, social, and cultural identity of nations. Antigua and Barbuda, a twin-island nation in the eastern Caribbean, boasts a diverse cultural and historical heritage that spans indigenous traditions, colonial influences, and a unique Afro-Caribbean heritage. The country's culture and heritage sites encompass historic buildings, ruins, archaeological sites, museums, and cultural festivals. These sites not only attract tourists but also foster a sense of identity, pride, and social cohesion among the local population.

The compact size of our islands significantly heightens the risk posed to cultural and heritage sites by severe winds, excessive precipitation, and storm surges resulting from tropical storms and hurricanes, with Barbuda being particularly susceptible. Such extreme weather events can cause severe damage to heritage sites, including structural collapse, flooding, and landslides. The historic forts, such as Fort James and Fort Barrington, for example, are at risk of deterioration and destruction due to these hazards.
Moreover, there are other significant perils that possess the potential to cause devastating consequences to the people, economy, infrastructure, and environment.

Antigua and Barbuda's culture and heritage sites, many of which are located along the coast, are particularly vulnerable to sea-level rise and coastal erosion[28]. Rising sea levels can cause permanent inundation of low-lying sites and lead to the erosion and destruction of coastal structures, including historic buildings and archaeological remains. For example, Betty's Hope, a significant historic sugar plantation, and the Nelson's Dockyard, a UNESCO World Heritage site, are at risk of being submerged or damaged due to these climate impacts.

While some of these threats may be deemed infrequent phenomena, historical records highlight their past impacts and ongoing menace. Such calamities have profoundly hindered the islands' progress, as evidenced by the recent havoc wreaked by Hurricanes Irma and Maria in 2017. The unprecedented devastation caused by these superstorms surpassed normal expectations and had a severe impact on the fragile cultural sectors.

Table 6: Climate Change Impacts (Source: Murphy, 2023).

Climate indicator	Climate Change Risk	Impacts on Cultural Heritage Sites
Moisture	Intense rainfall; Flooding; Groundwater changes; Changes in soil chemistry; Changes in humidity cycles	Damage to water systems; Physical changes to porous build materials and structures due to rising dampness; Mould

[28] Murphy, Reginald. 2023. Sectoral Adaptation Plan Culture. https://environment.gov.ag/assets/uploads/attachments/a012b-cultural-sector-sap.pdf

Temperature	Extreme events; Heat waves; Hurricanes; Storms; Agro-industry issues	Thermal stress to building materials; Productivity decline; Conservation issues
Sea-level rise	Coastal flooding; Sea water intrusion	Inundation of coastal heritage sites and archaeological sites; Coastal erosion; Population shift and disruption of communities; Loss of coastal infrastructure
Wind	Wind driven rain with salt and sand	Moisture penetration of porous walls of historical sites; Loss of unsupported walls of historical structures
Desertification	Drought; Heatwaves; Fall in water table; Loss of surface water	Erosion of sites and structures; Settlement issues on older unreinforced buildings; Loss of topsoil; Increase in free ranging livestock; Abandonment of arable land; Loss of cultural memory.

2.5. Tourism

The tourism industry is also negatively impacted by hurricanes/tropical storms, extreme rainfall, sea level rise, and higher temperatures. The sector, being the main economic sector, is very vulnerable to hurricanes because many accommodations and attractions are located on the coast, with risks associated with strong winds and surges usually impacting these infrastructures.

Most tourist amenities are dependent on international travellers, but hurricanes and tropical storms can limit or stop international travel. This causes cancellations which can negatively impact on the financial capabilities of the sector. Rainfall is projected to decrease. This will add pressure on water resources which is necessary to ensure the comfort of tourists. At the other extreme, flooding events may cause cancellations which can, again, limit the economic capabilities and viability of the tourism sector.

Sea level rise makes the sector vulnerable because rises in sea level cause beach loss and coastal flooding. Many locations and activities on and along the coastline become susceptible to losses and damage, particularly accommodations and restaurants. High temperatures because the demand for cooling is projected to increase, creating increased energy demand.

2.6. Wholesale and Retail

In recent times, the international community has increasingly recognized the significant implications of climate change on global economies, ecosystems, and societal structures. Within this context of heightened climate consciousness, Antigua and Barbuda, a small island state located in the Caribbean, faces unique challenges and vulnerabilities resulting from the adverse effects of climate change. These challenges permeate various sectors of the economy, including the crucial wholesale and retail industry, which plays a vital role in promoting the country's socio-economic progress.

The country's economy is predominantly composed of small businesses, and much of the population is employed in the private sector (The Inter-American Development Bank, 2013). The wholesale and retail trade sector, which contributed approximately 12% of the GDP in 2021, holds significant importance in the supply chain. This sector involves a two-tier distribution system, where goods manufactured are sold in large quantities (wholesale) to wholesalers, who then sell them to retailers, ultimately reaching the end customers. The wholesale and retail sector, therefore, represents a critical link between production and consumption.

Antigua and Barbuda's critical infrastructure is concentrated in the vicinity of St. John's, Antigua, including facilities for power generation, drinking water, and air and sea transport. However, these systems lack alternatives or redundancies, making them highly vulnerable. The main seaport for the islands is in St. John's, while Antigua has one international airport and two smaller airfields on Barbuda. The deep-water harbour in the capital serves as the primary transit point for trade and handles all imported cargo. The commercial buildings within the St. John's Central Business District (CBD) are typically low-rise structures, with occasional mid-rise buildings present.

Industrial regions in Antigua and Barbuda mainly consist of large warehouse storage and distribution centers, accompanied by supporting structures such as offices. The heights of these structures are typically limited to one or two stories.

The wholesale and retail sectors in Antigua and Barbuda can be significantly impacted by various climate-related factors, including hurricane winds and surges, sea-level rise, extreme heat, and drought[29]. The small island's status, economic reliance on limited sectors, and exposure to climate change effects underscore the pressing need for proactive measures to address vulnerabilities, enhance resilience, and promote sustainable development in the face of these challenges.

[29] ImageCat & Sustainable Managers. Antigua and Barbuda's Adaptation Plan for the Wholesale and Retail Sector. https://environment.gov.ag/assets/uploads/attachments/7b725-wholesale-and-retail-sap.pdf

Table 7: Climate Change Impacts on four (4) thematic areas (ImageCat, 2023)

Thematic Areas	Climate Change Impacts
Buildings	
	Physical damage to W&R commercial buildings and warehouses due to hurricane storm surge
	Physical damage to W&R commercial buildings and warehouses due to hurricane wind
	Physical damage to W&R assets (other than buildings) due to storm surge
	Physical damage to W&R assets (other than buildings) due to wind
	Cleaning costs
	Risk of employee injury/death (assessed while in the workplace)
	W&R Business Interruption (BI) due to damaged buildings and other assets
Lifelines / Critical Infrastructure	
	W&R BI due to accessibility issues caused by storm surge
	W&R BI due to accessibility issues caused by wind
	W&R BI due to loss of power
	W&R BI due to outages to water utilities
	W&R BI due to outages to telecommunication systems
Supply Chain	
	Disruptions to supply chains due to impacts on airport operations
	Disruptions to supply chains due to ships bypassing the islands during storms
	Disruptions to supply chains when hurricanes affect overseas suppliers
	Disruptions to supply chains due to impacts on port operations
Economic	
	Businesses impacted indirectly through customers being affected
	Reduction of consumer discretionary spending impacting sales
	Lost revenue when hotels are closed
	Forced closure
	Costly energy expenses during droughts and hurricanes

2.7. Finance Sector

As a SIDS, Antigua and Barbuda had strong resilience to storms and droughts; nevertheless, as of 2023, the country is very vulnerable to climate change and natural disasters. 10% of middle-class and low-income families are spending more money because of the effects of climate change. Moreover, the increased frequency of hurricanes from 15-20 years to now, 1 in 5 years has now

caused an increase in insurance by over 300% since 1990 and our budling code has since been revised to include climate-friendly solutions which also comes as additional cost to homeowners.

The topic of climate finance is important due to the nature of the small, undiversified, and usually heavily dependent on a single sector such as tourism, and due to the magnitude of their structural issues, Antigua and Barbuda and other SIDS's existing resources and capacities are insufficient to meet such economic and climate challenges.

In Antigua and Barbuda, 88% of financial institutions lack a vision or management statement that addresses climate change. 50% of organizations do not consider the impact of climate change in their annual plans, priorities, or actions.

Effective partnerships and collaboration among stakeholders, including government agencies, private sector entities, civil society organizations, and international development partners, are vital for mobilizing sustainable finance and leveraging additional resources.

2.8. Infrastructure and Housing

The building stock in Antigua and Barbuda is projected to suffer losses of up to US $451 million (EC $1218.9 million) by 2030 due to the impacts of tropical cyclones (storm surge and high winds), sea level rise (SLR), and flooding, which could result in additional losses of US $108 million (EC $291.9 million) under a worst-case emissions scenario using the Representative Concentration Pathway (RCP) 8.5. The deterioration of energy infrastructure and road networks will be accelerated by gradual changes in precipitation and rising temperatures, driving up the cost of ordinary maintenance and repairs and disrupting daily life for residents.

Housing

Housing in low-income regions often sustains the most damage, especially if they are in a floodplain (e.g., St. John's City, York's, Cashew Hill, McKinnon's, and Jolly Harbour). Exposure of building materials to moisture, excessive salinity, and sunlight may accelerate deterioration and compromise the structural integrity of Antigua and Barbuda's housing sector. The lack of regulation or licensing for contractors and builders in Antigua and Barbuda as a profession makes compliance with the building code even more problematic for the housing industry.

68% of households in Antigua rely on APUA water as their main water supply that is piped into their homes. Desalination supplies the majority of Antigua's APUA water, with surface water catchments providing water when and if catchments are supplied by rainy season rainfall. When water levels fall below permissible extraction levels, catchments like Potworks Dam frequently go offline, especially during the dry season.

Barbuda has limited groundwater reserves with groundwater supplies being extremely sensitive to saline intrusion, surface contamination, storm surge, and sea level rise.

At least 13% of homes are covered by insurance in Antigua. Low insurance uptake in Barbuda may be a result of choice or limited accessibility. Additionally, there seems to be a widespread lack of information and awareness of policyholder responsibilities on both islands. The high cost of premiums, especially for homes made of materials other than concrete (premiums are higher for homes made of wood), and the long wait times for pay-outs after disasters because they are based on an in-person damage assessment is another reason why this may be low. Public perceptions of insurance are also influenced by a lack of confidence in insurance providers, as well as incidents of fraud and financial disasters. Due to the significant risk to lenders, there are few funding options available for homeowners to improve resilience, particularly if their homes are in flood-prone areas or made of poor-quality materials.

Wastewater

Due to a near total reliance on septic tanks and soak-aways, many of which are shoddily built and neglected, the water table and downstream coastal waters have been contaminated in both Antigua and Barbuda due to the lack of centralized wastewater treatment infrastructure.

Localized flooding occurs in St. John's City due to the results of both rainfall and improperly treated sewage effluent that overflows from septic tank systems and into roads before draining into St. John Harbour and flowing into the ocean.

Sewage treatment in Barbuda involves a traditional septic tank plus a deep soak-away system to contain huge quantities of effluent to accommodate the sluggish percolation rates typical of limestone soils.

Roads

The flat geography of Barbuda slows down the natural water drainage of roads, and there are no storm-water drainage facilities or culverts on the island. Antigua's high soil moisture content and inadequate drainage present a challenge for major arteries, leading to foundation and sub-base structural failures and pavement distress in the form of potholes, patching, alligator cracking, edge cracking, ravelling, rutting, and settlement. The recently resurfaced Sir George Walter Highway and Friars Hill Road sustained significant damage because of a big rainfall event in November 2020, including the production of large potholes and asphalt stripping that revealed underlying pipes.

Some sections of the roads in Antigua just have open drains close to highways that empty into bodies of water, while other areas have stormwater drainage systems. Some roadways are not properly drained, which allows water to spill off onto the adjacent property. Due to the huge volume of trash in places with dense populations, much of which ends up in drains and culverts,

drainage systems are unable to function efficiently during periods of heavy rainfall, which results in localized floods.

SLR and coastal erosion are especially prone to affect roads in Antigua that are located near the coast. Sea wall protection for roads and the entire coastline is being destroyed by SLR and coastal erosion. Barbuda's roadways along the lagoon, including those in Codrington village, are particularly vulnerable because of their low elevations. Codrington also lacks the full level of coastline protection that it once had because of the sandbar break caused by Hurricane Irma in 2017.

Energy

Antigua and Barbuda depend on conventional fossil fuels for its energy supply, and imports around 96% of the petroleum products (diesel and oil) required to meet the nation's energy demands. Two power plants in Antigua, APC and Blackpine, generate 60.3 MW and 30.4 MW of energy, respectively.

Due to deteriorating infrastructure, inadequate maintenance, and unauthorized grid connections, the electricity system experiences significant inefficiencies and high system losses (24% relative to net generation). The grid encounters difficulties in its ability to recover from extreme events in addition to ongoing operational difficulties. Grid supplies were disrupted after Hurricane Luis (1994) for three months and again after Hurricane Gonzalo (2014) for two weeks. Some houses have backup diesel generators, particularly in Barbuda, because they were provided in the aftermath of Hurricane Irma.

Solar PVs are susceptible to damage from hurricanes because flying debris and wind pressure can cause the panels to break. Minimizing gaps between panels can lower the risk to solar installations, and quick dismount devices can be built on smaller installations so that panels can be taken down and stored before a hurricane.

2.9. Water Sector

Water resources and water supplies are highly exposed to variability and change in weather and climate conditions. Climate hazards including extreme weather events and episodic droughts disrupt both the quantity and quality of water available for supply, as well as impacting on the water provision infrastructure and operations. Climate change will result in changing hazards, weather patterns, and climate conditions, compounding existing risks. Underlying vulnerabilities in the water sector, for example, competition over resources, leakage, pollution, and poor land use management, act to exacerbate the impacts of climate hazards.

The key social and economic sectors of tourism and agriculture, as well as key public services, are highly exposed to risks relating to water and suffer when supplies are interrupted or affected by

extreme climatic hazards. These hazards already exist and will worsen as the effects of climate change arise.

Surface and groundwater sources are highly vulnerable to drought as evidenced in the 2013-2016 drought in which surface water source output dropped to zero, and groundwater production halved. This resulted in an almost total reliance on desalination. APUA estimated that additional fuel costs incurred for every month without surface water availability are EC$1 million/month. Lack of surface water also impacts food security and, during the 2013-2016 drought, a decrease of 40% in meat production was observed. Climate change projections indicate that although there is likely to be a decrease in average precipitation, extreme weather events that lead to intense rainfall events may become more frequent. Sea level rise may also exacerbate existing saline intrusion in coastal aquifers.

Barbuda is extremely prone to drought, which also worsens the level of salinity of groundwater due to unsustainable abstraction. Barbuda is also highly exposed to storms and hurricanes, which bring heavy rainfall, flooding, storm surge, strong waves, and high winds. The extensive sand-mining activities on the island have also reduced natural flood protection.

Due to the flat topography of the island, storm surges can cause saltwater contamination of the aquifer. Storm surges and high winds can also damage water production and distribution infrastructure and cause loss of power at RO plants and pumping stations, thereby resulting in further delays with respect to restoring services.

While desalination is relatively invulnerable to drought conditions, the desalination process is dependent on a consistent supply of electricity and the ability to abstract sea water from the nearshore environment – both of which are susceptible to the impacts of extreme weather events.

Case Example:

Category 5 Hurricane Irma in 2017 devastated infrastructure across Barbuda, resulting in a complete evacuation of the island. The main desalination plant at the ferry port (100,000 US gallon/day production) was damaged by Irma. The plant is located on the coast and was flooded internally to a depth of around 1.5 m. The plant's motors were flooded and required rebuilding, and the electrics were damaged. The building roof was damaged, but the main structure remained intact. The roof has been replaced using similar construction (wooden and galvanized steel). Water supply from the RO plant was restored to Codrington within two months. The pump house was destroyed, and the electricity was damaged. It is understood that it was a wooden structure, which has now been replaced with a concrete structure, including a concrete roof, in the same location. The water transmission mains, which are buried, were generally unaffected by Irma, but damage was incurred to secondary pipes and connections, which typically run over the surface. Currently, the plant is fully operational again, but the backup generator has not been repaired.

2.10.Biodiversity and the Natural Environment

While the decline in biodiversity is primarily attributed to invasive alien species and human interference in Antigua and Barbuda, climate change also plays a major role. Antigua and Barbuda are highly susceptible to chronic climate pressures, such as rising sea levels, fluctuations in ocean temperatures, extreme climate events like hurricanes, ocean acidification, sea level rise, heat waves and shifting rainfall patterns (*Health & Climate Change Country Profile*, 2020). These pressures disrupt the delicate balance within ecosystems, endangering both biodiversity and food security.

According to the United Nations Food and Agriculture Organization (U.N. FAO), 22.7% or about 10,000 hectares (ha) of Antigua and Barbuda is forested. Antigua and Barbuda's forests contain million metric tons of carbon in living forest biomass. The forest ecosystems are susceptible to the influences of changing temperature and precipitation patterns. Recurrent drought periods experienced have resulted in diminished vegetation cover, consequently heightening the risk of soil erosion and the sedimentation of coastal waters when rainfall resumes. Terrestrial habitats become more prone to forest fires, particularly in areas impacted by the invasive lemongrass species.

Native seagrasses are susceptible to sediment runoff, human-induced destruction, and the impact of storms. Rising sea levels pose a threat, and a potential decrease in light availability within the seagrass beds and coral reefs (Department of Environment, 2020; Antigua and Barbuda Coral Reef Report Card, 2015), while also entailing the intrusion of saline water into freshwater reserves, coastal erosion, and the destruction of wildlife habitats

While temperature increases are not expected to significantly harm mangroves and wetlands, they can cause damage to coral reefs, leaving mangroves vulnerable to greater wave action. Sea level rise poses the most substantial threat to mangroves, while coastal systems in general (e.g., seagrass beds and coral reefs) are projected to experience submergence, coastal flooding, and erosion. Coastal erosion endangers the nesting of marine turtles on beaches, jeopardizing their survival. Projections estimate annual reductions in tourism's contribution to Antigua and Barbuda's GDP ranging from US $102 million in 2050 to over US $340 million in 2080, based on a mid-range sea-level rise scenario (Convention on Biological Diversity, n.d.).

Ocean acidification, resulting from the escalating concentrations of atmospheric CO2, engenders supplementary hazards for coral reefs. Projections indicate that oceanic pH levels may decline by 0.3-0.4 units below pre-industrial levels within the next century (Wood et al., 2008)

2.11.Women, Youth, Persons with Disabilities, the Elderly, Ethnic Communities, and other Marginalized Groups

Women

Antigua and Barbuda experience a disproportionate number of women facing poverty and destitution. In the context of climate change, this imbalance exacerbates inequalities for women, leading to heightened vulnerability to gender-based violence, restricted mobility, decreased earning capacity, asset loss, and loss of life. It is crucial to acknowledge and address these challenges to effectively plan and implement adaptation strategies. One starting point involves integrating gender equality concerns into key sectoral policies, particularly in areas like protected zones and regulations governing small craft businesses, where women are prominently involved.

In line with a knowledge, attitude, behaviours, and practices survey conducted by UN Women and IISD, stakeholders in national consultations emphasized the necessity of retraining government employees. This retraining is essential to anticipate technological shifts and the evolving needs of industries, with a specific focus on incorporating considerations related to gender and climate change. Additionally, there is a recognized need for further data collection on gender and social factors in the context of adaptation in Antigua and Barbuda.

The findings suggested that any adverse effects of climate risks on women's livelihoods would have widespread consequences for both social and economic aspects. This is particularly notable because women often lead households and form the majority of the workforce in government and the tourism sector. Various coping mechanisms were identified in response to job losses stemming from hurricanes, storms, droughts, floods, flash floods, and the impacts of COVID-19, particularly in the protected areas, finance, and infrastructure sectors.

In the aftermath of climate-related events and the ongoing effects of COVID-19, women are reportedly more likely to turn to microfinancing for income support. The study focused on livelihoods within the protected areas sector, including small craft/business operators, fisheries, and tourism. Identified gaps in access within the infrastructure sector, particularly in communications, health, transportation, and utilities, need attention to diminish the vulnerability of women post-climate events.

Regarding health impacts associated with climate change, these can manifest as direct, indirect, or diffused effects. In the case of Antigua and Barbuda, direct health impacts are linked to extreme weather events. Indirect effects extend to repercussions in other sectors, such as the influence on water security and safety, leading to waterborne diseases. Diffused impacts encompass mental and psychosocial health issues as well as the prevalence of non-communicable diseases.

Youth in the Context of Climate Change

The consideration of youth in the context of climate change is of utmost importance, especially for those aged 10 to 24. Climate change, being a global issue, affects all people, irrespective of age. It has far-reaching consequences on health, income, security, education, and other vital aspects of individuals and families. As the youth confront climate change, they face the responsibility of contemplating the implications of environmental shifts and how it will shape their futures. Moreover, the youth are the ones who will inherit the consequences of current climate actions, making it essential to empower them with the knowledge, tools, and support to navigate these challenges effectively.

One critical area affected is health, particularly during adolescence. However, climate change can exacerbate poverty and food scarcity, making it challenging for adolescents to access nutritious foods. This may lead to malnutrition, obesity, and related health issues like diabetes and high blood pressure.

Moreover, climate change-induced anxieties about the future and its impact on the world can significantly affect mental health, especially among young people. Learning about climate change and its far-reaching consequences can be anxiety-inducing, leading to stress, depression, and emotional distress. Family life is also affected. In Antigua and Barbuda, only 33% of adolescents had parents/guardians who understood their problems and worries, and 39% had parents/guardians who knew what they were doing with their free time, indicating potential challenges in communication, and understanding between parents and adolescents.

The impact of climate change extends to education as well. Extreme weather events, such as floods, hurricanes, or prolonged droughts, can disrupt the accessibility of educational institutions, especially for students in vulnerable areas. Education could be impacted by climate change if certain regions of the nation face more adverse climate effects, hindering students' access to schools and educational opportunities.

Children and Youth Vulnerability to Climate Change

Children are generally exceptionally vulnerable to climate change due to their specific developmental needs and physiology (e.g., risk of injury and death during extreme weather events, heat stress, vector-borne diseases, air pollution). In the Eastern Caribbean, this vulnerability is exacerbated by the fact that children are disproportionally represented among the poor. In Antigua and Barbuda, 24.3% of them are estimated to live in poverty (Voluntary National Review, 2021), which has probably increased as an outcome of the COVID-19 pandemic. Likewise, young people face specific vulnerabilities. Youth (15-24) unemployment in Antigua and Barbuda is estimated at 25.7% (Ibid.). Young men are more likely to be unemployed than any other group. Faced with unemployment, climate change and now the pandemic and its myriad of impacts,

young people are also affected by mental health and behavioural issues. While these did not emerge solely because of the pandemic, a sharp increase has been observed since 2020.

Obesity represents another growing source of concern for children and young people's health and wellbeing. An estimated 19.1% of the adult population is affected (WHO/PAHO, 2020), which is linked to a high prevalence of diet-related non-communicable diseases (NCDs) such as diabetes. Climate change is likely to exacerbate the triple-burden of malnutrition, whereby undernutrition, micronutrient deficiencies and overweight/obesity exist simultaneously. It is expected to reduce short- and long-term food and nutrition security both directly, through its effects on agriculture and fisheries, and indirectly, by contributing to underlying risk factors such as water insecurity, dependency on imported foods, urbanization and migration, and health service disruptions. These risk factors are distributed unevenly, with some population groups (i.e., people living in poverty) experiencing greater vulnerability.

As children and young people do not represent a homogeneous group, they experience climate impacts differently. In addition to age, gender is one of the lenses through which to analyse the differentiated impacts that prevail. Globally, climate-related challenges facing women and girls can be worsened by overlapping issues of poverty, marginalization in decision-making, and control over land and resources. In Antigua and Barbuda, gender inequalities may be reinforced in subtle ways, such as a disproportionate representation of female employees in low-paying jobs. Similarly, women's roles and activities in the fisheries sector tend to be in supporting low-paid onshore roles, such as fish processing, food preparation and service sector roles.

Other Environmental Concerns

The country's acute vulnerability to climate-related pressures is exacerbated by locally driven environmental degradation and mismanagement of resources. Extensive development and increasing urbanization and industrialization, population growth, unsustainable agricultural practices, and the rapid growth of the tourism industry have led to significant environmental challenges, including:

Water scarcity: The sustainability of safe water supplies is one of the most serious issues facing Antigua and Barbuda. With an increase in dry periods and increased demand, the country is facing regular water shortages and is now relying on desalination for freshwater. Antigua has five – soon seven - reverse osmosis (RO) plants and two water treatment plants. Barbuda has one desalination plant; however, most drinking water is shipped in through Antigua. During the drought of 2015, consumption of desalinated water reached more than 90%, compared with the normal 60%. In parallel, with sea level rise, the risk for saline intrusion has increased. Besides, due to the switch in dependence on desalinated water, metal piping systems are being corroded, resulting in significant water loss. Land degradation:

Land degradation has long been a problem for Antigua and Barbuda, owing to inappropriate land use practices or the improper disposal of wastes that include wastewater and oily waste residues.

Degradation of vital ecosystems: Both Antigua and Barbuda are home to extensive mangrove wetland ecosystems. In 2012, the 36 recognized wetland sites in Antigua were reported to cover 3% of the land, while the 9 mangrove wetland sites in Barbuda covered 22% of the land. Climate change is increasing their fragility, as illustrated by die-off of Hanson's Bay wetlands on the West coast of Antigua, first observed in 2017, possibly due to hypersaline conditions (resulting from water evaporation). However, various human activities cause wetland degradation. These include deforestation (forest cover declined by 17% between 2015 and 2019) and infrastructure development. Of particular interest is the McKinnon's Salt Pond, an ecological area that is located within proximity to farm holdings and tourism developments but however has been severely degraded by pollution influxes. In Barbuda, new tourism developments have come under considerable land use conflict given their location within or close to the Codrington Lagoon, which is a protected area and has become Antigua and Barbuda's only Ramsar site since 2005.

Loss of biodiversity: Biodiversity is an important catalyst for economic growth, through its contribution to the attractiveness of Antigua and Barbuda as a tourism destination (e.g., Frigate Bird Sanctuary in Barbuda). Antigua and Barbuda's offshore islands remain hubs for birds, lizards and four are home to the Antigua Racer snake, which is endemic to Antigua and Barbuda, and the most iconic reptile in the country. However, biodiversity has for long been impacted, historically by the sugar and cotton industries (which caused the introduction of rats and mongooses in the 19th century, leading to the extinction of various endemic species) and more recently by tourism (beachfront resorts, cruise ship and yachting industries, and new developments such as floating facilities). Extreme weather events and emerging threats from invasive species, such as the Lionfish and Giant African Snail, have also led to significant losses.

Poor air quality: Rising levels of air pollution in the Eastern Caribbean are linked to increasing urbanization, polluting vehicles, and the burning of domestic waste. In Antigua and Barbuda, air quality monitoring may be undertaken at point locations, but there is no national air quality monitoring programme to provide baseline data. However, in April 2020, the World Health Organization (WHO) reported that air quality was considered moderately unsafe. The most recent data indicates an annual mean concentration of PM2.5 is 19 µg/m3, which exceeds the recommended maximum of 10 µg/m3. This is a concern as air pollutants, particularly from ozone and vehicle emissions, as well as mold and other allergens, have been recognized as important triggers for asthma. Asthma is endemic in the Caribbean, affecting almost one-third of the population in some countries.

Solid waste management: Waste management is a particular challenge, due to limited land area available for disposal, lack of capacity to handle increasing volumes of waste, particularly from the tourism industry, high importation rates of food and other non-biodegradable goods, leading to a high level of waste per capita, and attitudes regarding disposal. Poor waste management is associated with air, water and soil pollution, and significantly exacerbates flooding when solid waste blocks drains. A specific challenge is illegal dumping and the unregulated disposal of hazardous wastes. There are also reports of sewage being used to put out fires at old dump sites.

Sargassum seaweed: Antigua, Barbuda and Redonda have been affected by Sargassum seaweed since 2011. Sargassum blooms appear to originate off the coast of South America and have been affecting the Caribbean with varying ecological and socio-economic effects (impact on tourism). They biologically degrade upon contact with the shoreline, leading to negative impacts (while on the sea, they provide ecosystem services such as habitat for juvenile marine organisms including fish and turtles).

Youth Engagement in Climate Action

Antigua and Barbuda developed a Youth Engagement Strategy on Climate Action and Environmental Sustainability (YESCA) with an accompanying action plan. The YES-CA is structured based on three objectives and outcomes (transform education for sustainability; create training and employment opportunities; foster environmental stewardship); three strategic approaches (institutionalizing youth participation; adopting inclusive approaches; using innovation and new technologies); and four conditions for an enabling environment (advancing policy; partnerships and resource mobilization; capacity-building; monitoring progress and evaluation). It is accompanied by an action plan and performance indicators for the period 2022- 2030, as summarized in the following graph:

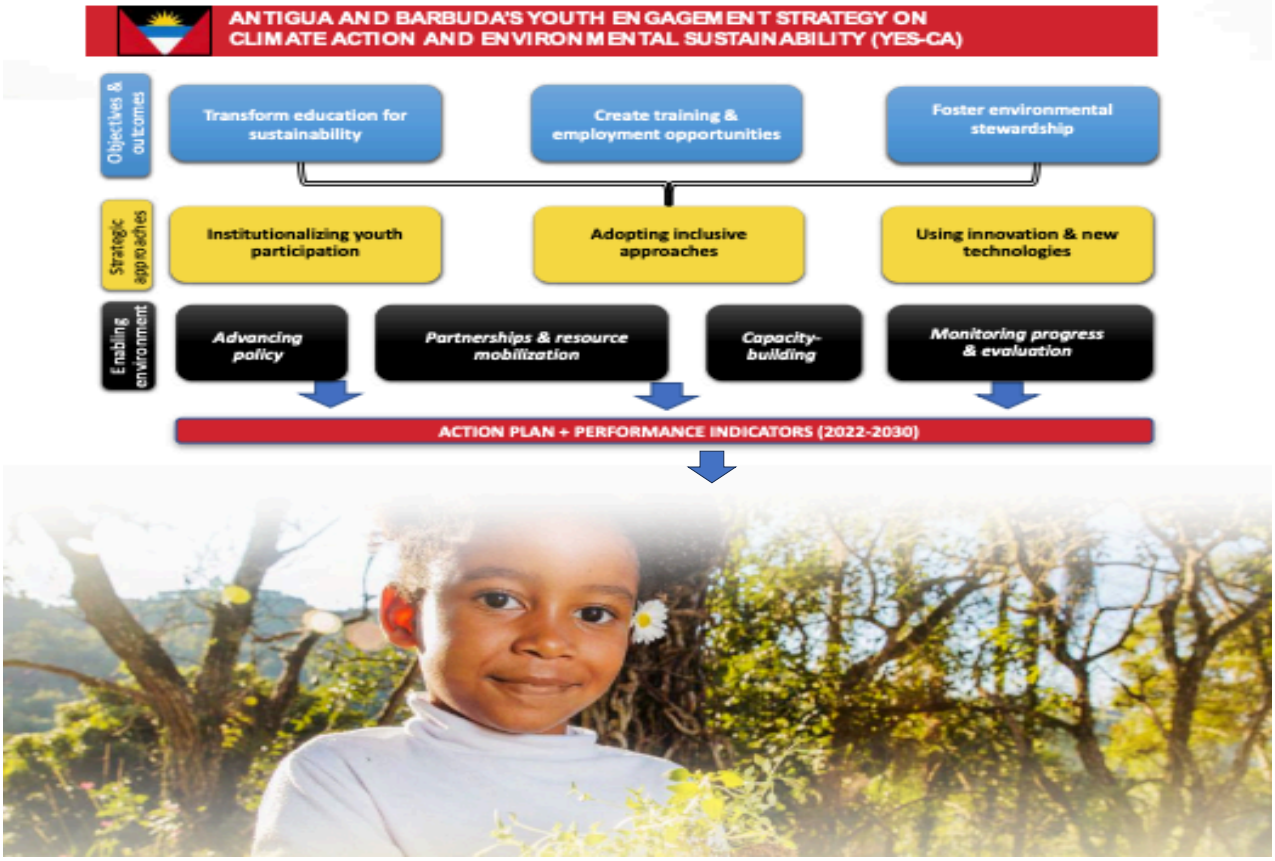

Figure 9: Strategy Overview of the YES-CA

The YES-CA is supported by (and supporting, complementing) a set of national policies, which identify youth engagement as key to achieving sustainable development and building Antigua and Barbuda's resilience:

Climate policies

The Nationally Determined Contributions (NDCs), revised in 2021, explicitly refer to the development of a Youth Engagement Strategy and Action Plan, in order to facilitate the involvement of children and youth, including the most vulnerable, and support the engagement of youth in adaptation and mitigation initiatives.

A commitment from the NDCs is to expand training and skills development programmes to enable the creation of new jobs in the labour force, enhance youth employability and ensure their access to meaningful and decent work, in support of Antigua and Barbuda's Just Transition Framework. In 2016, the Government had already developed a Workforce Development Strategy, which serves to identify the enabling activities required to create a "sufficient and appropriately trained workforce" to support the implementation and achievement of the initial NDC targets.
Antigua and Barbuda also committed to ensuring that Action for Climate Empowerment (ACE) becomes, as per Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) and Article 12 of the Paris Agreement on climate change, a key cross-cutting instrument to involve all levels of society in climate action, in particular children and youth (as well as other vulnerable groups including women, the elderly and people living with disabilities) in support of all elements of adaptation.

Youth Policies

Antigua and Barbuda's National Youth Policy 2021-2030 (launched in September 2021) was developed to guide the approaches that key stakeholders should adopt to enable youth development. One of the policy's nine thematic focuses is environmental sustainability, covering the following: the Blue Economy, the Green Economy, and Climate Change Mitigation & Adaptation (climate action). The latter corresponds to eleven (11) strategies:

The YES-CA is supported by (and supporting, complementing) a set of national policies, which identify youth engagement as key to achieving sustainable development and building Antigua and Barbuda's resilience:

1) The Nationally Determined Contributions (NDCs), revised in 2021, explicitly refer to the development of a Youth Engagement Strategy and Action Plan, in order to facilitate the involvement of children and youth, including the most vulnerable, and support the engagement of youth in adaptation and mitigation initiatives. A commitment from the NDCs is to expand training and skills development programmes to enable the creation of new jobs in the labour force, enhance youth employability and ensure their access to meaningful and decent work, in support of Antigua and Barbuda's Just Transition

Framework. The NDCs also include a commitment to promote environmental education to support the delivery of Antigua and Barbuda's climate change ambitions.

2) The National Youth Policy 2021-2030, launched in September 2021, was developed to guide the approaches that key stakeholders should adopt to enable youth development. A comprehensive Action Plan, expected to be completed in 2022, will support its implementation. One of the policy's nine thematic focuses is environmental sustainability, covering the following: the Blue Economy, the Green Economy and Climate Change Mitigation & Adaptation (climate action).

Table 8: National Youth Policy's Strategies on Climate Change Mitigation and Adaptation

National Youth Policy's strategies on Climate Change Mitigation & Adaptation	
Strategy 1	Encourage young people to join environmental groups or organisations
Strategy 2	Boost climate change awareness among youth via social media
Strategy 3	Integrate climate change adaptation into the school curricula
Strategy 4	Mainstream climate change education into national policies and development plans
Strategy 5	Offer more climate change scholarships and innovation grants to youth
Strategy 6	Involve youth in the planning and implementation of environmental programmes
Strategy 7	Provide arable land for more youth to engage in agricultural activities
Strategy 8	Promote more tree-planting activities
Strategy 9	Invest in schools' agricultural programmes
Strategy 10	Promote the 3Rs (Reduce, Re-use, Recycle) among youth
Strategy 11	Create an enabling environment to bolster youth engagement in climate adaptation

Education policies

Neither the Education Act of 2008 nor the Draft Education Sector Plan 2013-2018 mention climate change or environmental sustainability. The only reference to the environment in the Act is the mandate given to the Ministry of Education to "increased awareness and appreciation of the natural environment of the state" in the education system. As a way of comparison, the 2021 NDCs are more specific, by including a commitment "to promote environmental education to support the delivery of Antigua and Barbuda's climate change ambitions".

An important instrument is the 2020 National Safe School Policy, drafted as part of the Model Safe School Programme in the Caribbean, under the umbrella of the Caribbean Safe School Initiative (CSSI), initiated at a Regional Ministerial Forum in 2017 through the adoption of the Antigua and Barbuda Declaration on Safe Safety. The CSSI focuses on school safety in the context of natural disasters, including three pillars: infrastructure resilience, disaster management and resilience education (curriculum aspects). This is a priority in Antigua and Barbuda where many schools are located in hazard-prone areas.

The Elderly

The elderly population in Antigua and Barbuda faces unique vulnerabilities in the context of climate change, particularly due to increasing temperatures and more frequent heatwaves. Older individuals are generally more susceptible to heat-related illnesses due to physiological changes associated with aging. For example, diminished sweat production and reduced ability to regulate body temperature make them prone to heat stress and dehydration. As temperatures rise, the risk of heat-related health issues such as heatstroke and heat exhaustion significantly increase among the elderly.

Furthermore, extreme weather events, which are becoming more frequent and intense due to climate change, contribute to the disruption of the social fabric of communities. For the elderly, this disruption often translates into heightened social isolation. For instance, severe storms and flooding may damage infrastructure and transportation systems, making it challenging for older individuals to access essential services and interact with their communities. Social isolation, in turn, is associated with adverse health outcomes, including mental health issues, and exacerbated chronic conditions.

The intersection of health vulnerabilities and social challenges underscores the critical need to tailor climate adaptation and resilience strategies to address the specific needs of the elderly population in Antigua and Barbuda. This involves enhancing healthcare infrastructure to cope with the increased demand for medical services during climate-related health emergencies. Additionally, community support systems should be strengthened to ensure that older individuals have access to assistance, information, and social connections during and after extreme weather events. Moreover, strategies to mitigate the impacts of climate-induced social disruptions on the elderly, such as targeted outreach programs and communication networks, are essential to foster resilience and well-being within this vulnerable demographic.

Persons with Disabilities (PWDs):

Persons with disabilities (PWDs) in Antigua and Barbuda face a myriad of challenges, with the deleterious effects of climate change exacerbating their vulnerabilities. One prominent issue is the compromised state of existing infrastructure during extreme weather events, posing significant barriers to the evacuation and accessibility of emergency services. The implications of this are particularly dire for PWDs, who encounter substantial obstacles when attempting to navigate infrastructure that is either damaged or inadequately equipped. For instance, ramps, elevators, and other accessibility features may be rendered useless, hindering the mobility of individuals with disabilities during critical times.

During climate-related events, the evacuation process becomes a formidable challenge for PWDs due to the compromised infrastructure. Safe relocation to designated areas is impeded, leaving this demographic at a heightened risk of harm. The urgency for inclusive disaster preparedness becomes glaringly evident in these circumstances. The lack of comprehensive measures

exacerbates the vulnerability of PWDs, emphasizing the need for proactive planning that takes into account the unique needs and challenges they face. Inclusive disaster preparedness involves not only accessible infrastructure but also clear communication strategies and targeted support mechanisms to ensure the safety of individuals with disabilities during crises.

Furthermore, the impact of climate change extends beyond the immediate dangers posed during extreme weather events. Disruptions in healthcare services, both during and after such events, disproportionately affect PWDs, especially those with pre-existing health conditions. For example, individuals reliant on regular medical treatments or specialized care may find themselves in precarious situations when these services are interrupted. The consequences can be severe, ranging from exacerbated health conditions to life-threatening situations, underscoring the intricate relationship between climate change, healthcare access, and the well-being of persons with disabilities.

In conclusion, the intersection of disabilities and climate change in Antigua and Barbuda creates a complex web of challenges. From compromised infrastructure during extreme weather events to the lack of inclusive disaster preparedness and disruptions in healthcare services, PWDs bear a disproportionate burden. Addressing these issues requires a multifaceted approach that encompasses resilient infrastructure, inclusive disaster planning, and robust healthcare systems that prioritize the unique needs of individuals with disabilities. Only through such comprehensive measures can the adverse impacts of climate change on persons with disabilities be mitigated, ensuring their safety, well-being, and equal participation in society.

Ethnic Communities

The diverse ethnic communities in Antigua and Barbuda find themselves entwined in a complex tapestry of climate vulnerabilities, intricately connected to their cultural identity and geographical locations. One of the primary challenges faced by these communities is the imminent threat posed by rising sea levels and climate-induced changes. Coastal regions bear the brunt, leading to cultural displacement and the erosion of traditional practices that have been integral to the identity of these ethnic groups. The impact is not merely environmental but resonates deeply within the social and cultural spheres, creating a precarious balance between preservation and adaptation.

Coastal ethnic communities in Antigua and Barbuda are particularly susceptible to heightened vulnerabilities arising from the twin challenges of rising sea levels and shifting climate patterns. These communities often rely profoundly on specific natural resources for their livelihoods, and any disruption in these resources due to climate-induced changes carries profound economic and cultural implications. For example, changes in fish migration patterns or the degradation of coastal ecosystems can disrupt longstanding fishing practices, impacting the economic sustenance and cultural traditions of these communities.

The intricate relationship between the environment and cultural heritage necessitates a nuanced strategy for safeguarding the identity of these ethnic communities. A comprehensive approach is required, seamlessly integrating climate adaptation measures with sustainable resource management and community resilience efforts. Such an approach acknowledges the interdependence of cultural practices, economic activities, and the natural environment. It involves not only adapting to the changing climate but also ensuring the sustainable use of natural resources, thereby safeguarding the cultural heritage that is deeply embedded in the relationship between these communities and their surroundings.

Preserving the cultural fabric of these ethnic communities requires an understanding of the dynamic interplay between climate vulnerabilities and traditional practices. It involves empowering these communities with the knowledge and tools needed to adapt to changing environmental conditions while preserving their unique cultural identities. By fostering a balance between adaptation, sustainability, and resilience, Antigua and Barbuda can navigate the intricate challenges posed by climate change and ensure that the rich tapestry of cultural diversity continues to thrive amid evolving environmental realities.

Other Marginalized Groups:

Low-income populations and residents of informal settlements in Antigua and Barbuda grapple with a complex array of vulnerabilities intricately intertwined with the impacts of climate change. The challenges faced by these individuals are multifaceted, arising from both their high dependence on climate-sensitive sectors and the limited resources available to them. This combination exacerbates the difficulty of adapting to the evolving environmental conditions, creating a layered vulnerability that requires careful consideration.

Informal settlements, often characterized by a lack of proper infrastructure and situated in vulnerable locations, face heightened risks during climate-related events. These risks include flooding, resource scarcities, and inadequate access to emergency services, further amplifying the challenges faced by low-income populations. The vulnerability of these communities is not solely a result of environmental factors but is deeply rooted in socioeconomic disparities, making the need for targeted interventions even more pressing.

Addressing the vulnerabilities of marginalized groups in Antigua and Barbuda demands a comprehensive and holistic approach. This includes the implementation of targeted economic policies to uplift low-income populations and reduce their dependence on climate-sensitive sectors. Community-driven adaptation strategies are crucial, as they empower residents to actively participate in the decision-making processes that affect their lives. Moreover, infrastructural improvements are essential to fortify resilience within informal settlements, ensuring that they can withstand the impacts of climate change and enhance their adaptive capacity.

A key element of this comprehensive approach is recognizing the interconnectedness of social, economic, and environmental factors. It is not enough to address climate vulnerabilities in isolation; instead, a holistic strategy must consider the broader context of poverty, inequality, and inadequate infrastructure. By doing so, Antigua and Barbuda can foster resilience within these marginalized communities, promoting an equitable response to the challenges posed by climate change. This approach not only mitigates the immediate impacts of environmental changes but also addresses the underlying factors that contribute to the vulnerability of low-income populations and informal settlements.

2.12.Local Areas

Airport and Fitches Creek Area

The Airport and Fitches Creek Local Areas in Antigua is situated along the northern coast of the island and is bordered by roads, communities, and wetlands. It is a flat region with some small hills scattered around. The area hosts various points of interest, including residential communities, educational institutions, the V.C. Bird International Airport, military facilities, restaurants, villas, and historic sites, making it a popular destination for tourists.

The Fitches Creek watershed is one of the six major watersheds in Antigua. The coastal zone of the area is part of the Northeast Marine Management Area (NEMMA), a protected marine environment known for its fringing reefs and seagrass beds, but erosion caused by oceanic conditions and hurricanes poses a threat to these ecosystems.

The region is at risk of extreme weather events, with projected worsening impacts in the coming decades. The area has experienced severe flooding in the past, with hurricanes and tropical storms causing significant damage to inland areas like the Piggott's community. Storm surge projections indicate the vulnerable areas at risk during such events. The area has also been affected by coastal and flash flooding, with flash floods occurring more frequently in response to heavy rainfall events.

In the Airport/Fitches Creek area, there are challenges concerning water availability, primarily caused by frequent droughts. To address this issue, residents have taken measures such as installing personal water storage tanks and buying water delivered by trucks. It's important to note that the airport receives a higher priority in water supply because of its essential nature.
The weak spots within the critical infrastructure sector of this area that cause this sector to be vulnerable include a lack of documentation of disaster plans and protocols. Many facilities, including piers and jetties, and roadways situated along the coastline are susceptible to flooding and damage from hurricanes/tropical storms and sea level rise. Sediment resuspension in seawater from hurricanes/tropical storms puts RO plants at risk, and the lack of climate-proofing measures in place at RO plants enhances this vulnerability. High amounts of rainfall cause low-lying roads to be susceptible to flooding and inadequate bridges and drains in this area are not equipped to handle stormwater from watercourses during extreme rainfalls well. High amounts of precipitation and high temperatures also increase the likelihood of vector-borne disease outbreaks putting increased pressure on medical facilities.

On the other hand, extremely low amounts of precipitation also cause the critical infrastructure of the area to be vulnerable. High temperatures and low rainfall are a leading contribution to drought which results in weakening of the airport terminal tarmac, and as well as pavement cracking and splitting. Lack of rainfall also increases the cost of desalination to fulfil water requirements. This increases energy demand, but solar panels provide only partial relief for electricity demand. Increasing sea level rise makes critical infrastructure vulnerable in this area

because of beach erosion. It also causes underground metal pipes and other metallic installations to face a risk of corrosion.

The effectiveness of drainage systems may diminish due to sea level rise, leading to more frequent flooding due to inundation. Elevated temperatures make critical infrastructure vulnerable because it increases the demand for cooling which increases the pressure on utilities, and it increases the dependency on RO facilities. High temperatures also make the critical infrastructure sector vulnerable because it creates added pressure on the water scarcity issue in Antigua and Barbuda which limits health facility functionality and increases the risk of educational institutions' closure. Thus, the critical infrastructure sector of the Fitches Creek/Airport local area is vulnerable to hurricanes/tropical storms, rainfall extremes on both ends of the spectrum, sea level rise, and high temperatures.

The residential sector of the Fitches Creek area is also vulnerable to the same climate change impacts. Homes located in coastal areas and in flood prone zones are susceptible to damage, particularly homes near beaches with wooden structures such as piers. Homes that are not built with much resilience to hurricanes and flooding, for example, homes that are made of wood with zinc roofs or are not on raised stilts, are even more vulnerable. Extreme lack of rainfall and high temperatures makes the residential sector of this area vulnerable because it increases the water scarcity issue in homes and standpipes. Sea level rise impacts the residential sector by increasing beach loss and flooding, and it increases the amount of salt water that infiltrates fresh water which then increases water expenses. Higher temperatures also cause the sector to be more vulnerable because the severe water scarcity leads to water rationing. This is followed by impacts on the ability to implement household tasks, more effort being spent on storing water for future uses, increased expenses on drinking water, and the possibility of compromised hygiene which can, therefore, lead to diseases and outbreaks. Overall, the residential sector is affected by the impacts of climate change making it vulnerable to the changes.

The natural resource sector of the local area is also impacted by the same indicators of climate change as the two sectors above. Solid waste pollution that can be picked up by hurricanes/tropical storms degrades wetlands. Degraded wetlands have a decreased ability to buffer the impact of storm surges. There is great biodiversity loss to coral reefs which decreases the reefs' ability to break waves that come with storm surges. This puts the island at greater risk of storm surge.

Mining activities degraded Piggotts Hill which increases the threat of overland flow and sedimented surface runoff that ends up in the sea during storms. Rainfall extremes cause coral reefs and other marine ecosystems by creating an increased amount of sedimentation. This puts ecosystems at risk. Sea level rise increases the amount of salt content on land, putting the quality of the soil at risk, and can change the chemistry of the ambient water. This then affects the biodiversity of the area. Increasing sea levels will also cause more inundation which can place terrestrial greenery at risk. Increasing temperatures cause the natural resources to be vulnerable because higher temperatures will allow for an influx of Sargassum. High concentrations of

Sargassum create shading for coral reefs decreasing the amount of needed sun they receive. An increased amount of Sargassum also restricts water flow through mangroves. High temperatures exacerbate the limited water availability issue which thus causes a loss of flora and the migration of species. This decreases the overall biodiversity in the area.

St. John's Local Area

The capital of Antigua and Barbuda, St. John's City, is located on Antigua's northwest coast and has a dense urban landscape. The city, which has a maximum elevation of 59 meters above sea level, is bounded to the west by St. John's Harbour, to the north by Dickenson Bay Street, and to the east and south by other streets. It is roughly 10 km^2 in size. But because of the geography, clayey loam soil, and high-water table, there is significant surface runoff during rainfall events in addition to sporadic flooding brought on by poor drain design and upkeep. St. John's City is a rather developed location, hence there isn't much marine or terrestrial vegetation there. Instead, trees and bushes are mostly found near roads and waterways.

Over half of the country's population resides in the St. John's parish, making St. John's City the most densely populated area in the nation. Due to rising competition for urban property from commercial operations, the city has seen a movement in population from the center to the periphery, as seen by a 9% reduction in its percentage of the nation's population between 2001 and 2011. As the country's main commercial and financial center, St. John's City has several regional enterprises, grocery stores, dining establishments, and financial service providers, which considerably boosts the economy of the region. Workers in the secondary and tertiary sectors make up most of the city's labour force. St. John's City had difficulties despite being a thriving economic hub, including a higher unemployment rate. St. John's City, although being a bustling economic center, experienced issues, having a greater unemployment rate than other locations in Antigua. The city also has a sizable proportion of impoverished and vulnerable individuals. The city's unemployment rate fell in 2018, and labour force participation rates were higher than the national average. During the COVID-19 pandemic, however, unemployment rates rose across the country, impacting the service-oriented business in St. John's City and mirroring similar patterns found across the country.

One of the primary hazards threatening livelihoods in the St. John's City local area is flooding, particularly flash flooding resulting from heavy rainfall. Stakeholders have indicated that flooding is more prevalent in coastal areas, along watercourses, and major drain systems further inland due to the topography of the city. The eastern sections of St. John's City are elevated and gently slope westward to St. John's Harbour, leading to a flat and low-lying coastal plain, making these areas susceptible to flooding during prolonged heavy rains. Past flood events have caused significant disruptions, such as restricting access to roadways and sidewalks, damaging buildings, and properties, disrupting vehicular traffic, and impacting the activities of both locals and tourists. Flash flooding occurs frequently in response to moderate to heavy rainfall, but the water typically drains directly into the sea within 1-3 hours after rainfall ceases. However, human-related factors

exacerbate the flooding impacts. The city has numerous open drains alongside the road networks, including the Tanner Street and Grays Farm gutters, designed to handle stormwater runoff. Unfortunately, these channels sometimes overflow due to solid waste accumulation, leading to overwhelming damage. Illegal waste dumping and backfilling in drains and watercourses have also contributed to increased instances of flooding, even in previously non-flood-prone areas. These practices create stagnant water, posing risks of vector-borne and water-related diseases lasting for days after heavy rainfall events. An example of the city's vulnerability to flooding occurred in November 2020 when heavy rainfall caused impassable roads, washed away cars and vending stalls, and caught many individuals off-guard.

St. John's City is home to crucial facilities and infrastructure, including ports, piers, electrical poles, communication networks, roads, emergency response stations, health facilities, schools, and churches, which provide essential services but are vulnerable to wind damage, rising temperatures, and coastal flooding due to sea level rise and storm surges. Many critical facilities near the coastline or flat flood-prone regions are at heightened risk. Older wooden buildings and supporting structures, like piers and boardwalks, are particularly susceptible to damage. Government institutions concentrated in the city, along with other critical infrastructure, face slow recovery times, leading to business losses and delays in repairs. The St. John's Harbour, a main deep-water port, is also sensitive to storm surges and sea level rise. Reclaimed lands in the harbour are at risk of subsidence and damage from storms.

Water availability and access in the area are improved through desalination facilities, but water leakages and the high-water table remain challenges. Educational facilities and emergency services are at risk during floods, and the banking industry's online data systems are vulnerable to flooding and power disruptions. Pre-existing poor drainage facilities increase the vulnerability of coastal communities to flood events, impacting tourism and fisheries. Coastal lands may be lost to rising sea levels, requiring measures like flood defences, and retrofitting existing buildings to adapt to climate change. The city's capacity for climate change adaptation to rising sea levels is limited, necessitating considerations for protecting the coastline and constructing protective structures.

St. John's City, with its commercial nature, has residential areas scattered throughout, mainly in pockets towards the north and south sections. Communities like Grays Farm, Green Bay, and Ottos to the south, and Villa and Pointe to the north of St. John's Harbour, form the main residential hubs. The prevalence of squatting resulting from rural-urban drift and economic migrants settling in the area adds to the sensitivity of these communities. Initiatives to increase resilience have been implemented, including building codes with resilient practices. However, limited technical and financial capacity remains a challenge to fully address the impacts of hurricanes, particularly on low-income community infrastructure.

Heatwaves pose health risks to vulnerable subgroups, and demand for water increases during drought periods. While middle-income residents can afford water tanks and air conditioning,

lower-income residents benefit from government initiatives providing water tanks to indigent residents.

Due to human activities and the geological makeup of the central plain, St. John's City lacks natural ecosystems and coastal protection. Mangroves and marine ecosystems have been removed for construction, making the area vulnerable to storms and flooding. Dredging has also removed seagrass beds, further increasing sensitivity. The harbour's semi-enclosed nature hinders coral reef growth, leaving the city exposed to storm surges. There are no established forests, and the dense network of buildings increases flood risk. Restoring natural resources is challenging due to limited available areas in the city layout.

Jolly Harbour to Johnson's Point Local Area

The Darkwood Beach Local Area is a coastal community located within the Christian Valley Watershed located about 15 kilometres from the capital St. John's City. It spans through a large area, stretching from Jolly Harbour to Turner's Beach and Johnson's Point community, and is bordered to the west by Lignumvitae Bay, Ffryes Bay, and Picarts Bay and to the east by Valley Road. The land consists of wetlands, swamp ponds, mangroves, and volcanic areas, and it has various uses such as agriculture, recreation, tourism, and so many more. It is located, at max, 92 m above sea level.

The main climatic hazards in this area are hurricanes and storms, extreme rainfall, flash floods, and drought, which each bring vulnerability to various sectors, including critical infrastructure, residential, natural resources, tourism, agriculture, and fisheries.

The southwestern stretch of the coastline, from Darkwood Beach to Ffryes Point, including Jolly Harbour to Johnson's Point area, is highly vulnerable to the devasting impacts of hurricanes and extreme tropical storms. The southwestern stretch of the coastline, from Darkwood Beach to Ffryes Point, including Jolly Harbour to Johnson's Point area, is highly vulnerable to the devasting impacts of hurricanes and extreme tropical storms. These weather events cause significant loss of seagrass beds and lead to damage to coastal infrastructures such as hotels, restaurants, and critical facilities like roads, marinas, water pipelines, and drainage infrastructure. Major hurricanes have resulted in substantial income loss for fisherfolk due to damage to boats, fishing equipment, fish pots, and poor visibility, making their recovery lengthy and challenging. Storm surges associated with hurricanes and intense storms further exacerbate the situation, causing significant damage to the coastal areas and critical facilities. Storms create vulnerability to critical infrastructure as the area has many old infrastructures, storm surges could cause damage to the main route and the reverse osmosis plant, and flooding could easily happen.

Natural resources in the area are vulnerable to hurricanes because they aren't protected from storm surges, seagrass is uprooted and cannot break waves offshore, and runoff can result in water changes that negatively impact seagrass growth. Tourism is affected by hurricanes as

accommodations would decrease during large storms due to cancellation, increased cost of insurance, increased coastal erosion, and coastline attractions and accommodations are prone to storm surges.

The Jolly Harbour to Johnsons Point local area is prone to both coastal and flash flooding, primarily triggered by heavy continuous rainfall exceeding 3 inches. A significant portion of the area is susceptible to flooding, particularly along the coast due to its low-lying nature and limited drainage capacity. The construction of Valley Road has altered hydrological dynamics, leading to coastal flooding threats and fragmented wetlands during heavy rains. Rainfall extremes can cause flooding resulting in potholes, drains not fully draining, and increased pressure on healthcare facilities with increases in vector-borne diseases.

Farmers have been affected by drought in the area, experiencing reduced crop production and irrigation water supply, requiring additional water sources like storage tanks and retention ponds. Critical infrastructure is vulnerable to increased pressure on utilities due to cooling demand, risk of limited water in healthcare facilities and schools, thermal expansion of piers, and compromise of road integrity due to cracking and splitting of pavement in high temperatures. The residential sector faces vulnerabilities such as increased expenses on drinking water, negative health impacts of heat waves, increased energy demand, and compromised hygiene due to disease outbreaks. Increased sea temperatures can cause vulnerabilities to natural resources through the loss of mangroves, flora, and seagrass, and the rising surface temperature of the water is difficult to adapt to, leaving no real solution. In the tourism sector, vulnerabilities due to increasing temperature include increased energy demand due to cooling, discomfort during outdoor activities, reduced productivity of staff, increased probability of wildfire, and increased pressure on resources at pools and beaches.

Climate change projections for Antigua and Barbuda indicate sea level rise (SLR), posing significant threats to the low-lying Jolly Harbour to Johnsons Point local area. The rise in mean sea level could lead to severe damage to buildings, and critical infrastructure, and the loss of valuable coastal lands. Beach erosion compounds the risks, degrading sections along the southwest coastline and impacting the tourism industry. Rising sea levels cause vulnerabilities in the infrastructure sector through flooding close to the coastline where many buildings are located, flooding of the roads restricting movement of people, erosion of infrastructure due to higher tides, and drainage systems near Jolly Harbour becoming less effective. Rising sea levels create vulnerabilities in the residential sector due to homes in Jolly Harbour being more sensitive to sea level rise damage, low-lying communities are at risk of flooding, building foundations are at risk due to saltwater intrusion, and corrosion of appliances and other metal-based assets. Natural resources are vulnerable due to rising sea levels due to light limitation in deeper waters, changes in ambient water chemistry, and poor hydrology to wetlands cut off from the sea due to the road network. Agriculture and fisheries are negatively impacted by sea level rise due to saltwater intrusion into agricultural lands, the negative impact on food security, the increased demand without increased supply, and increased freshwater scarcity, which can be reduced through diversification of farming techniques and additional governmental support through the Ministry of Agriculture.

CHAPTER 3: IMPLEMENTING ADAPTATION

3. Adaptation Priorities for Combatting Adversities of Climate Change

3.1. Lessons Learned from Past Initiatives

Since the inception of the National Adaptation Plan Project's formulation in Antigua and Barbuda, several lessons have been learned from the execution of various project initiatives[30]:

Technical Capacity Enhancement: There is a critical need to enhance the technical capacity of local technocrats across various Ministries, Departments, and Agencies (MDAs). The successful implementation of climate adaptation strategies requires a robust understanding of complex scientific, engineering, and planning concepts. Investing in continuous training and skill development for local experts is essential to ensure effective decision-making, policy formulation, and project execution.

Stakeholder Engagement Lessons: Past initiatives have highlighted the significance of inclusive stakeholder engagement in climate adaptation efforts. Lessons have been learned regarding the importance of involving diverse stakeholders, including communities, civil society organizations, academia, and the private sector. Effective engagement fosters ownership, promotes collaboration, and ensures that the perspectives and needs of all stakeholders are integrated into adaptation strategies. However, it is crucial to manage stakeholder fatigue, which can result from overburdening stakeholders with multiple consultations. Careful scheduling, clear communication, and efficient feedback mechanisms can mitigate this challenge.

Finance Challenges and Private Sector Engagement: There is limited availability of in-country finance to fund large-scale adaptation efforts. To overcome this, the engagement of the private sector has been identified as a key solution. Partnerships with private entities can unlock additional financial resources, technical expertise, and innovation. However, it's important to recognize that the cost of expertise required for climate adaptation projects can be substantial. Striking a balance between securing the necessary expertise and managing costs is essential for sustainable implementation.

Addressing Data Gaps: Past initiatives have highlighted the existence of significant data gaps at the national level, which hinder informed decision-making for climate adaptation. While the NAP and Department of Environment (DOE) are expected to address some data gaps, resource limitations may prevent the comprehensive resolution of this issue. Strategic prioritization of data collection and analysis efforts is essential to focus on the most critical gaps that have the greatest impact on adaptation planning.

Enhancing Institutional Coordination: Institutional coordination among key MDAs of the government has proven to be an area with room for improvement. Effective climate adaptation requires seamless collaboration among various departments and agencies to ensure a coherent

[30] Constable, Ayesha. 2020. National Adaptation Plan Project: Status & Next Steps.

and integrated approach. Lessons from past initiatives emphasize the need for streamlined communication, shared responsibilities, and clearly defined roles to avoid duplication of efforts and maximize efficiency.

Education and Awareness: The growing awareness of climate change and its impacts is a positive outcome of previous initiatives. However, more needs to be done to educate the public about actionable steps they can take to contribute to broad-scale behavioural change. Empowering individuals with the knowledge and skills to adapt to changing climate conditions is crucial for building resilience at the community level.

Covid-19: The emergence of COVID-19 significantly disrupted the implementation of project activities, causing delays, resource reallocation, and shifts in priorities. Lockdowns, travel restrictions, and health concerns impeded fieldwork, stakeholder engagements, and timely decision-making. The pandemic also highlighted the need for enhanced resilience, adaptive strategies, and the integration of health considerations within the climate adaptation framework.

3.2. Adaptation Needs for Antigua and Barbuda

As a small island nation vulnerable to the impacts of climate change, Antigua and Barbuda possesses a range of adaptation needs that were identified by local stakeholders, and the National Adaptation Plan (NAP) Project is aimed at addressing adaptation priorities identified by stakeholders, which have been done within the six sectoral adaptation plans. Such adaptation needs include:

Coastal Areas Strengthening: The coastal areas of Antigua and Barbuda are highly vulnerable to rising sea levels, increased storm surges, and coastal erosion due to climate change. According to the Caribbean Climate Online Risk and Adaptation Tool (CCORAL), the islands are projected to experience more frequent and intense hurricanes, leading to increased flooding and erosion of coastlines.

Water Conservation: Water Scarcity is a growing concern for Antigua and Barbuda due to changing precipitation patterns and increased evaporation rates. With the opinions of the local stakeholders, the United Nations Development Programme highlights the need for innovative water conservation practices.

Food, Water, and Energy Security: Climate Change can disrupt food and water supply chains, affecting the overall security of these resources. The Caribbean Community (CARICOM) emphasizes the importance of diversifying agricultural practices and promoting climate-resilient crop varieties to enhance food security. Additionally, adopting renewable energy sources such as solar and wind can reduce dependence on imported fossil fuels and enhance energy security.

Populating Baseline Data: Collecting and analysing baseline data is essential for understanding the local context and assessing the potential impacts of climate change.

Financial Resources: Securing financial resources for climate change adaptation is a significant challenge, particularly for small island developing states like Antigua and Barbuda. Adequate funding is essential to implement adaptation projects and initiatives effectively.

3.3. Adaptation Strategy, Pathways, and Barriers

3.3.1. Adaptation Strategy

Antigua and Barbuda, situated in the Caribbean, confronts the vital importance for climate adaptation strategies in light of its susceptibility to hurricanes, rising sea levels, and other climate-related challenges. A crucial aspect of strengthening the islands capacity against such threats lies in the development of climate-resilient infrastructure. This involves the establishment of robust building codes and the retrofitting of existing structures. By incorporating stringent standards for construction materials and design principles, the objective is to ensure that buildings can withstand extreme weather events, particularly the high-intensity hurricanes that frequently impact the region.

Furthermore, an essential foundation of Antigua and Barbuda's adaptive approach is early warning systems. Utilizing advanced meteorological technologies, such as weather satellites and radars, the nation aims to enhance the accuracy and timeliness of weather forecasts. Moreover, involving local communities in the development and execution of community-based early warning systems is pivotal. This proactive engagement ensures that residents are not only informed but also well-prepared to respond to impending threats through drills and training sessions.

Recognizing the significance of natural resources, the islands are diligently working towards integrated coastal zone management. This encompasses a comprehensive plan to balance developmental needs with the preservation of coastal ecosystems. Stricter regulations on coastal development, alongside protective measures for mangroves and coral reefs, are integral to mitigating the impact of storm surges and sustaining biodiversity.

Diversification of the economy emerges as a strategic response to climate change facilitated by the twin island state. Antigua and Barbuda aim to reduce dependence on climate-sensitive sectors, such as tourism, by actively promoting investments in renewable energy projects and supporting the development of climate-resilient industries. This diversification strategy not only enhances economic sustainability but also contributes to the broader goal of reducing carbon footprints.

Embedded within Antigua and Barbuda's initiatives to enhance resilience is the integral integration of community-based adaptation. Through workshops and consultations, involving communities

becomes a catalyst for their ability to formulate and execute climate action plans tailored to their specific circumstances. These plans may span a range of endeavours, including sustainable agriculture and measures for disaster preparedness, strategically addressing vulnerabilities and capitalizing on local strengths.

Ecosystem-based adaptation is seamlessly integrated into the islands' tourism strategies, emphasizing sustainable and eco-friendly practices. Collaborative efforts to restore ecosystems, including reforestation and coral reef rehabilitation, underscore the commitment to preserving natural environments while fostering economic opportunities.

Water management assumes a critical role, particularly in the face of changing precipitation patterns. Antigua and Barbuda promote rainwater harvesting systems at various levels, from households to commercial entities. Additionally, advocating for efficient irrigation practices in agriculture aligns with broader goals of water conservation and adaptation to evolving climate conditions.

Capacity building and education initiatives extend across formal education systems and emergency response teams. Integrating climate change education into school curricula ensures that the younger generation is equipped with the knowledge and awareness needed for sustainable practices. Simultaneously, regular training exercises for emergency responders enhance their readiness and adaptability in managing climate-related disasters.

Insurance and risk transfer mechanisms are designed to provide financial resilience. By collaborating with international insurance agencies, Antigua and Barbuda explores parametric insurance schemes tailored to its specific climate risks. Rigorous risk assessments, encompassing sea-level rise, extreme weather events, and economic vulnerabilities, form the basis for these financial instruments, ensuring a swift and targeted response in the aftermath of climate-related events.

Internationally, Antigua and Barbuda recognize the necessity of collaboration. Engaging in joint research initiatives and contributing local knowledge to global climate change databases strengthens the nation's position in the broader discourse. Regional alliances, particularly within the Caribbean community, provide a platform for shared resources, information, and collective strength in negotiating for international climate funding.

3.3.2. Adaptation Pathways

Adapting to climate change is a critical for nations worldwide, and the integration of climate adaptation into national policies, plans, and development strategies is an essential pathway to address this global concern. By mainstreaming climate adaptation, a country like Antigua and Barbuda can ensure that climate considerations are central to decision-making processes across various sectors. This approach involves embedding climate resilience measures into the fabric of

governance, development planning, and policy implementation. Such a comprehensive strategy holds several potential benefits for Antigua and Barbuda.

By integrating climate adaptation into national policies, Antigua and Barbuda can enhance its resilience to the impacts of climate change. Given the vulnerability of small island nations to extreme weather events, rising sea levels, and changing precipitation patterns, a proactive and integrated approach is crucial. Mainstreaming adaptation ensures that climate considerations are not treated as standalone issues but are woven into the very fabric of governance, thereby promoting a holistic and sustainable response to climate challenges.

Integrating climate adaptation into development strategies allows for a more coherent and coordinated response. In a policy-integrated framework, various sectors, such as agriculture, infrastructure, and health, can work synergistically to address the multifaceted impacts of climate change. This avoids the siloed approach that may occur when climate considerations are treated separately, fostering a more effective and integrated response to the complex challenges posed by a changing climate.

Moreover, mainstreaming climate adaptation into national policies can contribute to the achievement of broader development goals. Climate-resilient strategies can enhance the overall sustainability and longevity of development initiatives, ensuring that investments made today are not compromised by future climate-related risks. This alignment between climate adaptation and national development objectives creates a mutually reinforcing relationship that promotes sustainable development in the face of climate uncertainty.

Additionally, policy integration fosters inclusivity by ensuring that the impacts of climate change are considered across all segments of society. Vulnerable populations, such as those dependent on agriculture or living in coastal areas, can be better protected through policies that explicitly address their unique challenges. Mainstreaming adaptation thus becomes a tool for promoting social equity and reducing the disproportionate impacts of climate change on marginalized communities.

3.3.3. Adaptation Barriers

Antigua and Barbuda, like many small island developing states (SIDS), faces a myriad of challenges in adapting to the impacts of climate change. These challenges are multifaceted, ranging from the economic dependence on climate-sensitive sectors to the geographical vulnerability of low-lying islands to rising sea levels and intense storms.

One of the primary barriers lies in the limited resources of the nation. The islands are often confronted with insufficient financial, human, and technological resources, making it difficult to implement comprehensive adaptation measures. Moreover, the economic backbone of Antigua and Barbuda, heavily reliant on tourism and agriculture, is particularly susceptible to climate-

related disruptions, including hurricanes, changes in precipitation patterns, and rising temperatures.

Water scarcity is another dire issue, exacerbated by changing precipitation patterns and increased evaporation. This poses a significant threat to agriculture, food security, and overall water availability. The islands' limited infrastructure, especially along coastlines, leaves the nation exposed to the impacts of sea-level rise and storm surges. Strengthening infrastructure for disaster preparedness, including early warning systems and evacuation routes, is imperative to mitigate these adverse impacts.

Furthermore, governance and institutional capacity play a pivotal role in effective adaptation. Developing and implementing climate change policies require strong governance structures, and ensuring coordination among various government departments is crucial. Additionally, there's a need for technical expertise in climate science and adaptation strategies and other related expertise, necessitating investments in education and training programs. Moreover, Institutional and government barriers, such as the need for improved governance frameworks and capacity gaps, underline the importance of institutional strengthening and policy integration. Aligning PPP processes with adaptation priorities requires strategic planning and transparent decision-making, while policy coherence ensures a coordinated approach across different sectors.

On a socio-political front, social resistance, and a lack of political will impede progress. Public awareness and education initiatives are essential to overcome resistance, and civil society and NGOs can play a vital role in advocating for climate-resilient policies. Lack of political will can be addressed through international cooperation, highlighting the urgency and benefits of climate adaptation.

Financial barriers, including the limited fiscal space of the government and financial restrictions in the private sector, pose substantial challenges. Exploring innovative financing mechanisms, such as green bonds and climate funds, can help mobilize resources. Involving the private sector through public-private partnerships (PPPs) and insurance schemes can contribute to climate resilience.

3.4. National Commitments Alignment

The climate-related contributions of Antigua & Barbuda, encompassing both adaptation and mitigation measures, are delineated in the Nationally Determined Contribution (NDC). This commitment received the endorsement of the Cabinet of Antigua and Barbuda prior to its submission to the United Nations Framework Convention on Climate Change.

The targets of the Nationally Determined Contributions (NDC) are based on the goal of limiting global temperature increase to 1.5°C and preparing for a 3.4°C rise in temperatures. These targets align with Antigua and Barbuda's aim to achieve net-zero emissions by 2040. These goals will be

achieved by using appropriate technologies and policies, such as better land use planning and updated building codes. Financial instruments like special insurance for extreme weather events will also be used. The achievement of these targets depends on various factors, including technology costs and transitional risks, which might make them conditional or unconditional.

Considering the climate effects observed during the first five years of the previous climate plan (INDC), the coming decade could lead to over 0.5 billion dollars in climate-related damage in the country. As a result, there is a pressing need to swiftly build resilience to minimize these impacts and reduce the risks related to climate change.

This updated NDC revises the 2015 INDC and doesn't replace the previous targets outlined in it. Instead, it keeps some unmet targets and raises the ambition level of certain goals. Since the INDC was meant to cover a decade and not all objectives were achieved, it remains relevant. The new NDC builds on the successes of the last five years and incorporates fresh data indicating decreased technology costs, enabling more ambitious targets.

This NDC's strategy aligns with the country's developmental priorities. It explores strategies like connecting the energy and agricultural sectors and enhancing energy resilience. The plan aims to reduce the cost of mitigation and adaptation projects while shifting away from fossil fuels towards abundant solar and wind energy resources. The strategy acknowledges the risks associated with making an inclusive energy transition, recognizing the varying roles and aspirations of different groups like men, women, and youth, ensuring that no one is left behind.

The NDC is also considering the financial and transitional challenges that could arise during implementation. It emphasizes the need for gender-sensitive approaches and a fair workforce transition. While acknowledging significant challenges and uncertainties, the plan also envisions opportunities for new business ventures for the people of Antigua and Barbuda.

The plan also looks at the financial challenges and risks that might come up during implementation. They're aware of the importance of gender equality and making sure the workforce transition is fair. They acknowledge that there are difficulties and uncertainties but also see opportunities for new businesses for the people of Antigua and Barbuda.

The following are the National Adaptation goals of Antigua and Barbuda:

1. By the year 2025, seawater desalination capacity by 50% above the levels documented in 2015.
2. By the year 2030, enhance and fortify all structures to effectively withstand extreme climatic occurrences, encompassing droughts, inundations, and hurricanes.
3. By the year 2030, ensure that 100% of the electricity requisites within vital sectors such as water management and other essential services encompassing healthcare, food preservation, and emergency services, are sourced from off-grid renewable resources.
4. By the year 2030, implement comprehensive measures to safeguard all water bodies, mitigating flood hazards and associated health implications.

5. By the year 2030, establish an affordable insurance framework to support farmers, fishermen, and proprietors of residential and commercial properties in managing losses arising from climatic vagaries.

The NAP is aimed to serve as a pivotal instrument in assisting the country in attaining its NDC objectives and fulfilling its obligations regarding reporting, transparency, and compliance within the Paris Agreement reporting. The NAP envisions itself as a practical document, supplying detailed climate forecasts, guidelines, and standards tailored to local contexts. This information will be utilized by engineers, community members, financial institutions, insurance providers, and other stakeholders, including politicians, to inform their initiatives and promote multi-sectoral advancements for the sake of achieving climate resilience.

3.5. Policies and regulations

Antigua and Barbuda's National Adaptation Plan (NAP) pursues enabling policies, regulations, and plans. These measures indicate the nation's commitment to climate change adaptation and its resilience-building efforts. The following are the key policies, regulations, and plans which provided the basis for the NAP:

Government of Antigua and Barbuda (GOAB) Medium Term Development Strategy (2015): This strategic framework stands as the cornerstone of the NAP by setting forth a comprehensive national development vision. Its approval by the Cabinet lends the NAP a solid foundation, as it guides various sectors towards unified climate adaptation goals, ensuring that adaptation efforts are fully integrated into the country's overall development trajectory.

National Physical Development Plan (SIRMZP 2012): The significance of this plan is twofold. Firstly, it identifies areas prone to environmental vulnerabilities, forming a basis for targeted adaptation strategies. Secondly, its sustainable development spatial plan aligns with the NAP's objectives, providing a blueprint for environmentally conscious growth and infrastructure development.

Draft Building Code for the OECS: This forthcoming code plays a crucial role in the NAP by demanding resilient infrastructure. Its mandate for hurricane-resistant homes and drought-resistant features ensures that future constructions align with the nation's climate adaptation priorities, directly contributing to the enhancement of Antigua and Barbuda's resilience.

Coastal Zone Management Plan (2016): Although faced with data gaps, this plan remains vital to the NAP. It aims to protect the nation's coastal areas, which are particularly vulnerable to climate impacts. By establishing appropriate coastal setbacks once data limitations are addressed, this plan will help safeguard coastal communities and ecosystems against sea-level rise and extreme weather events.

Policy Framework for Integrated Adaptation Planning and Management (2002): This framework is pivotal in guiding the NAP's direction. By pinpointing priority sectors for adaptation, it enables Antigua and Barbuda to channel resources effectively and address vulnerabilities in a targeted manner, aligning adaptation actions with specific needs.

National Comprehensive Disaster Management Policy and Strategy (2015–2017): The proposed modifications to the Disaster Management Act (2002) provide a legal basis for integrating various environmental policies. This legislative alignment reinforces the NAP's mission, promoting coordination and synergy among disaster management and environmental policies, thus enhancing the nation's adaptive capacity.

Environmental Protection and Management Act (2015) and draft Paris Agreement Regulations: These legislative measures fortify the NAP by ensuring a robust legal framework for environmental commitments. By stipulating data collection, climate risk mapping, and Vulnerability Risk Assessment and Adaptation Plans, these regulations provide a systematic approach to climate adaptation, embedding it firmly into the country's legal and policy landscape.

3.6. Institutional Arrangements and Coordination

Antigua and Barbuda's NAP initiatives were carefully crafted to yield enduring, tangible results. These outcomes encompass tasks such as gathering and organizing data, establishing a legal framework for various sectors and businesses, conducting climate vulnerability assessments and crafting adaptation plans, formulating a sustainable financing strategy for NAP implementation, demonstrating practical applications, offering training and certification, and more. To facilitate this, the consultancies procured for services within this project are designed to be cost-effective, making use of local and regional expertise. This approach not only helps control costs but also aligns with the project's goals of capacity building. However, it is important to note that professional fees for qualified individuals and firms in the Caribbean region are comparably high in relation to other developing nations.

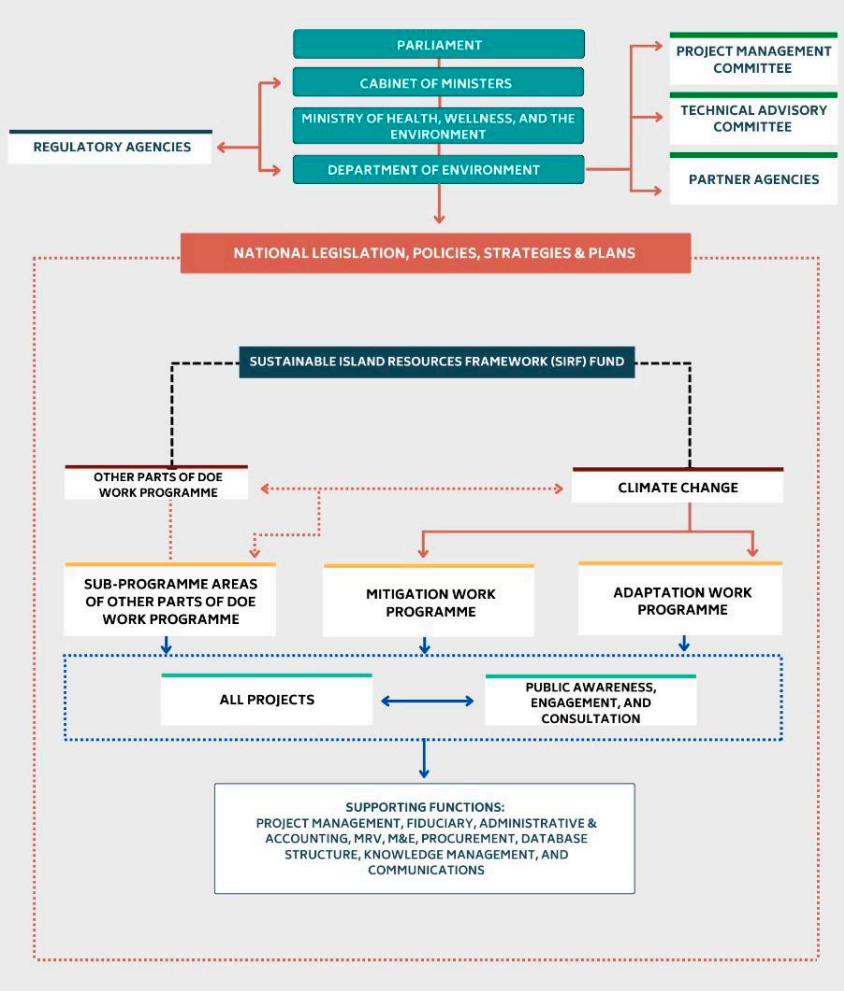

Figure 10: Institutional Arrangements to support climate change adaptation (ADCOM, 2022)

Antigua and Barbuda's national adaptation planning process was led by the UNFCCC Focal Point, the Department of Environment. The development process of the NAP document was supported by the Project Management Unit (PMU), which is the DOE's implementing entity. The PMU oversaw the day-to-day management of the NAP Readiness project. Serving as the practical arm of the Department, the PMU consists of technical and administrative personnel, many holding master's degrees in fields such as climate adaptation, marine biology, civil engineering, and project management. The PMU assists the DOE in fulfilling its responsibilities across projects, offering flexibility in staffing, secondments from the public sector, and promoting the sharing of expertise and ideas. This is particularly crucial for a small island nation with limited resources and human capital, where the government employs the country's most qualified experts. The PMU is made up of consultants supported by ad-hoc staff from various governmental departments and the private sector. It is a strategic component of the DOE, called upon to procure services like part-time and full-time consultants, project coordinators, technical experts, and technical coordinators.

The PMU operates under the oversight of the DOE's Director, the Project Management Committee (PMC) and its Audit Committee. Its structure aims to streamline management and implementation, covering numerous projects funded by various donors and the government itself.

It ensures effective coordination, especially when project activities overlap or depend on each other. As Antigua and Barbuda is a Small Island Developing State (SIDS) with limited technical capacity, the PMU acts as a measure to mitigate risks and enhance efficiency through experiential learning. The PMU handles day-to-day tasks of the NAP project, including the appointment of the NAP Coordinator and other part-time consultants and technical officers. This approach optimizes resource allocation and enables the NAP project to focus on results.

Additionally, data collection, analysis and data management services are provided by the DOE's Data Management Unit (DMU) and monitoring, evaluation, and learning (MEL) services by its MEL-Unit.

In the development of the NAP, the Technical Advisory Committee (TAC) plays a pivotal role. This committee includes representatives from key government agencies, non-governmental organizations (NGOs), and private sector coalitions. It convenes monthly and provides technical guidance, policy suggestions, and facilitates communication among stakeholders throughout project identification, development, and implementation. The TAC's involvement ensures the incorporation of socio-economic and environmental factors, broadens the dissemination of information, manages stakeholder expectations, and addresses challenges that may arise in executing activities within the Adaptation Work Programme. Additionally, the TAC enables these agencies to report on their actions related to climate change adaptation.

When the National Adaptation Plan document is completed, the Cabinet of Antigua and Barbuda will be responsible for approving it. Once approved, the plan will be published in the gazette.

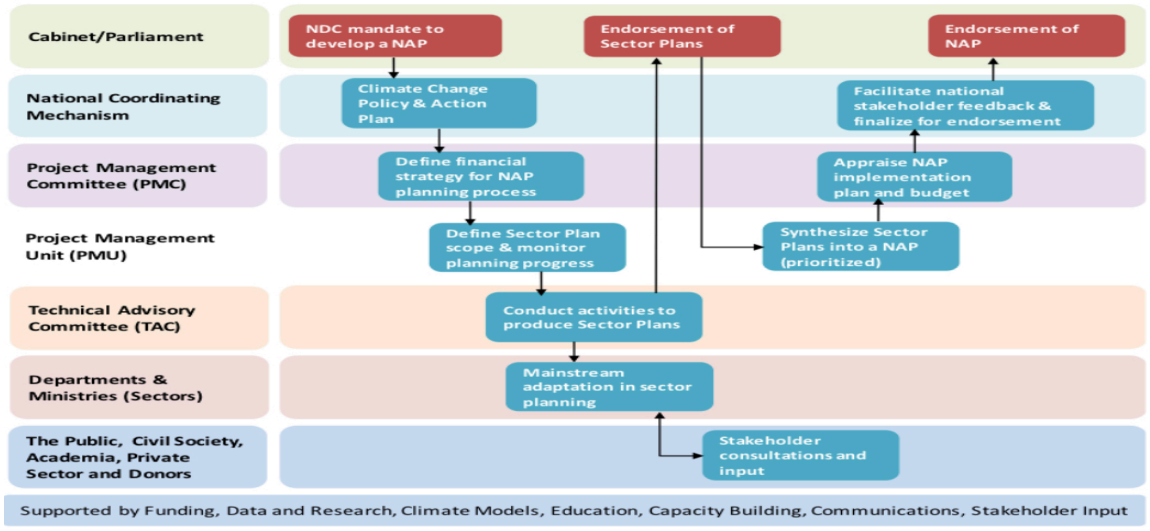

Figure 11: Indicative process flow for Antigua and Barbuda's National Adaptation planning process (Source: ADCOM, 2022)

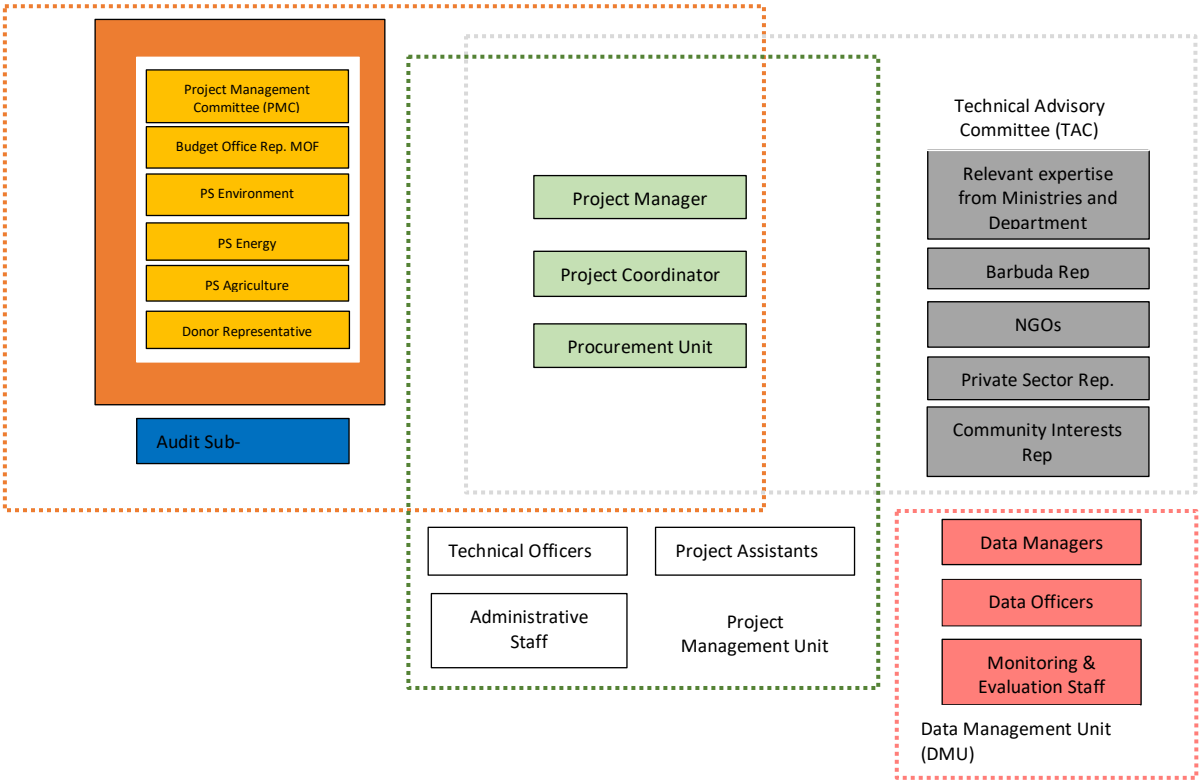

Figure 12: The Department of Environment's implementation arrangements for project management in Antigua and Barbuda

3.7. Sectoral Adaptation

Six Sectoral Adaptation plans (SAP) were made for six different sectors in the Antigua and Barbuda economy. These plans were developed to support Antigua and Barbuda's National Adaptation Plan Sub-programme, which aims at facilitating effective mid- and long-term climate change adaptation planning. The SAPs are aimed at addressing the numerous and interlinked vulnerabilities of Antigua and Barbuda's main sectors to future climate change, as well as the impacts of major baseline challenges that jeopardize these sectors. These plans outline, in detail, specific vulnerabilities, establish cross cutting themes, and give direction toward specific initiatives and methods of monitoring and evaluation within each sector. The following section of the NAP will give a guideline of the results of each sector's SAP including background and general implementation plans. The sectors that have an SAP written include:

I. The Culture and Historical Sites
II. Food Security
III. Infrastructure and Housing
IV. Tourism
V. Finance

VI. Wholesale and Retail

Cultural and Historical Sites Sector

The objective of the Culture and Historical Sites Sector Adaptation Plan is to address the current and prospective impacts of climate change, disasters and any other factors that impact the cultural and historic sites sectors. Based on, but not limited to, the analysis of climate-related risks, the review of related policy and legislation, the review of previous national documents, and consultations with policymakers and other national stakeholders. The plan is envisioned to help the development of an effective adaptation strategy and action plan designed to reduce vulnerability and enhance the resilience of cultural and historical resources to climate change across the culture and historic sector of Antigua and Barbuda. This project will contribute by:

1. Reviewing and presenting a baseline/data of current climate and weather-related impacts and consequences for the sector, and stakeholder consultations.
2. Assessment of current climate trends, vulnerabilities, and priorities for the sector.
3. Identifying the key risks to the sector.
4. Providing a list of adaptation actions with analysis of options and prioritized adaptation actions towards a sectoral plan.
5. Recommending indicators as part of monitoring and evaluation.

This Plan provides strategic direction across organizations involved in the built cultural heritage and historic sites management, for integration of adaptation planning into the national development planning.

Background

Antigua and Barbuda are a nation steeped in history and culture yet carries the legacies of centuries of exploitation, poverty, lack of resources and adequate infrastructure, and others. There are about 180 prehistoric sites, over 170 sugar estates, 54 fortifications and an estimated 300 shipwrecks, and more. The economy is almost entirely dependent on tourism, which is largely a result of the rich natural and cultural heritage resources. However, the newly emerging threat that is beginning to impact the island is climate change with all its associated issues. These include, sea-level rise, increasing storm frequencies, the increasing power of hurricanes, storm surges, wind driven rain, all of which leads to coastal erosion, loss of beaches and coastal infrastructure, damage to the built cultural heritage, loss of archaeological sites, resulting in losses to the economy and heritage assets. Interestingly, archaeological research, which has been monitoring and documenting the cultural heritage and archaeological sites of Antigua and Barbuda is beginning to observe a sudden acceleration of negative impacts to the tangible cultural heritage assets far beyond the norm. This leads to great vulnerabilities within the cultural sector as described in section 3.4.

Implementation

Vulnerabilities can be reduced, and resilience can be enhanced within the culture and historical sites sector by creating a disaster management plan for cultural heritage sites. Disaster planning has two goals: the first is to develop a contingency plan, designed to take effect when an unforeseen event strikes or is imminent. The second goal is to ensure longer term mitigation actions are undertaken to minimize the impact of an anticipated event. Below is a list of steps to take to create a management plan for cultural heritage sites.

DEVELOPING A DISASTER MANAGEMENT PLAN FOR CULTURAL HERITAGE SITES

1. Establish legal boundaries for sites.
2. Determine ownership/responsibilities.
3. Assess sites (financial value, structural integrity, vulnerability, replacement value).
4. Identify measures to prevent response to potential disasters.
5. Create funding mechanisms to support disaster management.
6. Work on modalities for access to support for each site.
7. Plan for the worst.
8. Plan for all circumstances and types of disasters: fire, hurricane, earthquake.
9. Assume there will be no outside help or resources.
10. Plan for the aftermath: what to do immediately after to secure, evaluate, for safety.
11. Determine who can help and how.
12. Keep contact information on site managers and key persons on site, first responders, and essential services current and easily available.
13. Develop a list of essential workers with necessary skills/trades.
14. Plan to have an accessible stockpile of emergency items, first aid, tools, waterproof containers etc.
15. Training your first response team and have annual upgrading of skills.
16. Establish good maintenance practices.
17. Ensure your insurance policies for structures and contents are updated regularly.
18. Include staff and essential outside disaster management persons in your planning and drills.
19. Digitize and backup all computer data files, digital photographs, and plans of building records (documents) to an external provider.

Below includes a list of actions that can be taken to reduce the vulnerabilities within the culture sector from the effects of climate change.

IMPLEMENTATION PLAN

1. *Continue Data Gathering and Research*: This is essential to provide more information to facilitate planning and adaptation.:

2. *Capacity Building*: Provide training in recognizing cultural heritage sites, particularly archaeological sites to persons involved in survey, development planning, environmental assessment teams.
3. *Facilitate Cross-Sectoral Institutional Cooperation* for site protection, reporting, protection, PDNA.
4. *Encourage the gathering and use of qualitative data*, such as, traffic flow, visitor numbers, site users to determine site use, infrastructure and staff requirements, potential income, and management needs.
5. *Develop a program for vulnerability assessments* at all listed sites.
6. *Improve site survey documentation* by seeking funding for improved survey resources and methodology to enable longer-term research.
7. *Establish the formation of a Competent National Authority* for management of cultural heritage sites.
8. Begin the process of establishing a National Registry of Sites.
9. Lobby Government to support the CNA and National Registry.
10. Raise awareness with social media to get public support that will encourage Ministerial support.
11. Promote the inclusion of Cultural Heritage Impact Assessment surveys prior to construction and development.
12. Review and use UNESCO Cultural Conventions as Guidelines and Policies, increase contact with their technical field officers.
13. Review with intent to consider ratification of other UNESCO cultural conventions.
14. Encourage the bi-annual preparation and review of State of Conservation Reports from Cultural Heritage managers.
15. Develop rescue archaeological proposals for funding opportunities, (which will include analysis, conservation, reporting/publications, cataloguing, and storage).
16. Involve the community in research.
17. Review the 1990s studies for the development of heritage areas in St. John's and Parham which are also coastal sites.

More information can be found in the Culture Adaptation Plan.

Food Security Sector

The vision of the Food Security Adaptation sector is to increase access to affordable and nutritional food for residents and visitors to Antigua and Barbuda by increasing the resilience of the food system to climate change and variability. The strategic objective to achieving this vision is to directly respond to the multiple, interlinking challenges to the country's food system and

strengthen the system's robustness, redundancy, flexibility and adaptability to increase overall resilience (Section 4.1.1). A major element of this objective involves reducing the country's reliance on food imports and concurrently making local food production — particularly agriculture and fisheries — processing and distribution more resilient to future climate change.

Background

Food security in the twin-island Caribbean state of Antigua and Barbuda is currently heavily reliant on imports and, to a lesser extent, local food production. These local production systems include the production of crops, livestock and bee products, as well as the harvesting of primarily reef-based fish. Both local food production and imports support other elements of the food system, including processing, distribution and consumption by residents and by tourists visiting the islands. Antigua and Barbuda's food system, however, is impacted by a number of existing baseline challenges. These challenges primarily affect food production by i) limiting water availability; ii) reducing soil quality; iii) resulting in losses of agricultural and fisheries products through theft; iv) degrading ecosystems that support food production; v) limiting land availability for agriculture; vi) limiting the availability of equipment and financing for producers; and vii) resulting in higher prices for consumers through increased production costs and a higher dependency on imported foods. In addition, there are insufficient food processing and storage facilities and capacities in the country, meaning that there are seasonal surpluses and scarcities in certain foods, and that the country is vulnerable to prolonged disruptions in food production or imports. Changing social preferences influenced by the high influx of tourists to the country also means that there is a transition away from demand for local foods and cuisines to imported alternatives that are often less nutritious.

The impacts of the above challenges to the food system will be aggravated by projected changes in climate. These changes include rising temperatures, reductions in rainfall, more frequent and severe droughts, increasingly intense hurricanes, rising ocean temperatures and ocean acidification and sea level rise. Climate change hazards are expected to negatively impact food production in Antigua and Barbuda. For example, increasingly severe and frequent hurricanes and storm surges are expected to cause increased damages to infrastructure, equipment and produce, and worsening disruptions in the availability of imported food. The increased economic losses from damage to infrastructure and utilities will ultimately reduce the ability of consumers to afford sufficient and nutritious food. Other impacts include the erosion of coastal areas, saltwater intrusion into groundwater reserves and the degradation of both terrestrial and marine ecosystems. All of these hazards and impacts — combined with the existing baseline challenges — will contribute to increased food insecurity in the future.

Implementation

To achieve the above vision and objective, and to catalyse an impactful and sustainable shift towards climate change resilience across Antigua and Barbuda, a change in basic assumptions across the existing food system is required. According to the Green Climate Fund Sectoral Guide on Agriculture and Food Security, a transformation towards climate change resilient and low-emission agriculture and food systems can be reached through three paradigm-shifting

investment pathways. These pathways include: i) promoting resilient agroecology; ii) facilitating informed advisory and risk management services; and iii) reconfiguring food systems. The first of these pathways, namely promoting resilient agroecology, aims to support climate-resilient interventions to reduce the impacts of climate change on agricultural productivity while promoting low-emission synergies. Second, the paradigm shifting pathway on facilitating climate informed advisory and risk management services highlights the importance of climate information in mainstreaming climate considerations in agricultural management. Finally, the third pathway, namely reconfiguring food systems, promotes the transformation of the full food system towards one that uses resilient and low emission practices and technologies to feed the growing population.

Key actions may be implemented across the above three paradigm-shifting pathways to assist in addressing these barriers. These actions are listed below.

- Alignment of incentive systems and policies at the national and sub-national levels through
- institutional and regulatory reforms aimed at fostering change.
- Empowerment of communities and local leadership, combined with the use of traditional.
- knowledge and resources.
- Inclusion of women, youth and marginalized groups to enhance the ownership of improved.
- practices and increase productivity to attract the workforce towards the adoption of climate.
- resilient measures and technologies.
- Engagement with the private sector at all levels as both actors and innovators on investments and
- financing of businesses across all food system value chains.
- Evidence-based monitoring, evaluation and learning informed by science and data, along with
- knowledge management that links the three paradigm-shifting pathways.
- Capacity development of all stakeholder groups, targeting their specific requirements.

A four-pronged approach to support the implementation of the above activities across the paradigm shifting pathways for adaptive agriculture and food security has been developed by the GCF. This four-pronged approach includes: i) transformational planning and programming; ii) catalysing climate innovation; iii) mobilization of finance at scale; and iv) coalitions and knowledge to scale up success.

Based on stakeholder consultations and desktop research, specific adaptation options have been identified to increase the resilience of Antigua and Barbuda's food system to climate change. These options all have the potential to align with and contribute to the above paradigm-shifting pathways and drivers. The relevance and urgency of identified adaptation options were assessed using a multi-criteria analysis (MCA).

Based on the different identified adaptations' alignments and MCA scorings, the identified adaptation options were structured around eight Investment Programmes (IPs) that reflect the strategic priorities for achieving a change in thinking towards a resilient food system. These Investment Programmes are listed below.

Table 9: Investment Programmes (Ips) and activities for achieving a resilient food system.

	Investment Programme	Activities
1	Enabling environment strengthened to support local food production through legislation and plans.	1.1. Develop an updated national land use plan and local area plans that support the preservation of farmland and natural ecosystems, and that promote agricultural production zoning.
		1.2. Support the development of improved legislation and task forces to address praedial larceny.
		1.3. Draft policies that better regulate and promote sustainable tourism.
		1.4. Update current food pricing legislation.
		1.5. Improve standards and regulations for local food production and processing.
		1.6. Increase the technical and human resource capacity of managing bodies and extension officers to support producers.
2	Governmental and civil coordination mechanisms enhanced.	2.1. Strengthen cross-institutional coordination and policy coherence to develop a regulatory system for food security.
		2.2. Improve coordination between meteorological, hydrological and agricultural extension services to determine climate information needs for producers.
		2.3. Promote the development of an overarching farmers' cooperative.
		2.4. Incentivize farmers to sell products to CMC as a central marketing hub.
3	Climate and food system data collection and research supported to	3.1. Improve data collection and research for agricultural production and consumer indicators that can be disseminated to end users across the food system.

	inform the agricultural and fisheries sectors	
4	Innovative technologies and practices mainstreamed to promote the climate-resilience of the fisheries sector.	4.1. Introduce hurricane-resilient equipment for fisherfolk.
		4.2. Promote and upscale awareness-raising of environmental management and restoration practices within communities and fisheries.
		4.3. Promote the restoration and maintenance of marine ecosystems to support fisherfolk.
		4.4. Provide training for fisherfolk on sustainable practices, first aid, navigation, and mechanics to increase safety and efficiency.
5	Innovative technologies and practices mainstreamed to promote the climate-resilience of the agricultural sector.	5.1. Upscale the natural resource management of watersheds.
		5.2. Upscale sustainable and low-emission agricultural soil management practices.
		5.3. Develop and promote value chains for the production of local organic fertilizers from disposed food and Sargassum seaweed.
		5.4. Promote biological or non-chemical pest control.
6	Private investment and Public-Private Partnerships (PPPs) promoted to encourage the sustainability of climate-resilient interventions.	6.1. Strengthen risk insurance and social safety net mechanisms for farmers and fisherfolk.
		6.2. Promote skills-based business models that support climate-resilient agricultural practices.
		6.3. Introduce infrastructure and equipment to promote the diversification of local crop products. Antigua and Barbuda Food Security Sectoral Adaptation Plan 110 climate-resilient interventions.
		6.4. Support PPPs to introduce low-emission agro-processing and food storage facilities to meet demand.
7	Training and awareness raising facilitated to promote local	7.1. Facilitate and promote international knowledge sharing exchange programmes and learning opportunities for producers.

	production.	7.2 Provide business management training for farmers and fisherfolk.
		7.3. Undertake awareness-raising campaigns that promote agriculture and fisheries as viable careers within schools.
		7.4. Undertake an awareness-raising programme aimed at promoting backyard gardening and preserving natural ecosystems.
		7.5. Undertake an awareness-raising programme to promote the purchase of locally produced food.
8	Funding mechanisms mobilized to finance food security resilience interventions.	8.1. Mobilize national and global funds to upscale training programmes and adaptation options.
		8.2. Establish or support micro-finance and loans for farmers and fisherfolk.
		8.3. Promote the use of credit unions and village savings and loans associations (VSLAs) within producer cooperatives.

Find descriptions and specific proposed actions for each investment programme in the Food Security Adaptation Plan.

Infrastructure and Housing

The goal of adapting the infrastructure and housing sector is to enhance climate resilience by proposing a range of adaptation measures that can be implemented over the course of the next decade to increase sectoral resilience to current and projected climate impacts and deliver broader social and environmental benefits to the residents of Antigua and Barbuda. Climate resilience can be defined as the ability of the infrastructure and housing sectors to withstand climate change impacts, both from extreme and slow-onset events, and to be able to maintain operations during such events to swiftly recover from associated impacts. Increasing infrastructure resilience may require both physical measures (e.g., engineering a drainage system to manage higher rates of runoff) and soft measures such as processes, procedures, and the institutional capacity to ensure proper planning and maintenance of infrastructure.

Background

Infrastructure is wide-ranging and multi-faceted by its functional and qualitative attributes, and its purpose. This section examines 'hard' (lifeline) infrastructure sectors (e.g., power, water, telecommunications, utilities, wastewater, roads, hospitals, shelters) as they are critically

vulnerable to the impacts of climate change and are central to the populations' health, survival, and well-being. This section prioritizes four sectors within infrastructure and housing for analysis; housing, roads, wastewater, and energy, which were identified as both at-risk to future climate impacts and critical to the nation's resilience through stakeholder engagement and a critical infrastructure assessment.

Under a worst-case emissions scenario using the Representative Concentration Pathway (RCP), projections show that by 2030, Antigua and Barbuda's building stock is expected to incur losses of up to US $451 million (EC $1218.9 million26) owing to the impacts associated with tropical cyclones (storm surge and high winds), sea level rise (SLR), and flooding, which could result in additional losses of US $108 million (EC $291.9 million). Gradual changes in precipitation and rising temperatures will accelerate the deterioration of energy infrastructure and road networks, increasing routine maintenance and repair costs, and disrupting the lives of citizens. Planning for climate change through appropriate adaptation measures can enable Antigua and Barbuda to 'Build Back Better', helping to reduce impacts to infrastructure assets, and allowing for a faster recovery after extreme shocks. Both existing and new infrastructure assets must consider climate changes that are likely to occur over the asset's lifetime, and potential adaptation measures, both physical and soft, that can strengthen resilience.

Yet, as disaster-prone islands, the resilience of Antigua and Barbuda's infrastructure and housing sectors are not only defined by the resilience of infrastructure assets alone, but also by the broader planning and development decisions, both past and future, that impact the resilience of the islands, and the role of natural ecosystems (e.g., sand dunes, beaches, sandbars, mangroves, wetlands) in protecting inland areas.

All sectors have a goal based on the key climate risks that pose a threat to their resilience which can be found below.

Table 10: Key goals for I&H subsectors based on key climate risks that pose a threat to their resilience.

Sector	Goal
Road	To ensure that roads and drainage systems can withstand the impacts of climate change, such as flooding, hurricanes, extreme heat and SLR
Wastewater	Protect public health and the environment by ensuring that wastewater treatment and disposal systems can withstand the impacts of climate change
Housing	To enhance the resilience of housing assets, homeowners, and the services that they depend on (e.g., water, electricity) to hurricanes, flooding, and drought
Energy	To enhance the resilience of Antigua and Barbuda's domestic energy supply to hurricane events, droughts, flooding, and rising temperatures.

Implementation

Given the above ultimate goals, the below tables based on sector detail all adaptation measures as well as their corresponding climate hazard, adaptation measure category, and location. The table also incorporates a results chain approach where the anticipated outcome (short- and medium-term) and anticipated impact(s), if successfully implemented, are denoted. Oftentimes, the long-term impacts of adaptation measures extend far beyond enhancing the resilience of the asset, or sector itself, and result in positive externalities to communities and ecosystems.

More information on the financing, monitoring, and evaluation of these implementation plans can be found in the infrastructure and housing sectoral adaptation plan.

Table 11: Housing: Summary of prioritized adaptation measures

Adaptation Measures	Location	Category	Associated climate hazard(s)	Anticipated outcome (short & medium term)	Anticipated impact (long term)
Obtain financing to complete the construction (specifically plastering) of the 104 EU funded homes, constructed post-hurricane Irma to mitigate flood water intrusion associated with heavy rainfall events	Barbuda	Physical	Flooding Hurricane	Homes are protected against flooding	Adequate housing stock that is resilient to rainfall, flood, and hurricane events, and does not deteriorate as quickly
Provide homeowners with financial incentives (e.g., tax breaks, credits, low interest loans) to build or retrofit homes so that they are hurricane-resilient (e.g., reinforce two rooms, one with plumbing and one to sleep in).	Antigua and Barbuda	Financial	Hurricane	Increase homeowners' accessibility to finance dedicated to build or retrofit hurricane resilient homes	Reduced impact to the housing sector and households (e.g., physical damage and need for shelters) associated with hurricanes
Enhance awareness of insurance eligibility, policyholder responsibilities, terms of reference, and coverage	Antigua and Barbuda	Informational	Hurricane	Enhanced awareness and understanding of the benefits and terms of insurance among homeowners	Increased uptake of insurance to protect homeowners against climate-related risks
Design of a pilot program of micro parametric insurance schemes for homeowners.	Antigua and Barbuda	Financial	Hurricane	Understand viability of parametric insurance scheme for homeowners	If successful, additional financial resources are available to cover damages caused to homes by climate-related hazards

Develop a comprehensive community-led and community-informed plan to restore and condemn derelict and hurricane-damaged housing in Codrington, which includes cleaning up debris and adequately disposing of materials.	Barbuda	Physical	Hurricane	Removal and disposal of derelict housing	Reduced loss and damages to building stock from derelict housing and debris from hurricanes
Develop and maintain an up-to-date inventory of derelict housing in Antigua (including locations and land titles) as a precursor to plan and prioritize condemnation of derelict homes (including the option to assess feasibility of converting homes into social housing).	Antigua	Informational	Hurricane	Up-to-date database on derelict homes available to facilitate condemnation or conversion into climate-resilient social homes	Prioritization of key areas to condemn or convert into social housing to reduce hurricane-induced damage to housing and infrastructure stock
Provide financial incentives for homeowners to build new homes with cisterns, rather than rain barrels which are vulnerable to hurricane impacts (flying away).	Antigua and Barbuda	Financial	Hurricane Drought	Incentives in place to make homes more hurricane - resilient	A higher proportion of new homes are constructed with cisterns versus rain barrels
Enforce coastal development setbacks for beaches and coastlines so that structures are not built in ecologically sensitive areas	Antigua and Barbuda	Administrative , Policy, capacity	SLR Flooding	Future coastal developments adhere to coastal setbacks	Improved coastal resilience which in turn safeguards the housing sector and other infrastructure assets from SLR and hurricane induced damage

that compromise resilience.					
Enhance enforcement capacity within the DCA to enforce the building code in Antigua (e.g., to inspect each phase of housing development and properties for compliance, to enforce adequate setbacks both from roads and adjacent structures in cities and in coastal areas, to prohibit development on lands less than 0.13m above the SLR risk line, etc.)	Antigua	Capacity	Hurricane SLR Flooding	Enhanced enforcement capacity to ensure that homes are constructed in line with the building code	New housing developments are constructed and sited as per the building code, enhancing sector-wide resilience
Re-instate the Barbuda Planning Commission and employ an inspector (e.g., engineer, architect, or draftsman with in-depth knowledge of the building code) to enforce the building code.	Barbuda	Capacity	SLR Flooding	Re-instated Planning Commission and Inspector	Houses are built to code, thereby increasing resilience of the housing stock
Create licensing and certification for contractors and builders to build homes in line with climate resilient building practices as per the OECS Building Code Reduce barriers to access by providing comprehensive education and	Antigua and Barbuda	Administrative, Policy, Capacity	Hurricane SLR Flooding	Certified contractors equipped with the knowledge and skills to build climate-resilient housing as per the building code	New builds are highly resilient to climate impacts, minimizing overall damage to the housing sector Reduced requirements for sheltering and disaster assistance post- hurricane

training for contractors to acquire the necessary skillset.					
Information dissemination to homeowners on climate resilient housing and construction as outlined in the building code. (e.g., information on how to hire a contractor and draftsmen; DCA inspection process; setbacks for septic tank systems; material selection and other ways to enhance resilience if affordability is an issue (e.g., potential financial incentives)	Antigua and Barbuda	Informational	Hurricane SLR Flooding	Up-to-date information available to homeowners regarding best practices for climate-resilient houses and the construction process	Increased number of homes are constructed with best practices as per the building code.
Develop incentive programs for homeowners to increase water efficiency (e.g., through purchasing water-efficient appliances).	Antigua and Barbuda	Financial	Drought	Availability of financial incentives to purchase water-efficient appliances	Greater uptake of water efficient appliances
Fund educational campaigns and/or programs to raise awareness of household water management and practices to implement, particularly during dry days / drought periods	Antigua and Barbuda	Informational	Drought	Widespread information targeted at households to conserve water during drought	Greater adoption of water conservation practices particularly during drought periods

Table 12: Roads: Summary of prioritized adaptation measures

Adaptation Measures	Location	Category	Associated climate hazard(s)	Anticipated outcome (short & medium term)	Anticipated impact (long term)
Develop a culverting system and an associated management plan	Barbuda	Physical, administrative	Flooding	Culverting system is planned and implemented in key areas to reduce roadway flooding	Reduced instances of flooding in roadways and adjacent areas, and reduced maintenance and repair requirements
Routine clean-up of litter/debris that clogs drainage systems and culverts, particularly in preparation for an extreme rainfall event (e.g., tropical cyclone). Removal of vegetation that blocks culverts, and de-silting of drainage systems.	Antigua and Barbuda	Maintenance	Flooding	Reduced litter in drains and culverts	Increased efficacy of drainage systems to handle rainfall flows, and a consequent reduction in flooding and recurrent maintenance expenditures and disruptions
Undertake a comprehensive study to increase drainage capacity along roadways where inadequate drainage exists, to account for projected water flows under future climate change.	Antigua and Barbuda	Administrative	Flooding	Identification of areas where inadequate drainage exists in consideration of present day and future climate change impacts	Prioritize, assess, and undertake drainage enhancement (public works) in key areas resulting in reduced flooding
Increase capacity of MWH to plan and design climate resilient roadways in anticipation of future climate impacts and enhance coordination with other agencies (e.g., APUA) that impact roadway	Antigua and Barbuda	Administrative	Hurricane SLR Flooding	Increased capacity within MWH to plan and design climate resilient roadways	Future roadways are planned and designed to be climate-resilient, reducing disruption and maintenance requirements Improved cross agency coordination for public works.

construction and maintenance					
Ensure that future road upgrades are designed to account for hard surface runoff in development projections	Antigua and Barbuda	Physical	Flooding	Future roadway upgrades incorporate projections on anticipated hard surface runoff	Roads are upgraded to be flood resilient
Enact policies to prohibit future road and public infrastructure development in areas of projected SLR.	Antigua and Barbuda	Administrative	SLR	Policies in place to prohibit road and infrastructure development in areas of projected SLR	Reduced risk of loss, damage, and stranded assets
Undertake a study to identify which segments of coastal roadways are at the greatest risk of coastal erosion and SLR. Define which adaptation measures are most appropriate for at-risk road segments (e.g., relocate existing roads, elevate roadways, coastal defenses green and gray) Ensure that the design of future coastal roadway accounts for SLR and coastal erosion in the design phase (and considers required maintenance works)	Antigua and Barbuda	Administrative	SLR	Identify coastal roadways vulnerable to SLR and an assess appropriate adaptation measures	Planning and implementation of prioritized adaptation measures to reduce roadway exposure to SLR.
Youth education programs to reduce waste and avoid littering in roadway and drainage systems.	Antigua and Barbuda	Informational	Hurricane Flooding	Increased awareness among youth of waste reduction and adequate disposal	Significant reduction of waste in public spaces and enhanced functioning of drainage systems

Table 13: Wastewater: Summary of prioritized adaptation measures

Adaptation Measures	Location	Category	Associated climate hazard(s)	Anticipated outcome (short & medium term)	Anticipated impact (long term)
Develop a national wastewater management and sanitation policy that integrates climate change considerations and local knowledge. Specifically, to reduce wastewater spillage following heavy rainfall and flood events.	Antigua and Barbuda	Administrative / Policy	Flooding Hurricane Drought	Climate-resilient national wastewater management and sanitation policy in place	Adequate regulatory framework to support the policy.
Develop an associated wastewater and sanitation action plan and ecologically sustainable framework that integrates climate change adaptation planning	Antigua and Barbuda	Administrative / Policy	Flooding Hurricane Drought	Implement actions detailed in the national wastewater management strategy	Eliminate wastewater spillage associated with heavy rainfall events. Improved health of fisheries, and marine ecosystems (e.g., coral reefs, wetlands, seagrass), and a reduction of eutrophication caused by algal blooms and red tides.
Promote household greywater reuse under hygienic and safe conditions by educating and incentivizing homeowners (e.g., subsidies included in mortgages) to install low-cost and low-maintenance grey water treatment,	Antigua and Barbuda	Financial	Drought	Increased availability of financial incentives for households to install greywater treatment systems.	Reduction in water usage, enhanced water conservation

which can be used for irrigation and/ or cleaning.					
Address greywater reduction at the point of use by including water efficient fixtures in new residential development	Antigua and Barbuda	Physical	Drought	Increased uptake of water efficient fixtures (versus conventional)	Reduction in water waste, enhanced water conservation
Centralized sewage system in St. John's City that collects both sewage and grey water to reduce flood impacts in St. John's City.	Antigua	Physical	Flooding	Planning, procurement, and public works to construct a sewage system in St. John's	Elimination of wastewater overflow into St. John's city and harbor, and a consequent improvement in public health and the marine environment
Upgrade existing 2 chamber septic tank systems to a 4-chamber system with soak aways and drain fields, including managed wetland systems.	Barbuda	Physical	Flooding	Widespread adoption of four chamber systems leading to an improvement in public health and the marine environment.	
Adoption and enforcement of building and siting guidelines that specify the design and maintenance requirements for residential wastewater treatment systems DCA Building inspectors and Barbuda Planning Commission inspectors conduct site visits to ensure that septic tank systems are sized and sited correctly (e.g., adherence	Antigua and Barbuda	Capacity	Flooding Hurricane	Wastewater treatment systems (e.g., septic tank systems) are sited, constructed, and maintained (CBH) according to approved plans	Reduction in wastewater overflow and consequent health and environmental consequences

to setbacks as specified in the Building Code) and CBH capacity to ensure that systems are correctly maintained					

Table 14: Energy: Summary of prioritized adaptation measures

Adaptation Measures	Location	Category	Associated climate hazard(s)	Anticipated outcome (short & medium term)	Anticipated impact (long term)
Decentralize energy distribution through microgrids and renewable energy technologies (e.g., solar PV)	Antigua and Barbuda	Administrative /Policy Physical	Flooding Hurricane Drought	Reduction of energy supply disruptions following extreme events.	Greater energy independence, less disruption, and faster post-disaster recovery (aided by a more resilient and decentralized energy system) Improved functioning of the centralized grid, due to reduced users and demand
Incentive scheme for renewable energy, particularly for installations of greater than 5KW (e.g., through a one-to-one buy and sell ratio)	Antigua and Barbuda	Financial	Flooding Hurricanes Drought	Increased installation of renewable energy technologies, particularly for users >5kwh	Greater energy independence, less disruption, and faster post-disaster recovery (aided by a more resilient and decentralized energy system) Improved functioning of the centralized grid, due to reduced users and demand
Adequate battery storage for solar power plants to ensure grid stabilization and energy storage	Antigua and Barbuda	Physical	Flooding Hurricanes Drought	Increased performance of the solar power plants with respect to installed capacity and larger contribution of solar energy to the centralized grid	Greater proportion of grid-energy is fueled by renewable power Greater energy independence and reduced reliance on imported fossil fuels (diesel and natural gas) which are vulnerable to

					climate change disruption through transport (at sea) and storage, as facilities are exposed to climate risk
Investigate feasibility of wind power (offshore and land based), that incorporates hurricane-resilient design (e.g., blades that can fold down) and siting considerations	Antigua and Barbuda	Informational	Hurricanes	Undertake wind feasibility assessment	If feasible, develop project proposal and financing mechanisms

Tourism

The tourism sector adaptation plan intends to create an adaptation baseline to then enhance adaptive capacity, strengthen resilience, and reduce vulnerability to the adverse effects of climate change in Antigua & Barbuda. It details specific vulnerabilities, priority areas, proposed activities, and methods to monitor and evaluate the progress of the proposed projects. This plan looks at all the subsections within the tourism sector of Antigua and Barbuda. The Plan was guided by the principles of climate change adaptation, diversification of tourism products, partnerships, social inclusion, protecting the sense of place and ecological sustainability.

Background

Antigua and Barbuda's tourism service-based economy is heavily dependent on natural resources, low-lying coastal zones, and favourable climate conditions to support the sector. The tourism sector is also an economic driver, contributing 83.3% to the total economy and supporting 87.7% of jobs in Antigua and Barbuda in 2019. However, Climate change is anticipated to result in an increase in temperature, increase in intensity and frequency of storms, sea level rise and changes in rainfall with a drying trend anticipated for Antigua and Barbuda.

The tourism adaptation plan is therefore essential for building the resilience of the sector to climate change and its related hazards.

Antigua and Barbuda heavily rely on the tourism sector. As a result of Antigua and Barbuda's dependence on tourism, the country's economy is sensitive to changes in the global economy as well as climate change. In 2017, Antigua and Barbuda's economy contracted as a result of the passage of Hurricane Irma, where real GDP Growth in 2017 was 2.7% compared to 5.3% in 2016 (Caribbean Development Bank, 2018). Whereas in 2020, Antigua and Barbuda's economy contracted by 16% due to the COVID-19 pandemic (Caribbean Development Bank, 2021).

Peak tourism season occurs between December to April, when visitors escape cold winters and can experience the warm climate and enjoy festivals and events. The low season is the period with the least visitors and occurs between July to November, and the shoulder season is neither the high nor low season occurring from May to June.

The three main types of tourism in Antigua and Barbuda include stay-over tourism, cruise tourism, and marine tourism (primarily consisting of yachting). However, Antigua and Barbuda is currently developing a homeporting facility that may result in the classification of excursionists. The main tourism markets for Antigua and Barbuda include the United States of America, Canada, Europe, and the Caribbean.

Implementation

This national adaptation plan for the tourism sector covers a 10-year strategic period 2023– 2033 and is not intended to function in isolation but strongly support sector strategies such as the Tourism Master Plan (2007) as well as the Tourism Strategic Policy and Plan (2005-2009). Of note

is that the Ministry is currently in the process of developing a National Sustainable Tourism Plan and Policy, which is intended to repeal the previously named outdated plan and policy. The development of the new policy and plan should ensure that there's coherence and synergies with the tourism SAP. The Tourism SAP consists of 5 prioritized adaptation options, 5 outcomes and 13 outputs that are deemed critical to reduce the impacts of climate and disaster risks and strengthen the resilience of the sector. The overarching goal and outcomes of the TSAP were established based on the review of literature and discussion with stakeholders of the major adaptation needs. The following table outlines the 5 adaptation options, 5 outcomes, and 13 outputs. Further details on the specific activities that should be implemented within each output can be found in the full tourism sector adaptation plan.

Table 15: Priority areas for the tourism sector and their strategic objective, outcomes, and outputs.

Priority Area	Strategic Objective	Outcome	Output
Enhancing resilience of tourist facilities and infrastructure including key support sectors (agriculture, water, energy) to the impacts of Climate Change	Increase the adaptive capacity of tourism sector and key support sectors to climate and disaster risks	Implementation of climate resilient practices in response to a changing climate accelerated	Output 1.1 - Ecosystem based Approaches (EbA) integrated in risk reduction and adaptation
			Output 1.2 – Reduced risk at subsector level
			Output 1.3 – Sustainable Energy Water and Waste Management Practices
Improve resilience of the tourism sector through collaborations and synergies with all other sectors	All-inclusive and participatory approach for building a sustainable and resilient tourism sector in a changing climate	Strengthened partnerships for resilience building in the tourism sector.	Output 2.1 – Private sector and civil society organizations are fully engaged in CCA planning and implementation
			Output 2.2 – Public awareness and capacity building for tourism actors and stakeholders
Improving evidence-based decision-making on the planning and management of disaster and climate	Improve risk identification and assessment and use of scientific models to support risk informed decision-making	Evidence-based decision-making enhanced through research and innovation	Output 3.1 – Multi-hazard risk assessments that integrate climate projections conducted

related risks in the sector			Output 3.2 – Sector/sub-sector specific analyses of climate impacts conducted
			Output 3.3 – Research and innovation in technologies for knowledge creation & resilience building
Develop sustainable financing mechanisms for DRR/CCA actions for resilience building	Establish a well-defined framework for DRR/CCA financing for resilience building in the tourism sector	Sustainable financing mechanism for resilience building in the tourism sector established and resourced.	Output 4.1 – Enhanced capacity to access funding for DRR/CCA
			Output 4.2 –Economic analyses of specific tourism climate change adaptation actions evaluated
			Output 4.3 – Increased investments in and financing of CCA and livelihood protection insurance schemes
Strengthening governance mechanism to sustain DRM/CCA interventions in the sector	Strengthen the legal, policy and institutional framework to facilitate climate change adaptation in the tourism sector	Enabling environment to support disaster risk management and climate change adaptation strengthened	Output 5.1 – National Sustainable Tourism Plan and Policy formulated and promulgated
			Output 5.2 – Institutional and human capacity for the design, implementation, monitoring and evaluation of CCA projects in place
			Output 5.3 - Climate change issues incorporated in school curricula

Wholesale and Retail Sector

The Adaptation Plan for the Wholesale and Retail sector is designed to support the development and implementation of an effective sectoral adaptation strategy and action plan to form part of Antigua and Barbuda's National Adaptation Plan (NAP), ultimately designed to reduce vulnerability and enhance the resilience of the Wholesale and Retail sector. The key objectives of this project were to conduct a situational analysis of the sector to include a review of key documents and policies; lead consultations with key stakeholders to map climate risks to the sector; to assess the vulnerability of the sector based on national, regional, and global trends in climate and current and projected economic variables; to identify entry points within institutional, policy, and legislative frameworks for prioritized adaptation actions; and to develop a Monitoring, Evaluation, and Learning (MEL) plan that outlines an approach to integrating adaptation options in sectoral policies and plans with related indicators for monitoring and evaluation. The outcomes of these tasks informed the creation of this adaptation plan. The plan is intended to support the DOE to prioritize adaptation actions that reduce vulnerability and enhance resilience of the sector. Although the primary user for this plan is the DOE, the W&R sector have a role in leading some of the implementation actions.

Background

Generally, the wholesale and retail sector are defined as a two-distribution arrangement that constitutes a major part of the supply chain, meaning that when goods are manufactured, they are sold in large quantities (wholesale) to the wholesalers who further sells them to the retailers who finally sells them to the ultimate customers. The wholesale and retail sector therefore represents the critical link between manufacture and consumption. The wholesale and retail sector includes 136 establishments with a little over 90 per cent of these establishments being in retail with a little less than 10 per cent of the total being wholesale establishments.

Of the 136 establishments, two operated both in wholesale and retail – one of these establishments is in the Dairy Product, Beverage Product and Manufacturing Industry and the other is in the Grocery Stores Industry. The sector is dominated by the grocery stores industry and the hardware, plumbing, building materials and supplies industry. The wholesale and retail trade sector contributed to approximately 12% of the GDP in 2021

The economy of Antigua and Barbuda is predominantly a service economy. According to the Labour Force Survey Report, two out of every three workers (66.9%) in Antigua and Barbuda worked in services industries in 2018. The hotel and restaurants industry were the largest employer with 17.4 percent of the employed population. Public administration and defence were the second largest, followed by wholesale and retail trade with 11.0 percent (Antigua and Barbuda Ministry of Finance and Corporate Governance, Statistics Division, 2020). It is important to recognize that these sectors do not stand alone but work together to create the overall economy. The Wholesale and Retail sector is vital to this system. As importers and sellers of necessary goods in the country, negative impacts it experiences will ripple through the other sectors as well.

Approximately 5,517 people are employed in the wholesale and retail sector, representing about 16 percent of the employed force (UN Women). The sector employs the second largest number of workers, with the first being the hotels and restaurants sector which employs 17 percent of the labour force. In 2018, the number of men and women employed in the wholesale and retail sector was almost equal. In addition, wholesale and retail was one of the top two industries that female managers worked in (Antigua and Barbuda Ministry of Finance and Corporate Governance, Statistics Division, 2015).

Implementation

The adaptive technologies and strategies are designed to reduce vulnerability and enhance resilience of the wholesale and retail sector to climate change. Four key adaptation action areas were identified which are:

- Physical adaptation and policy planning
- Climate proofing wholesale and retail buildings
- Financing and financial instruments for adaptation
- Training, capacity building, knowledge transfer for adaptation, and business continuity planning

The first area, physical adaptation, and policy planning is focused on the built environment and improving its resilience and reducing its vulnerability. The goal of this area is to ensure that climate change impacts are considered when planning and designing infrastructure, deciding locations, and construction principles. They include structural and engineering options to harden infrastructure as well as urban planning instruments such as land-use planning and the development, application, and enforcement of building codes. The wholesale and retail sectoral adaptation plan lays out specific projects that would work towards building resilience, reducing vulnerabilities, and incorporating adaptive strategies in the building sector.

The second area, climate proofing wholesale and retail buildings, focuses on adaptation actions to climate-proof buildings pertaining to the wholesale and retail sector. Actions are proposed to make buildings resilient to climate change effects such as heatwaves, coastal flooding, and hurricane wind and surge.

The third category, financing and financial instruments for adaptation, considers finance and economic instruments for adaptation activities and disaster recovery from public, private, alternative, or blended sources. Access to finance and insurance cover is a major concern for Antigua and Barbuda businesses. There are several approaches being used currently in adaptation planning and implementation in different parts of the world. The government could offer financing instruments including loans, bonds, and seed capital. Insurance (micro, parametric) can be a cost-effective tool for adaptation planning and implementation. Several cases exist for insurance schemes in low income and developing countries which are a partnership project between private and public entities.

The fourth category, training, capacity building and knowledge transfer for climate adaptation and business continuity planning, highlights adaptation actions that strengthen the knowledge and capacity of the wholesale and retail sector to respond to and adapt to the effects of climate change. Such measures include knowledge transfer and training on how wholesale and retail businesses can structure their strategic plans to consider and include climate change adaptation practices and design effective business continuity plans that factor in climate change effects.

Local Area Adaptation Plans (LAAP)

The Local Area Adaptation Plans (LAAP) that have been developed for three areas in Antigua set a strategic framework for guiding and integrating the efforts of national and local government, local development corporations, civil society, businesses, and the international community in strengthening these areas' capacities to adapt to climate change between 2023 and 2033. The three areas that have been considered are the Airport/Fitches Creek Local Area, St John's City, and the Jolly Harbour to Johnson's Point. These LAAPs provide sets of implementable actions identified by multiple stakeholders as being key to reducing experienced and projected climate impacts in the most vulnerable portions of these areas. They also present combinations of cross-sectoral interventions to strengthen the capacity of the institutions that will play key roles in planning the adaptation actions and integrating these adaptation considerations into current and future development agendas, plans, programmes, and projects. These LAAPs serve as living documents that should undergo periodic revision and modification, where needed. The adaptation options and strategies included in these LAAPs identify indicative lead institutions. The period for implementing the measures, within the LAAP 2023-2033 cycle will be contingent on the availability of both the financial and technical resources required to implement and execute the actions outlined.

LAAP Function and Audience

The LAAPs have been formulated to:

1. Inform the process of planning, coordinating, and implementing actions urgently needed throughout the three local areas defined to prepare for, and cope with, the impacts of climate variability and change in the medium and long term and, when possible, tap into opportunities to address climate change.
2. Guide the integration of climate change adaptation considerations into ongoing, planned and emerging decision-making processes developed for the portions within each of the three areas that are deemed most vulnerable to climate impacts by stakeholders, i.e., critical infrastructure and facilities, the built environment and residential communities, natural ecosystems, tourism and local businesses.
3. Raise awareness on climate change projections, vulnerabilities, challenges and proposed solutions to promote action for the three defined areas, and encourage collaboration between, ministries, departments, parliamentary representatives and inter-ministerial committees to support the integration of climate change adaptation considerations in all

decisions made on ongoing and new development activities, programmes, projects and investments for these areas between 2023 and 2033.

4. Be an instrument for the mobilization of resources. The priority measures recommended can be included in projects to be presented to, and funded by, regional and/or international climate finance sources and can also be used by long-standing donor agencies to identify activities to support, based on their own funding priorities and preferences. It is also expected that, where possible, national resources will be allocated to adaptation as these considerations are increasingly included into national development policies, plans and programmes.

Goal and Objectives

The following adaptation goal and objectives help to provide a structure for the next steps, by clearly defining what the local area stakeholders would like to achieve through adaptation actions. The success of this LAAP will be reliant on the degree to which the overarching goal is accomplished to yield actual climate impact risk reductions.

To increase the technical and physical capacity of St. John's City, the Jolly Harbour to Johnson's Point local area, and Airport/Fitches Creek local area to prepare for the impacts of climate change as they seek to become climate-robust areas through effective and coordinated adaptation efforts.

Guiding Principles and Cross-cutting Themes

The LAAPs are aligned in particular with the National Communications (NCs) to the UNFCCC, and the guides and plans recently developed to advance the overall NAP process. As such, the development of these plans retained some of the same fundamental principles and cross-cutting themes of this NAP which includes:

- *Ownership*: LAAP should be integrated into sectoral policies and plans so that the entire government and key local stakeholders commit to and take ownership of climate-resilient development.
- *Considerations on demography, gender and social inclusion*: the LAAPs and the recommended actions will take into account the differentiated impacts of climate change on men, women, children, the indigent, the elderly, informal business operators, migrants and other potentially vulnerable groups.
- *Climate measures that are suitable at the local level*: The LAAPs will facilitate meeting urgent climate adaptation needs and advancing medium- and long-term adaptation and resilience-building measures so that they are adapted to local and national conditions and needs.
- *The whole-of-government approach*: The LAAPs will seek to benefit from financial climate change investment and sustainable resources to ensure optimal implementation of the priorities identified by the relevant stakeholders.

- *Integration of climate, resilience and livelihood approaches*: The LAAPs will guide the implementation of climate change adaptation (CCA) measures within the areas in an integrated manner in order to promote the effectiveness and efficiency of the plans' implementation. By integrating climate resilience into livelihoods, integrated interventions contribute to economic growth and environmental and socio-economic benefits.
- *Climate-sensitive planning and budgeting*: the LAAPs, through this NAP, will identify entry points and guide the integration of CCA considerations into sectoral planning and budgeting processes as part of the focus on mainstreaming CCA in day-to-day governance processes.
- *Community stakeholder involvement*: the LAAPs intend to identify and implement community centred and -led approaches whereby communities are empowered to strengthen their adaptive capacity and improve coping mechanisms for long-term climate resilience.
- *The ecosystem-based adaptation approach*: the LAAPs identify implementation pathways that strengthen the resilience of biodiversity and ecosystem resources and take a systemic approach to adaptation with respect to natural capital.
- *The adaptation approach to reinforce the resilience of local area communities to climate change*: climate change can have negative impacts on infrastructure and access to services for a large percentage of the population.
- Innovation: The LAAPs will provide innovative tools and techniques to improve efficiency and implementation in order to maximize the impact of priority actions.

Priority Adaptation Areas and Strategic Objectives

Each of the following represents adaptation priorities that have been developed to address climate risk across Antigua, as outlined in the island's GCF Country Programme:

- *Improving water security*. Antigua and Barbuda must approach 100% reverse osmosis as droughts are becoming more frequent and lasting longer. There is also a need for additional on-site water storage for community buildings (e.g., schools and clinics) to decentralize supply and build resilience when centralized supplies are disrupted by extreme climate events.
- *Improving energy sector resilience*. The country already has approximately 40% redundancy at the national level via back-up diesel generators. The backup energy is primarily in the business sector. One of the resilience targets is a 60–70% increase in renewable back-up energy systems in vulnerable homes and for community businesses

over a four-year period to build resilience, as the centralized power supply can be disrupted for weeks due to extreme climate events.

- *Increasing flood and high-intensity hurricane resilience* of the national grid infrastructure.
- *Increasing resilience of buildings*. The revised Building Codes for climate resilience will establish guidelines for the construction of new buildings or upgrading of existing buildings that can withstand Category 5 hurricanes. As a key area of concern for Antigua and Barbuda, financing should be secured for this response, particularly at reasonable rates for private homes and businesses.
- *Improving the protection of coastal areas*. The DOE has not yet conducted a significant assessment in this area. **The overall NAP is intended to provide more details on the impacts of sea level rise as well as storm surge.**
- *Protecting watersheds and waterways* to reduce flooding and control surges in vector populations (e.g., mosquitoes)

Based on consultations and a review of the risks across each local area, St. John's City, the Jolly Harbour to Johnson's Point local area, and Airport/Fitches Creek local area, the following strategies and techniques may be considered as a part of the efforts to climate-proof and build resilience for each area:

- Climate-proofing utilities
  - Elevating or relocating important electrical equipment to protect them from flooding.
  - Installing smart grid technologies and switches that can redirect power to undamaged sections of the powerline whilst isolating problem areas. Smart grids can also allow utilities that are faced with storm damage to use that data to successfully identify and quickly respond to problem areas in much quicker times.
  - Burying transmission and distribution lines, where feasible.
  - Reinforcing or replacing above-ground poles with more robust alternatives to reduce storm and heat damage.
  - Implementing 'demand-response' programs to help make the grid more flexible and resilient during heat waves and periods of high demand.
  - Improving grid reliability and efficiency by expanding transmission capacity, and integrating energy storage, particularly during periods of high usage.
  - Installing more efficient conductors to reduce 'stress' on adjacent sections of the grid to further improve overall grid efficiency during periods of demand.
- Climate-proofing roads (against flooding and high temperatures)
  - Build flood-barriers.

- Adjust the bituminous mixture design (consider the use of binders with higher softening point, including polymer modification of bitumen, and the selection of stronger aggregate skeleton)
- Adjust the structural design of sidewalk pavements to make them flexible, semi-rigid and rigid/composite by design.
- Greater use of concrete due to its higher temperature resistance and other advantages like its longer lifespan, possibility to bear an increased load, and lower need for maintenance.
- Changing the design of concrete pavement mixtures to reduce the amount of water required.
- Use of permeable pavements which allows water to be stored in the pavement structure and infiltrated into the soil or discharged by a drainage system.
- Use of porous top layers that can facilitate the drainage of the water to the sides of the road and prevent aquaplaning.
- For concrete surfaces, consider using higher cement contents and lower water to cement ratios.
- Consider the use of hydrophobic coatings suitable for use at the micro-mechanical and or pavement surfacing level.
- Road maintenance must also be taken into account and should include all maintenance services, like cleaning and maintenance of drainage systems, removing of debris, cleaning of roads, and pruning of brushes.

➢ Increasing the capacity of ecosystems for protection
- Mangrove wetland and seagrass rehabilitation for areas that have been degraded from anthropogenic activities to maintain ecosystem functioning.
- Vegetation replanting along roads in flood-prone areas can help to minimize the impact by acting as buffers and also protect roads from direct sunlight. Vegetation should be planted at a sufficient distance from the road.

➢ Climate-proofing homes and businesses
- Integrate the use of renewable energy to decrease the load demand for power from the grid.
- Construct and renovate according to the revised national building code.
- Diversify options for water supply and/or expand current sources to reduce the risk that water supply will fall below water demand.
- Construct buildings in flood-prone areas on pillars/stilts or construct them within waterproof foundation systems.

➢ Climate proofing bridges
- Consider the design, construction and management of bridge structures to withstand higher occurrences of flooding, erosion and temperature fluctuation.

- Climate-proofing waterways, pipelines and drainage systems
  - Consider widening water-retaining structures.
  - The design for culverts should be adjusted to accommodate higher water volumes within a short period of time.
  - Consider the use of intensity-duration-frequency curves to define the capacity design of the drainage system, which takes into account the influence of climate change and future climate scenarios.
- Climate-proofing critical/emergency facilities
  - Diversify options for water supply and expand current sources to reduce the risk that water supply will fall below water demand.
  - Increase water storage capacity.
  - Plan and establish alternative or on-site power supply.
  - Install stormwater pumps for backflow prevention.
  - Sea-level rise and coastal storm surges can cause wastewater outlets to backflow. To prevent this, stronger pumps may be necessary.
- Climate-proofing tourism assets
  - Diversify options for water supply and expand current sources to reduce the risk that water supply will fall below water demand.
  - Increase water storage capacity.
  - Finance and facilitate systems to recycle water. Greywater frees up more finished water for other uses, thus expanding the supply.
  - Consider installing renewable energy supply.
  - Install stormwater discharge trenches/channels and/or pipes.

The following strategies may additionally be set in place for the St. John's City area:

- Climate-proofing ports and piers
  - Install stormwater culverts/pipes to channel water away from assets.
  - Install stormwater pumps/pipes that pump water away to prevent flooding. Where there are already pumps, measures can be taken to increase the strength of these pumps for backflow prevention since sea-level rise and coastal storm surge can cause water outlets to backflow.
  - Install wave attenuators such as bulkheads and seawalls—to combat sea level rise, flooding, and increased wave action from extreme weather.
  - Develop site-specific plans that account for meteorological conditions, climatic hazards, orientation, coastline dynamics, bathymetry, and sediment regime.
  - Adopt a managed adaptive approach that acknowledges uncertainty and encourages appropriately managed flexible and adaptable designs.

- Adapt existing ports to the increases in sea level and wave height by either raising or upgrading the crest of breakwaters, the operating level of quay walls and the mooring facilities at quay walls.

The following strategies may additionally be set in place for the Jolly Harbour to Johnson's Point local area:

- Resilient RO Plants
  - Reduce energy usage and the resultant carbon footprint of reverse osmosis plants by adopting renewable sources of energy to power both reverse osmosis plants.
  - Upgrading the membranes, pump and energy recovery technologies used.
  - Replacing most of the metal desalination plant equipment and piping with high-quality, non-corroding plastic equipment and piping, or with non-corrosive grade steel.
  - Establish a plant-specific emergency action plan with protocols, particularly for hurricanes/storms, that includes a detailed list of physical preparations, timelines, and communication directives. Ensuring that operators have satellite phones to communicate if cell towers become unresponsive/damaged during an extreme event.
  - Long-term monitoring programs that characterize seawater quality should be conducted at the plant intake site(s).
  - RO plants can potentially prevent hydraulically irreversible fouling and continue operations during periods of high-density sargassum blooms by using techniques like reducing flux, recirculating flow, use of coagulation by either optimizing the dose or switching on coagulation in response to blooms, and decreasing backwashing intervals, among other techniques.
- Protecting heritage sites and ruins
  - Build flood barriers to protect infrastructure, like levees or seawalls.
- Increasing the capacity of ecosystems for protection
  - Mangrove wetland and seagrass rehabilitation for areas that have been degraded from anthropogenic activities to maintain ecosystem functioning.
  - Conduct a study to understand the hydrodynamics and response of nearby wetlands to storm surge event.
  - Vegetation replanting along roads in flood-prone areas can help to minimize the impact by acting as buffers and protect roads from direct sunlight. Vegetation should be planted at a sufficient distance from the road.
- Additional resiliency measures for the Airport
  - Diversify options for water supply and expand current sources to reduce the risk that water supply will fall below water demand.

- Increase water storage capacity.
- Plan and establish alternative or on-site renewable energy power supply.
- Maintain existing hurricane/storm proof measures that were considered during the construction of the new establishment.

➢ Climate-proofing Marinas

- Install stormwater culverts/pipes to channel water away from assets.
- Install stormwater pumps/pipes that pump water away to prevent flooding. Where there are already pumps, measures can be taken to increase the strength of these pumps for backflow prevention since sea-level rise and coastal storm surge can cause water outlets to backflow.
- Install wave attenuators such as bulkheads and seawalls—to combat sea level rise, flooding, and increased wave action from extreme weather.
- Develop site-specific plans that account for meteorological conditions, climatic hazards, orientation, coastline dynamics, bathymetry, and sediment regime.
- Adopt a managed adaptive approach that acknowledges uncertainty and encourages appropriately managed flexible and adaptable designs.
- Adapt existing ports to the increases in sea level and wave height by either raising or upgrading the crest of breakwaters, the operating level of quay walls and the mooring facilities at quay walls.

➢ Climate-proofing the educational institutions

- Install flood barriers to protect critical infrastructure.
- Consider flood proofing critical equipment, placing important assets within waterproof containers.
- Plan and establish an alternative power supply.
- Install stormwater culverts/pipes to channel water away from assets.
- Install stormwater pumps/pipes that pump water away to prevent flooding.
- Rainwater harvesting and recharge systems that capture water on the roofs of buildings.
- Create vegetation barrier.

➢ Other measures relevant to the Airport/Fitches Creek local area

- Implement watershed management to include a range of policy and technical measures that focuses on preserving or restoring vegetated land cover in a watershed and managing stormwater runoff to help mimic natural watershed hydrology, increase groundwater recharge, reduce runoff, and improve the quality of runoff.
- Implement saltwater intrusion barriers by injecting fresh water into aquifers to act as a barrier, while intrusion recharges groundwater resources.

- Ensuring the rehabilitation of mines/quarries by replanting vegetation limits sedimented runoff into watercourses and the sea.

Based on these priority areas, the following strategic action plan, with four (4) strategic objectives, was developed:

- Strategic Objective 1: Building coastal resilience to hurricanes and tropical storm impacts through improved coastal zone management and climate adaptation action/measures.
- Strategic Objective 2: Eliminating future losses from flood hazards through strengthening critical infrastructure and building institutional capacity.
- Strategic Objective 3: Enhancing resilience to drought hazards and warmer temperatures.
- Strategic Objective 4: Mainstreaming considerations for future sea level rise

St John's City Local Area Adaptation Plan

St. John's City is the capital of Antigua and Barbuda which is located on the northwest coast of Antigua, adjacent to a sheltered natural deep-water harbour. The demarcated area of focus is bordered by St. John's Harbour to the west; Dickenson Bay Street to the north; Stapleton Lane, Independence Avenue and Camacho Avenue to the east; and the Grays Farm Main Road to the south. Surrounding St. John's City is St. John's Rural which makes up the remainder of the St. John's parish. St. John's City is the most urban and developed area in the country and serves as the chief commercial centre and port of entry for Antigua. It is also the largest city in the country, being approximately 10 km^2 in size, with a maximum elevation of 59 meters (194 feet) above mean sea level.

One of the main hazards that threaten livelihoods in the St John's City local area is flooding, particularly flash flooding following heavy rains. Stakeholders consulted have indicated that flooding is more prominent in areas near the coast, along watercourses, and major drain systems for areas further inland (Figure 3-3). This is linked to the topography of St. John's City, as eastern sections are elevated and gently slope westward to St. John's Harbour, ending in a coastal plain that is flat and low-lying. As a result, areas along the coastline are prone to flooding from heavy prolonged rainfall events. In the past, flood waters triggered by such events have resulted in surface water levels high enough to restrict access to roadways and sidewalks, damage low-lying building structures, flood homes, stores, stalls, and businesses, limit vehicular traffic flow and disrupt the activities of both local and tourist-based pedestrians and shoppers.

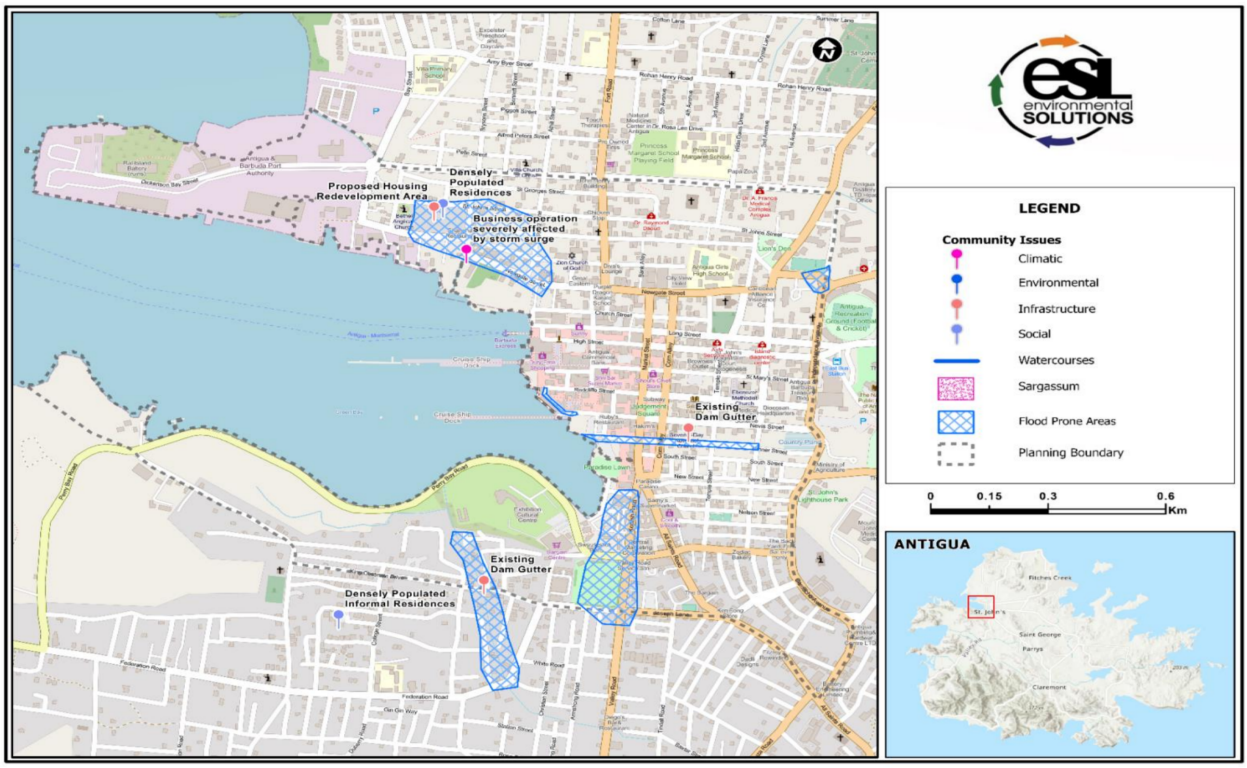

Figure 13: Stakeholder Perception Map of key Climatic and Non-Climatic Hazards affecting the St. John's City Local Area

St. John's City has been impacted by the onset of hurricanes and tropical storms in the past. Despite past impacts, stakeholders have noted that the sheltered geography of the city has limited the extent of damage to the area. Nevertheless, the impact of the strong hurricane and storm-forced winds and storm surge from storms and hurricanes that have made landfall in Antigua i.e., Dorian (1971), Helena (1963), Luis (1995), Georges (1998), Jose (1999), and Gonzalo (2014) have resulted in widespread damage.

The low-lying coastal nature of St. John's City also puts coastal infrastructure and operations at risk from coastal inundation associated with rising sea levels. Several important sites in the city are already near mean sea level and are at risk of coastal inundation. The Antigua Distillery Limited Beverage Bottling Facility, James Service Station, the Fisheries Office, the cruise ports, and markets, for instance, are generally flat and lie at just over 10 feet above mean sea level. The low elevation also means that with future increases in mean sea level, existing groundwater resources are at risk of saline intrusion, underground fuel storage tanks are at risk of corroding, and other coastal structures will be more susceptible to flooding.

Antigua and Barbuda rank as one of the most water-stressed countries in the Caribbean (United Nations, 2021). The country's Voluntary National Review of SDGs, 2021 noted that "the demand for water has drastically exceeded the available supply from ground and surface water". This demand, however, is a challenge, since rainfall has decreased in the Caribbean in the last century (as established under the Mainstreaming Adaptation to Climate Change (MACC) Project, 2010) with below-average rainfall being recorded across the Caribbean in 2015 (NOAA, 2015).

St. John's Implementation Plans

Based on the strategic objectives previously defined, there are corresponding cross-cutting outcomes aimed at establishing and managing activities geared towards addressing climate adaptation based on the main climatic hazards affecting the area (*See appendix for the ten (10) outcomes and associated outputs for the St. John's City LAAP 2023-2033*).

Darkwood Beach Local Area Adaptation Plan

The designated Jolly Harbour to Johnsons Point local area is located along the southwestern coast of Antigua in the parish of St. Mary, about 15 km from the St. John's City. The area stretches from Jolly Harbour to Turner's Beach and the Johnsons Point community and is bordered to the west by Lignumvitae Bay, Ffryes Bay, and Picarts Bay. To the east, it is bordered by Valley Road and includes the adjacent swamp ponds, wetlands, and communities. Adjacent to this local area are the Bolans and Jennings communities as well as the higher-elevation areas of Crabb's Hill. The Parish of St. Mary's is located in Antigua's southwest volcanic region. The volcanic areas contain several small alluvial valleys rising to Boggy Peak at 402 meters above sea level.

The Jolly Harbour to Johnsons Point local area is located within the Christian Valley Watershed and includes most of the developments along the southwestern coast. This watershed is 1,780 hectares with a ground water yield of 610,000 m^3 /year. The watershed facilitates 3.7 hectares of storage for agricultural purposes and 67.2 hectares of municipal storage. The Bolans Watershed, which includes a section of the Christian Valley watershed, occupies about 19 km^2 and is bounded by the southwest watershed. Uncontrolled and unregulated topsoil and sand mining in the Christian Valley watershed have affected agricultural fields and the erosive force of the heavy rains has had an impact on the overall ecosystems in the area.

The Jolly Harbour to Johnsons Point local area is affected by both coastal and flash flooding. The impacts are often seen when there is heavy continuous rainfall that produces >3 inches of rainfall, meaning that intermittent rainfall does not typically result in any notable flooding. To identify the area's most at risk of flooding and the extent of the potential impact, flood inundation maps were developed using locally available georeferenced data sets provided by the Department of Environment (Figure 3-4 and Figure 3-5). The maps depict flood inundation levels ranging from less than 0.5 meters to 4.5 meters overlaid against the natural and built environment in the area. The maps show that while flood risks are uneven and highly localized, a significant proportion of the Jolly Harbour to Johnsons Point Area is susceptible to flood inundation.

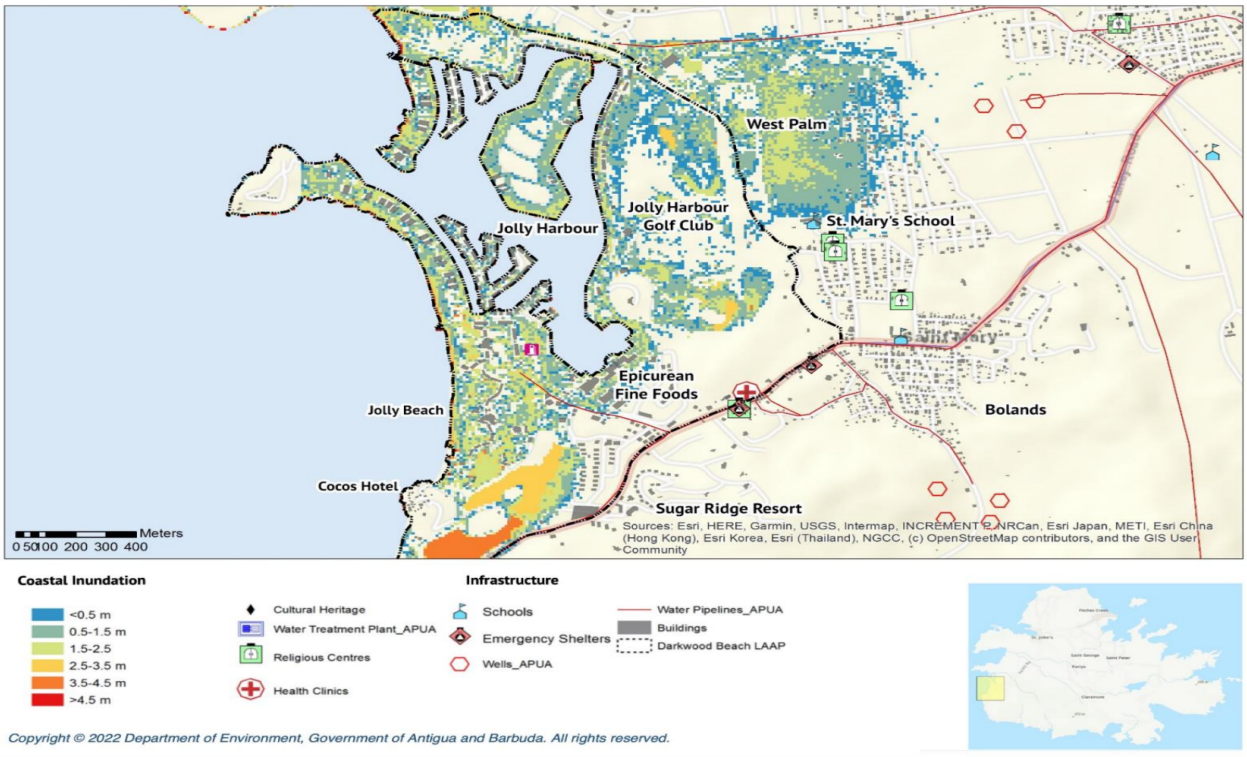

Figure 14: Coastal Inundation Scenarios for Jolly Harbour

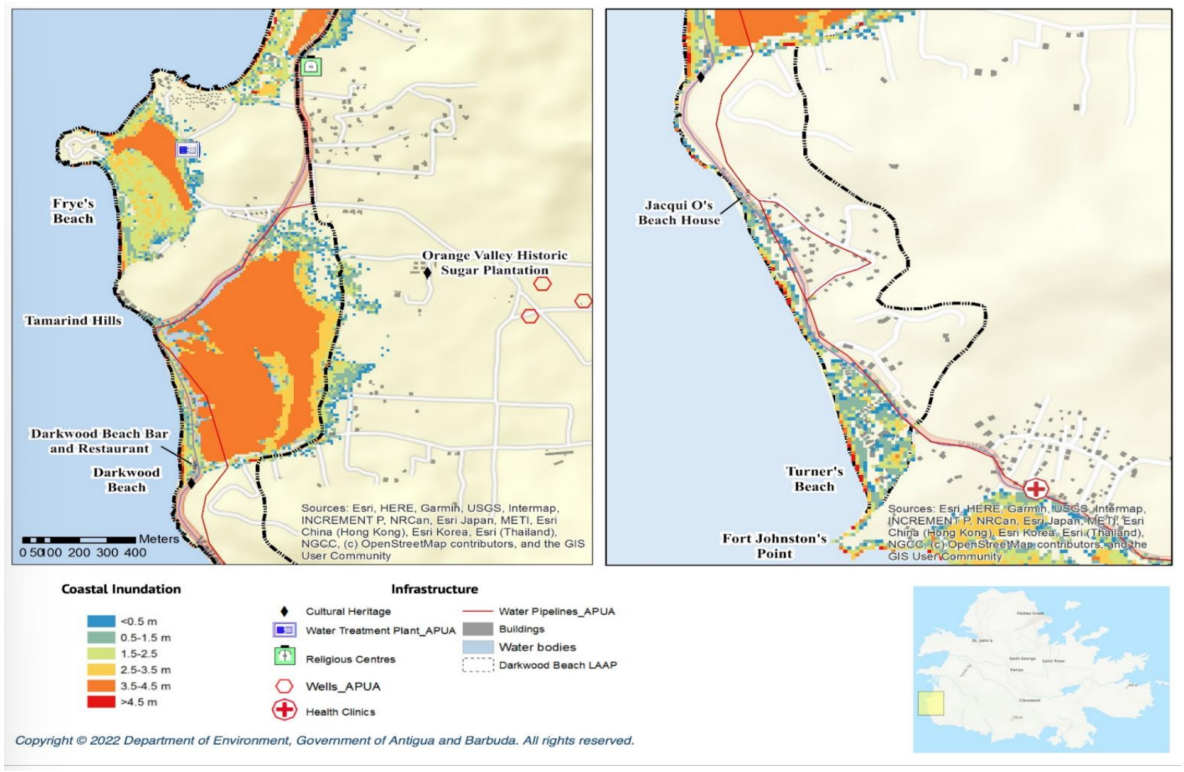

Figure 15: Coastal Inundation Scenarios for Ffryes Beach to Johnsons Point

Hurricanes and extreme tropical storms have been reported to cause significant loss to seagrass beds as well as damage to coastal infrastructures such as hotels and restaurants that are located along the southwestern stretch of the coastline. Additionally, major hurricanes in the past have resulted in significant loss of income for fisherfolk due to the lengthy period it normally takes for them to recover after a hurricane as a result of damage to boats, poor visibility, excess debris, damage to fish pots, and drifting of fish pots. For example, during Hurricane Earl (2010), fisherfolk in Jolly Harbour expressed loss of fishing vessels and equipment damage. Further studies conducted following the hurricane estimated this cost to be approximately EC$352,730.

Although not as densely populated as St. John's City, the Jolly Harbour to Johnson's Point local area has several established communities and tourism establishments. Whilst the replacement costs may not be as high for this local area when compared to St. John's City, the cost implications are still very high. The total built infrastructure would cost an estimated US$244,750,875. Projections for more intense hurricanes thus suggest a continued and growing risk of storm surge impacts for the area.

Drought has become a recurrent hazard in Antigua which typically results in a severe reduction in water availability. Although some stakeholders indicated that the ongoing drought has not resulted in significant water shortages as is being experienced in other areas across Antigua, the hotels and surrounding health facilities that have a high-water demand, have indicated that they are feeling the effects through the consistently limited water availability. Similarly, farmers have also noted that drought conditions have been affecting their crop production and irrigation water supply. They have had to seek supplemental water supply with storage tanks and water retention ponds. Across the board, this has resulted in financial strain.

Based on the climate change projections for the island, sea level rise is expected along the coastline of Antigua and Barbuda. Given the low-lying nature of the Jolly Harbour to Johnsons Point local area, any significant increase in mean sea level will threaten large tracts of land along the coast, with the potential to cause significant damage to buildings and key infrastructure and the permanent loss of valuable coastal lands. Figure 3-9 and Figure 3-10 show SLR projections for the Darkwood Beach local area for two scenarios (0.13m and 1.45m) based on the respective lower and upper values of mean SLR predictions for the Caribbean by 2100, i.e., end of century. The lower value of 0.13m SLR corresponds with the IPCC SRES B1 scenario and the upper value of 1.45m is based on research by Rahmstorf (2007) which suggests that future SLR might be in the order of twice the maximum level that the IPCC predicted for the worst case A2 scenario (Simpson et al, 2010). The dataset was created by JECO Caribbean for the OECS ICZM Policy Setback Guidelines, 2015.

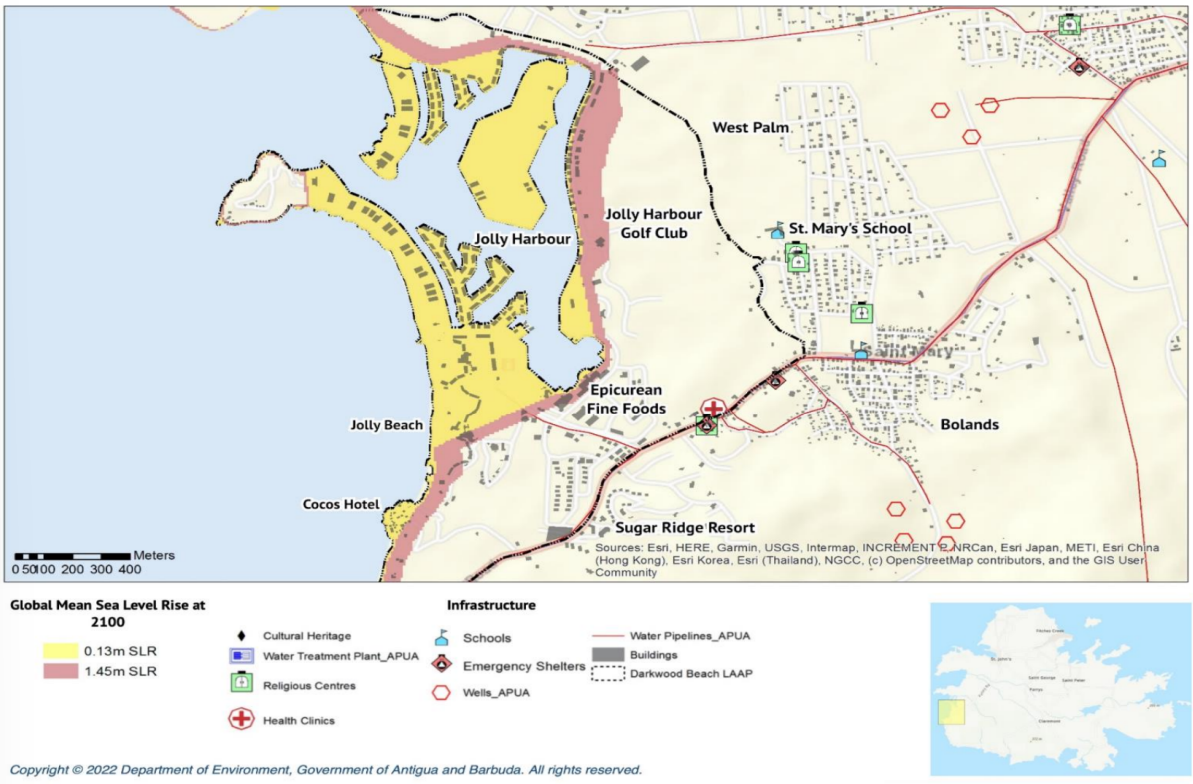

Figure 16 : Sea Level Rise Perception for Jolly Harbour

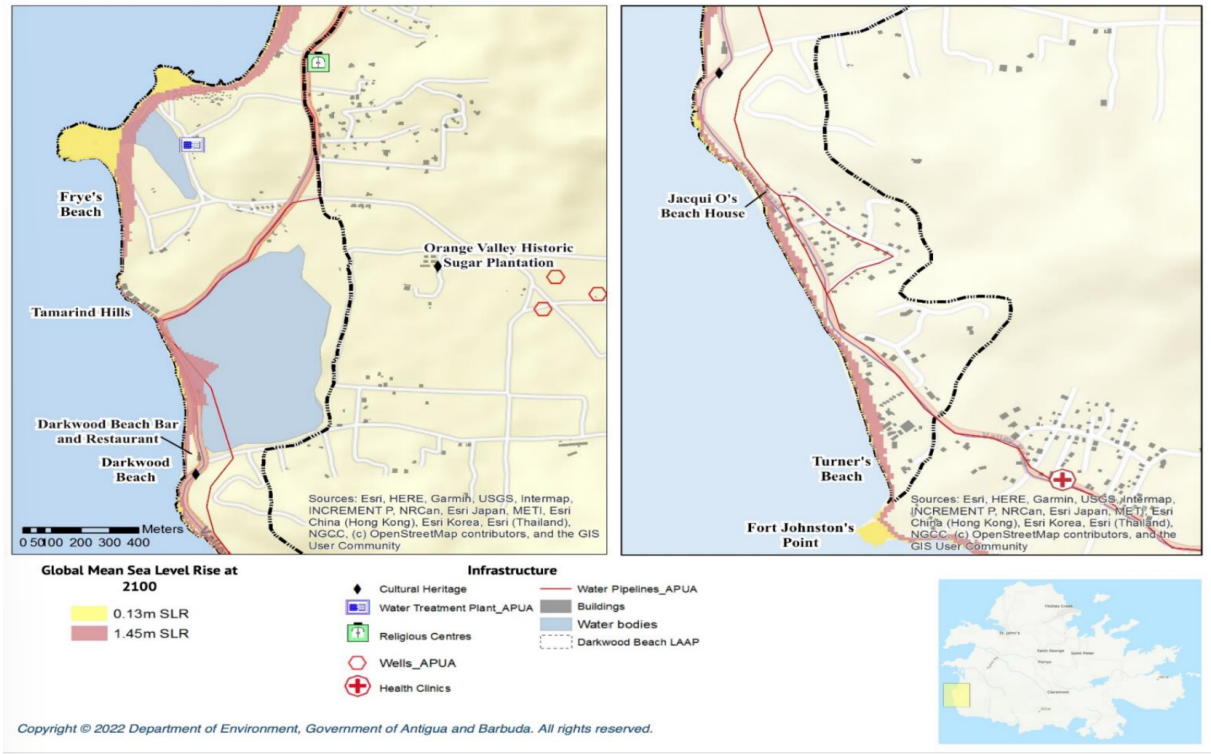

Figure 17: Sea Level Rise Perceptions for Jolly Harbour

Darkwood Beach Implementation Plans

Based on the strategic objectives previously defined, there are corresponding cross-cutting outcomes aimed at establishing and managing activities geared towards addressing climate adaptation based on the main climatic hazards affecting the area. (*See appendix for the eleven (11) outcomes and associated outputs for the Darkwood Beach LAAP 2023-2033*).

Airport/Fitches Creek Local Area Adaptation Plan

The Airport and Fitches Creek Local Area is located along the northern coast of Antigua in the parish of St. George. The area of focus is bordered by Jabberwock Road and Sir George Walter Highway to the west, Palmetto Drive, and the Piggott's community to the south and the Fitches Creek Bay and wetlands to the east. The area is mainly flat with an undulating topography consisting of several small hills across the area. Notable points of interest within the area include the Fitches Creek and Piggott's residential communities; the V.C. Bird International Airport; educational institutions like the American University of Antigua, the Antigua and Barbuda Hospitality Training Institute, Antigua and Barbuda International Institute of Technology and the American International College of Arts and Sciences Antigua; the Camp Blizzard Military Base and the associated Reverse Osmosis Plant, the Shell Beach Reverse Osmosis Plant, restaurants and villas like the Dutchman's Bay Cottages, Cecelia's and The Anchor Bar and Restaurant; the Coolidge Cricket Grounds, and historic sites like the Nibbs Sugar Windmill Ruins, Barnacle Point, the St. George Anglican Church, the Antigua Sugar Mills and the Dungeon which are frequented by tourists. The property on which the Antigua Sugar Mills resided has been converted into an upscale housing development.

Additionally, the Fitches Creek watershed is one of the six major watersheds in Antigua which has been recognized as critical based on their agro-ecological, hydrological, and socio-economic values. This watershed is 1,040 hectares in size with an existing 135.4 hectares of storage for agricultural purposes. The coastal zone of the Fitches Creek/Airport Local Area, i.e., Jabberwock Beach, Shoal Bay, Dutchman's Bay, and the Fitches Creek Bay is also included as a part of the Northeast Marine Management Area (NEMMA), a large multi-use protected area located on the Northeast Coast of Antigua covering over 30 square miles. It includes a rich marine environment containing fringing reefs and seagrass beds. Beaches within the NEMMA are important as nesting habitats for marine turtles. Some of the beaches show erosion caused by oceanic conditions and hurricanes. Fitches Creek Bay and the Parham Harbour (located on the outskirts of the defined local area) are two large bays separated by Blackman's Point which support an almost unbroken stretch of mangroves. At Fitches Creek Bay, a deep, mangrove-lined channel extends 1.5 km inland, and mangroves fringe the coast for ~1 km. This is a wetland site where the vulnerable West Indian Whistling-Duck is known to be found.

Extreme weather events like hurricanes and tropical storms are expected to worsen in the coming decades under all emission scenarios. During the hurricane season, the area is at risk of being affected by strong winds and storm surges. In the past, inland areas like the Piggott's community have been severely affected by hurricanes and tropical storms. In 1999, Hurricane Jose and

Tropical Storm Lenny occurred within a month of each other. The events resulted in extensive flooding to the point where an estimated 62 residents from the Piggott's community had to be rescued from rooftops in boats. A total of 98 homes in Piggott's were affected, which amounted to 468 persons being impacted. Based on storm surge projections, the entire Jabberwock area, the coastline, and roadway along Winthorpes Bay (northwest of the V.C. Bird International Airport), St. Georges Drive, and the sections of the Fitches Creek wetlands are the main areas that are also at risk of exposure from as low as 1.2m storm surge associated with hurricanes and tropical storms.

SLR projections for the Airport/Fitches Creek local area for two scenarios (0.13m and 1.45m) are based on the respective lower and upper values of mean SLR predictions for the Caribbean by 2100, i.e., end of century. The lower value of 0.13m SLR corresponds with IPCC SRES B1 scenario and the upper value of 1.45m is based on research by Rahmstorf (2007) which suggests that future SLR might be in the order of twice the maximum level that the IPCC predicted for the worst case A2 scenario (Simpson et al, 2010). The dataset was created by JECO Caribbean for the OECS ICZM Policy Setback Guidelines, 2015.

Antigua is affected by droughts every 3 to 5 years as drought has become a recurrent feature that typically results in a severe reduction in water availability. In the Airport/ Fitches Creek Area, water is supplied by the APUA. The effects of drought are being felt by both residents and business operators. The residents from the Fitches Creek community and resort owners have indicated that the APUA has consequently restricted access to piped water to 2-3 days per week. As such, there is inconsistent access to water. In response, residents in the community have retained their own water storage tanks and purchased trucked water. Since the nature of the airport services are deemed essential, priority is given for water supply.

The Airport/Fitches Creek area has been affected by both coastal and flash flooding in the past. This type of hazard is projected to affect some sections of the local area in the future. Of the two, flash floods occur more frequently and are characterized by either rapid accumulation or runoff of surface water in response to heavy rainfall events.

Airport/Fitches Creek Implementation Plan

Based on the strategic objectives previously defined, there are corresponding cross-cutting outcomes aimed at establishing and managing activities geared towards addressing climate adaptation based on the main climatic hazards affecting the area. The twelve (12) outcomes and associated outputs for the Airport/Fitches Creek LAAP 2023-2033 are summarized below:

Overall LAAP Implementation

It is anticipated that the adaptation measures presented in the LAAP for St. John's City will be implemented or at least initiated during the 2023-2033 period, according to their degree of urgency. However, their implementation will depend on funding, policy and other opportunities opening during this time, as it is expected that opportunities for implementation will be seized as

they arise. Although the plan focuses on a particular local area, given the cross-sectorial nature of the LAAP, it is to be expected that the execution of most of the specific measures may occur because of their inclusion in projects and programmes funded by both national and international sources. The LAAP includes indicative outputs to facilitate the planning and design of such projects and programmes.

The execution of most activities included in the LAAP relies on the assumption that further to national budgetary efforts that are commensurate with national circumstances, the level of international support that Antigua and Barbuda has received for development and for climate change projects and programmes will be maintained and that additional climate finance for adaptation in the sectors will be attracted through entities like the Green Climate Fund (GCF), Adaptation Fund and multilateral and bilateral arrangements. It is also assumed that over time, adaptation will become immersed in all new development projects.

In view of the above considerations, it is in the area's best interest, in the coming years, and to the maximum extent possible, that elements of the LAAP be integrated into the existing and proposed cooperation programmes of Antigua and Barbuda's bilateral and multilateral partners. The LAAP should be shared and discussed with all relevant partner agencies and stakeholders to facilitate awareness raising of its objectives and planned activities and secure high-level buy-in that will enhance opportunities for the inclusion of the priorities in national and sectoral policy and budgets, as appropriate.

3.8. Communications Plan

The National Adaptation Plan (NAP) necessitates the effective implementation of strategic communication practices to foster a comprehensive transformation on both sectoral and national fronts, addressing the challenges posed by climate change adaptation. A seamless integration of strategic communication throughout all phases of the NAP process—Planning, Implementation, and Evaluation—is essential to achieve these overarching objectives.

In the Planning stage, the conduct of a comprehensive scoping exercise assumes critical importance. This exercise serves as a pivotal tool in assessing existing and projected climate conditions, facilitating the identification of potential challenges and opportunities that are integral to formulating effective adaptation strategies.

Transitioning to the Implementation phase, a robust coordination mechanism among all pertinent stakeholders within the sector becomes paramount. Collaboration of this nature is central to the successful execution of the NAP and the realization of its intended objectives.

In the Evaluation phase, the collation of relevant data takes precedence in order to gauge the extent of goal attainment. Valuable insights garnered from the evaluation process subsequently guide informed decisions, facilitating the refinement of adaptation strategies for future endeavours.

The underlying strategy seeks to highlight the pivotal role of strategic communications in support of the NAP's success. The strategic objectives encompass building public awareness of environmental policies, clarifying actionable steps for individual contribution, advocating for a comprehensive governmental approach, highlighting the urgency of adaptation efforts, and enhancing global recognition of the NAP process.

The Communication outreach targets both internal and external audiences. Internally, stakeholders directly involved in sectoral planning and other associated ministries are prioritized, while externally, the focus extends to encompass the public, media, private sector, NGOs, academia, and technical experts. Effective message delivery is done by employing relatable narratives, factsheets, statistics, and memorable phrases to engage a wide spectrum of demographics.

Strategies for communication effectiveness include the development of a recognizable NAP logo and slogan, the utilization of media formats such as animated and live-action videos, the engagement of influential figures as climate ambassadors, and the establishment of a structured dissemination schedule. Public engagement through workshops, consultations, and climate conversations facilitates informed dialogue and corrections of misinformation were also paramount. Moreover, much of the content produced was uploaded on the Department of Environment's webpage and social media platforms for them to be easily accessed and viewed by the public.

Furthermore, the integration of digital engagement through social media platforms ensures broader reach and stakeholder engagement. A comprehensive approach encompasses capacity-building initiatives, such as training programs and scholarships, reinforcing the knowledge and skills required for effective climate change adaptation.

3.9. Incorporation of Climate Change into Development Policies and Strategy (i.e., Mainstreaming Guidelines)

Development Control Authority (DCA)

The physical development process is fundamentally contained and guided by the Physical Planning Act (PPA) 2003. Physical development in Antigua and Barbuda is managed by (i) zoning and (ii) development control for specific activities. The primary agency responsible for the enforcement of provisions under the PPA is the Development Control Authority (DCA).

Zoning

The PPA allows the DCA to engage in a process of developing plans for large areas of land either covering the whole or part of Antigua and Barbuda. Zoning classifies land into groupings which ensures that the general land use follows the most suited development pathway as suggested by

the classification. An important part of this is recognizing the best available scientific and technical knowledge to achieve sustainability. As such, ecosystem function, vulnerability to environmental extremes, historical events, geology, hydrology, customary usage, and prospective for future economic activities all play important roles in developing effective zoning plans.

In 2012, the government of Antigua and Barbuda completed a multi-year process in the development of a national physical development plan with the formal adoption by the Parliament of the Sustainable Island Resource Management Zoning Plan (SIRMZP). Funded through the GEF-sponsored SIRMM project, the SIRMZP specifically, "Vulnerability to external economic shocks and natural environmental events, such as economic recessions and hurricanes, and climate change;" as a major issue which the SIRMZP was intended to address.

Development Control

The Ministry of Housing, Lands, and Urban Renewal is responsible for Physical Planning in Antigua and Barbuda through its agency, the DCA. The DCA enforces control over development, and prepares and enforces development plans and proposals, whereas zoning achieves overall general conformity and suitability of activities within an area, the Development Control Application and Approval process looks at the proposed activity from a more detailed human and environmental health and safety approach.

Climate change is mainstreamed in several ways:

- Implementing and updating of building code
- Establishing Environmental Impact Assessment (EIA) provisions within the PPA and the Environmental Protection and Management Act (EPMA)

Updating the Building Code

Given the latest climate science from the IPCC, the DoE in collaboration with the DCA has reviewed the OECS 2016 code as Antigua and Barbuda building code. The main aim of the revised code is to increase the resilience of the building sector standard in Antigua and Barbuda in keeping with Climate change science and which is underpinned by "Sustainable Development" & Health & Wellness". It incorporates health and wellness dimensions of air quality, sound pollution, lighting & thermal comfort. With respect to sustainable development, the updated code will include standards for designing for Cat5 considerations, energy efficiency, updated water efficiency & storage, coastal setback, SLR, materials, resources inclusions & sustainable site, and zoning recommendation. Noted that with respect to storms, the minimum standard of the code is still for low cat 3, and high cat 4 winds, but it allows for voluntary compliance to higher cat-rated standards because of the economic implications. The code considers droughts and rainwater harvesting.

Formalizing the EIA process

Prior to the passage of the PPA in 2003, there was no legal requirement for an EIA in Antigua and Barbuda.

The preeminent legal guidance addressing the EIA process in Antigua and Barbuda can be found in the PPA 2003. Specifically, Section 23 (1), (2), and Schedule 3 of PPA, 2003 outline those activities that require an EIA. Additionally, the Director of the Department of Environment may also require, in consultation with the Chief Town and Country Planner that any matter that is likely to cause any serious social impact, or harm to the environment or to human health be subject to an environmental impact assessment. Section 23 (1), (2), and Schedule III of the PPA 2003, lists activities and undertakings that require an EIA. All projects undertaken for or on behalf of the DoE are subjected to a screening process, which will signal if an EIA is required.

Within the DoE, the Biodiversity Ecosystem and Protected Areas Management (BEPAM) Unit is primarily responsible for oversight of EIA-related activities. Other Units within the DoE may be required to provide assistance as may be necessary based on needed skill sets.

The inclusion of the SIRMZP, Building Code, and the EIA Process into the Development Control Application and Approval system has allowed climate change to be considered at multiple stages.

Table 16: EIA process and responsible parties.

Development Application Stage	Climate Change Concerns	Responsible Party
Pre-submission of application	Is the area regularly subjected to extreme climate events-flooding, high waves, drought, storms, heat?	Developer
Submission of application	Does it require EIA?	DCA/DoE
EIA Process	Will the proposed development be potentially disruptive to ecosystem services? What in-depth studies to examine climate change risks and propose mitigation measures need to be undertaken?	EIA Consultant, DoE, other relevant agencies
Detailed drawings submitted-Construction	Does it meet building code criteria for human and environmental health and safety? Is it strong enough to withstand storms?	Contractor, DCA EIA Consultant, DOE

The office of the BEPAM Unit works closely with the Office of the Director of Environment and has significant overlaps. This Unit has responsibility for:

1. Environmental Policies and Plans (Part IV of the EPMA 2015)
2. Natural Resources Management (Part VII of the EPMA 2015)
    a. Watersheds and Wetlands
    b. Protected Areas
    c. Wildlife Protection and Trade
3. Access to Genetic Resources and the Sharing of Benefits (Part VIII of the EPMA 2015)
4. Implementation of Biodiversity Projects in Collaboration with the PMU.

In the implementation of these aspects of the legislation the BPAM:

- Reviews DCA plan applications to identify potential environmental risks.
- Responds to requests for environmental advice from other units within the DoE, government agencies, the private sector, Non-Governmental Organizations (NGOs), and the public.
- Receives and responds to environmental complaints and incident concerns.
- Provides recommendations for solving environmental incidents that could be reported to or observed by the staff of the DoE.
- Implements those actions aimed at achieving conservation and management of selected natural resources.

Within the scope of work in the unit, climate change and its impacts have been taken into consideration when reviewing DCA applications and environmental complaints. Screening and Scoping exercises for each application are carried out, as well as applying the Ccoral tool. Aspects such as SLR, Setbacks, Coastal Engineering Studies, protection for mature trees, replanting vegetation if removed, and protection of mangroves and other wetlands are also examined in the review process. The DoE has also been very vocal when it pertains to sand mining and the need to stop such activities. Various developments in Barbuda for example, the unit has received numerous applications along the more vulnerable sandbar and other sensitive areas of the coastline. Susceptible areas prone to flooding and storm surges in Antigua such as Cades Bay, Dickenson's Bay, and McKinnon's Pond, the unit requests the developers disclose the impacts the developments will have on adjacent properties and the financial costs they will incur. However, most of these applications would have been rejected or recommended that alternative sites be chosen considering impacts from climate change including storm surges from hurricanes and flooding from torrential rainfall.

The Terms of Reference (ToR) provided by the unit to produce an Environmental Impact Assessment (EIA) contains a section that requests the developer to note the impacts of climate change. Given the nature of these proposed developments and the sensitive environment in which they are proposed to be located, the investment will likely be exposed to projected impacts of climate change, including, but not limited to increasing rainfall intensity, sea-level rise, decreasing average annual rainfall, and extreme temperatures. To ensure that the development is climate-resilient, potential impacts must be assessed and mitigation measures proposed in the planning and assessment stage. The unit includes the below table within the ToR.

Impact	Brief Description	Risk Significance High/Medium/Low	Mitigation Measures
Extreme rainfall event			
Extreme drought			
Extreme atmospheric temperatures			
Hurricanes			
Sea Level Rise			
Other			

Table 17: Summary of risks associated with climate change impacts and mitigation measures

The unit has also seen applications where developers intend to integrate renewable energy into the power supply. This was commendable and in line with the Greenhouse Gas reduction statements made by the government within its Intended Nationally Determined Contribution to the Paris Climate Change Agreement. It should also be noted that Antigua and Barbuda has participated in the development and has adopted the regional (Renewable Energy) RE Building Code. Further, the government has waived taxes on RE and energy-efficient technologies.

For development and subdivisions along waterways, the unit has included a caveat that encourages the DCA to have the relevant agencies implement protective borderline measures, such as boulders and signage informing developers of the imminent risk of development close to the waterway, as well as climate change impacts and its implication.

Other Agencies who Contribute to the Physical Planning Aspect of Development

NODS- Disaster Planning, Build Back Better, Climate Adaptation closely linked to Disaster mitigation.

Fisheries Division – Marine Protected Areas, Coastal and marine resources

APUA /PWD /CBH -Water courses

Green Barbuda Project

Antigua and Barbuda produced most of its emissions from the electricity sector, specifically the large diesel generators used in the generation process. By removing those generators and putting in renewable energy, as in the case of the Green Barbuda Power Plant, we are going to reduce our emissions a lot.

In 2015, Antigua and Barbuda submitted its first NDC. The target is to phase out 90 percent of fossil fuels in the electricity sector by 203. As a result, therefore, the DoE would need to learn how to conduct and assess fossil fuels when processing development applications. In the end, the DoE

conducted a training field assessment during the period of July 27- 29, 2020, in Barbuda. The aim was to gather as much baseline data, to aid in the preparation of an Environment Impact Statement (EIS) for the project.

This EIS practical field exercise served as a training opportunity, while also achieving **'Output 5.1: Climate Change mainstreamed into the national development process,'** of the 4NC implementation plan. This will also build the DoE's capacity for the inclusion of climate change impacts in the national development process. On completion of the field exercise, and preparation of the EIS, best practices and lessons learned were documented for future EIAs.

Ministry of Finance

The Ministry of Finance (MoF) with the support of the NDC Partnership has engaged a climate finance analyst and an economic advisor. Both consultants have started their work, and their intended deliverables include incorporating the NDCs in the updated Medium Term Development Plan and the Macroeconomic framework. The Consultants were sourced through WRI, and they are funded by the United Kingdom and the World Bank.

Similarly, the MoF is working with respect to Post Disaster Management. The ministry is currently undertaking a project with the World Bank and Canada to improve Post Disaster Procurement and Public Financial Management. The government launched a Climate Resilience Fund in the 2020 budget, however, due to COVID-19 this fund is now scheduled for roll out in 2021.

The budget circular for 2020 and 2021 advised ministries of their need to identify climate risks as part of their budget estimates and planning and the MoF intends to further strengthen this integration in budget management going forward.

CHAPTER 4: FINANCING STRATEGY

4. Financing Strategy

Achieving ambitious adaptation actions requires adequate planning, analysis, and resource mobilization from a wide range of sources. Antigua and Barbuda's NAP financing strategy includes an overview of actions, sources of funding, as well as some key stakeholders in the process. This draws from work previously undertaken by the government and creates synergies with previous efforts to ensure that the NAP builds on a robust and comprehensive framework. This section thus identifies relevant potential sources of finance, different streams of finance, and key stakeholders in the NAP financing process.

Process for Sourcing Funding

In the pursuit of funding for NAP implementation for Antigua and Barbuda, a systematic approach is essential to navigate the climate finance landscape. This section outlines a structured process for sourcing funding, beginning with the critical task of problem prioritization. By identifying and ranking environmental issues based on urgency and impact, stakeholders can lay the foundation for targeted interventions. The subsequent phases delve into the project idea conceptualization, engaging with diverse stakeholders, mapping potential funding sources, and project and proposal development. Together, these steps form a comprehensive guide for the process entailing securing access to climate finance for NAP implementation.

Problem Prioritization

This initial step involves identifying and prioritizing climate-related challenges that need to be addressed. It entails analysing the urgency, severity, and impact of these issues within a specific context or region, laying the groundwork for potential projects to tackle these problems. This step involves identifying prioritization criteria and corresponding indicators to capture the degree of strategic alignment with broader goals, feasibility of implementation, and outcomes of the activity. Problem prioritization is a key step that is essential to the appropriate channelling of finance and resources into projects and activities that have the greatest adaptation potential in alignment with the NAP's priorities.

Project Idea Conceptualization

During this stage, the project features, objectives, goals, and expectations that are set to determine what the focus of the project will be, and basic information on the potential barriers and requirements for implementing the project are compiled. Here, brainstorming and developing innovative project ideas are required to adequately map the identified problems to their appropriate and viable solutions. It is also important for this stage to identify potential barriers, gaps and challenges that might arise during the project that will need addressing, including within institutional or financing arrangements.

4.1. Stakeholder Engagement

Engaging with various stakeholders such as local communities, NGOs, government agencies, and experts become crucial. This step involves garnering support, gathering insights, and involving key stakeholders in the project's design and development, ensuring a more comprehensive and inclusive approach. Stakeholder engagement is essential to improve data sharing for project criteria and indicators, as well as to increase buy-in in the project pipeline.

Additionally, the Government of Antigua and Barbuda (GoAB) and the DOE have worked extensively with various policy planning support agencies that can also be considered key stakeholders for broader engagement in the NAP process. These agencies include the NDC Partnership, NAP Global Network, CCCCC, CDB, and Commonwealth Climate Finance. The Santiago Network on Loss and Damage can additionally provide technical assistance where appropriate.

Mapping of potential funding sources

Conducting research and mapping potential funding sources follows, involving identifying and assessing various funding options available — including public funds, private investors, grants, and specialized climate finance institutions that align with the project's objectives. This step enables the identification of potential sources of funding available, which will also further determine the proposal development phase of the project. In previous work undertaken to advance access to climate finance, implement NDCs, build capacity, and enhance institutional arrangements for climate in the country, the DOE has received funding from and partnered with various multilateral climate financing agencies, many of which have provided varied types of funding over the years. Some of these key funding sources are the Green Climate Fund (GCF), Adaptation Fund (AF), Global Environment Fund (GEF) and GEF Small Grants Programme (SGP), Climate Technology Centre and Network (CTCN), and the Caribbean Catastrophe Risk Insurance Facility (CCRIF).

Project and proposal development

Project and proposal development is the process of translating NAP priorities and investment needs into specific projects that are ready for financing and implementation. Using the identified priorities and matched potential source of funding from the previous steps, projects move from the idea stage to the proposal stage such that they can be submitted to the identified funder for implementation. The following requirements will likely be necessary when submitting a concept note or funding proposal to various funding sources:

- Due diligence
- Feasibility studies
- Environmental impact assessments or compliance with environmental safeguards
- Project budget and financing costs
- Economic or financial analysis, including cost-benefit analysis.
- Other funder-specific requirements

4.2. Sustainable Financing Mechanisms

The GoAB has a multi-faceted approach to secure funding and address pressing environmental challenges. This section provides an overview of some of these financing mechanisms to illustrate innovative climate financing mechanisms that already exist and could potentially support the NAP process.

Sustainable Island Resource Framework (SIRF) Fund

The GoAB has established the Sustainable Island Resource Framework Fund (SIRF Fund) as the central conduit for receiving environmental, climate mitigation, and adaptation financing from both international and domestic sources. The SIRF Fund was created as a Special Fund in accordance with the Finance Administration Act (2006).

The SIRF Fund has the responsibility of facilitating funding access for the public sector, private sector, as well as non-governmental and community organizations within Antigua and Barbuda. Additionally, it has the capacity to assist in environmental management efforts across various islands within the Organization of Eastern Caribbean States (OECS). Income to the SIRF Fund is derived from a combination of domestic and international channels. Domestically, this includes revenue generated from Green Card Park visitation fees, pollution charges, carbon credits, taxes, levies, and any other fees specified by regulations. On the international front, the SIRF Fund functions as an executing body and a sustainable financing mechanism for bilateral and multilateral funding sources allocated for the objectives outlined in the Environmental Protection and Management Act (2019).

The SIRF Fund continues to represent an opportunity for the Government and people of Antigua and Barbuda to attract substantial financing to support green growth, the Nationally Determined Contributions (NDCs) targets and an overall sustainable development agenda for the country.

Debt for Climate Swaps

Despite achieving high per capita income and robust growth rates in 2019, Antigua and Barbuda's economy still maintains a relatively modest scale, marked by persistently elevated levels of public debt. While recent economic growth, diligent efforts at debt restructuring, and fiscal reforms have yielded some success in lessening the weight of public debt, the country faces significant challenges in servicing these debts. This challenge primarily arises from the escalating financial and economic toll of climate change, which has placed substantial constraints on the nation's fiscal capacity.

To break free from this challenging financial situation, the GoAB has initiated discussions with both the GCF and their creditors who are part of the Paris Club. The objective is to establish a trilateral arrangement known as a Debt for Climate Swap. In this innovative arrangement, the GCF would provide financial support or partial financing to facilitate the repurposing of Antigua and Barbuda's

substantial debt, totalling around US$147 million. This redirected capital would be channelled into domestic initiatives focused on climate change projects within the country.

GCF Readiness Programmes

Antigua and Barbuda have harnessed the GCF Readiness Preparatory Support Programme to enhance its institutional and technical capabilities for securing and leveraging climate finance. A notable initiative is the introduction of the Multiyear Readiness (MYR) project, aimed at advancing the implementation of key concept notes that were earlier identified in the country's GCF country programme.

Insurance prospective for farmers and fishers

The likelihood of agricultural losses in Antigua and Barbuda is on the rise because of climate change, particularly concerning factors like droughts and strong winds. While farmers and fishers are implementing specific measures to mitigate these risks, there is a pressing need to improve and formalize the entire risk management system. A comprehensive approach to risk management should address the vulnerability of farmers and fishers to climate change impacts in Antigua and Barbuda.

A study was conducted by the United Nations Development Program (UNDP) in collaboration with the Department of Environment (DOE) to report on the Insurance prospective for farmers and fishers in Antigua and Barbuda. One of the major findings in this study was that the agricultural insurance that would cover the production losses of farmers and fishers is not present yet in the country but is highly needed as a risk transfer instrument in the face of climate change.

Subsequently, recommendations made by the UNDP included that Insurance companies join their efforts with the government in financial education of fishers and farmers: explaining which insurance products are already available and in which cases they bring the benefits.

Additionally, two possible insurance types were suggested for Antigua and Barbuda – indemnity insurance and/or parametric insurance. Indemnity insurance can provide the coverage for all risk categories (climatic and man-made), whereas parametric insurance would only cover measurable climatic risks.

All in all, further assessments along with these recommendations will help in insurance product development moving forward for the agricultural sector as well as other sectors that are highly impacted by climate change.

4.3. Key National Stakeholders

Antigua and Barbuda collaborate with various local, regional, and international partners to address issues around climate change, disaster management, trade, and economic development.

The country has persistently leveraged technical support from a diverse range of partners, resulting in the reinforcement of essential institutional, policy, and regulatory structures, and the enhancement of capabilities to facilitate better access to climate finance.

Accreditation of the NDA

The country through its National Designated Authority (NDA), is accredited to the GCF and the AF. This accreditation allowed the country to propose and implement adaptation projects that address climate change impacts. The NDA serves as the country's official contact point with the GCF and AF to facilitate the submission and approval of funding proposals. Funding through the country's NDA can also be accessed from the GEF to support projects and initiatives aimed at addressing global environmental challenges, including biodiversity conservation, climate change, and land degradation.

Accreditation to these international finance mechanisms is a significant step for Antigua and Barbuda in securing the necessary resources to address climate change and environmental challenges. It allows the government to access funding, technical expertise, and capacity-building support to implement projects and programmes that support climate resilience and sustainability goals.

Private Sector

Many private sector organizations, particularly small and medium-sized enterprises (SMEs), face difficulties in accessing affordable financing for climate projects. Banks and financial institutions may be reluctant to provide loans or capital for projects perceived as high-risk or unfamiliar. However, financing through the SIRF Fund is available to the private sector in the form of grants, loans, and equity.

SIRF Fund Revolving Loan Programme

The SIRF Fund Revolving Loan Programme (RLP) in Antigua and Barbuda has made significant progress in enhancing climate change resilience for households and private businesses. The RLP provides low-cost loans for households and businesses to adapt to climate change impacts. The programme offers a wide range of adaptation measures to include hurricane shutters, roof reinforcement, water harvesting systems, energy efficient appliances, renewable energy systems and vector control measures.

SIRF Fund Blended Finance Programme for SMEs

Funds from the GEF has enabled the SIRF Fund to initiate a blended finance programme as part of the PATH to 2020 Project. This pioneering programme combines various financial instruments,

including grant-based technical assistance, loans, and equity investments. Specifically, it incorporates equity investments to inject capital into renewable energy (RE) and climate-smart technology businesses. This novel approach will contribute to a more resilient and sustainable future for SMEs. This ground-breaking initiative seeks to revolutionize the financial landscape in Antigua and Barbuda by piloting support systems for sustainable livelihoods. The programme aims to establish innovative financial mechanisms that open new opportunities for residents to pursue viable livelihoods while discouraging environmentally harmful practices.

4.4. NAP Synergies with NDC Implementation

Especially given the Antigua and Barbuda's NDC and NDC Implementation Plan distinctively identify the importance of adaptation as well as key adaptation priorities, ensuring that the NAP complements NDC implementation is crucial for fostering effective and coherent climate action. The NAP and NDC together are integral components of the country's strategy to address climate change, and ensuring synergies between the two allows for integrated planning, streamlined resilience-building and efficient resource allocation. This section highlights significant existing and potential future opportunities for NAP-NDC synergies.

NDC Financing Strategy

The GoAB, continuing in its collaborations with the NDC Partnership, has developed a NDC Financing Strategy. The Strategy reviews the country's capacity to access climate finance, clarify roles of key institutions, and establish approaches to key actions including stakeholder engagement and finance monitoring system. The strategy also explores investment needs for achieving the NDC, identifies gaps and explores a prioritisation process to secure investments. Finally, the Strategy determines barriers to financing climate action, potential policy interventions to overcome them, and identifies potential sources of finance and a pipeline of climate investments to achieve Antigua and Barbuda's NDC.

Given the country's focus on both mitigation and adaptation in the NDC, the Strategy follows suit to explore opportunities for adaptation investments. Water, AFOLU, Buildings and Infrastructure, Just Transition, Gender, Children and Youth, Finance and Regional Engagement are all identified as key sectors for adaptation actions within the NDC. The total amount of financing required to implement the adaptation specific NDC measures was estimated at USD 469.9 million, with a current financing gap of USD332 million that still needs to be procured for the full implementation of the adaptation targets. The Strategy includes a prioritization of adaptation outputs based on timeline, financing gap, impact potential and alignment with national priorities, as well as provides matching sources of finance for the adaptation outputs. Altogether, the NDC Financing Strategy, given its overlap in adaptation focus with the NAP, creates an opportunity for effective mobilisation of resources.

Private Sector Engagement Strategy for NDC

Antigua and Barbuda's Private Sector Engagement Strategy establishes a systematic approach for the public sector to collaborate with private sector entities to align action and mobilise resources to achieve the country's NDC targets and commitments. The strategy focuses on supporting country efforts to reduce emissions to support the NDC implementation, while facilitating a clean energy and sustainable transition. Private sector engagement is a key element to achieving the country's NDC due to the private sector's contribution by adopting greener policies and practices and undertaking the transformation towards a more sustainable and circular supply chain. The strategy lays out a four-phased approach to ensure meaningful and effective collaboration and progress.

Phase 1 establishes the initiation of engagement to lay a foundation for long-lasting collaboration through the entire implementation process. This is followed by **Phase 2** on providing stakeholders with necessary information to make informed decisions. **Phase 3** involves the formalization of engagement and decision-making of collaboration mechanisms into institutional structures. Finally, **Phase 4** establishes an iterative process to the strategy to reflect feedback, reflections, and revisions to the process to ensure that the strategy evolves with changes in the NDC implementation landscape. This entire strategy is important to the NAP process given how NDC implementation also includes adaptation priorities and objectives. The PSES similarly can also be adopted for NAP implementation with revisions made where necessary for appropriate stakeholder engagement and institutional arrangements. Given the goal of the PSES is to leverage and enhance public-private collaboration, engagement and resources, there are many synergies that can be optimized within NDC and NAP implementation using this strategy.

4.5. NAP Costs and Prioritisation

The NAP includes a set of complementary Sectoral and Local Adaptation Plans (SAPs and LAPs, respectively), which outline a series of additional activities, outcomes and objectives aimed at improving the adaptability and resilience of the country. For the SAPs and LAPs, a preliminary costing exercise was conducted to provide initial guidance on the amount of finance required to implement the activities outlined in the SAPs and LAPs as outlined below:

- Sectoral Adaptation Plans:
    1. Wholesale and Retail
    2. Infrastructure and Housing
    3. Food Security
    4. Tourism
- Culture and Historical Sites Local Adaptation Plans
    1. St. Johns City Local Area Adaptation Plan 2023-2033
    2. Jolly Harbour to Johnsons Point Local Area Adaptation Plan 2023-2033
    3. Airport/Fitches Creek Local Area Adaptation Plan 2023-2033

After costing the SAPs and LAPs, a prioritization exercise with the same methodology as the one used for the development of the NDC Financing Strategy and Action Plan was conducted.

Costing for the NAP complimentary SAPs and LAPs

Table 18 shows the total number of activities per output and the estimated costs from the sectoral and local adaptation plan outputs considered in the costing exercise. The estimated total amount for the implementation of the five (5) SAPs and three (3) LAPs is USD 500 million.

However, it should be noted that these are just preliminary costs, and a detailed cost analysis would be performed before implementing any of the SAPs or LAPs. Additionally, some of the costs from the SAPs or LAPs might have already been identified in the NDC Financing Strategy and Action Plan, taking as basis the NDC implementation Plan 2021-2030, but it falls outside the scope of this costing exercise to determine the amount of financing already procured for the SAPs and LAPs, or even if some of the activities have already been implemented as part of the climate finance support received to date for A&B.

Table 18: Costing Estimates for SAPs and LAPs (in USD million)

Thematic Area	Output	No. of Activities	Est. Cost (USD million)
Wholesale and Retail SAP	WR.1 Physical Adaptation and Policy Planning for Wholesale & Retail	6	31.3
	WR.2 Climate-proofing Wholesale & Retail Buildings	8	24.0
	WR.3 Financing and Financial Instruments for Adaptation	8	1.4
	WR.4 Training, Capacity Building and Knowledge Transfer for Climate Adaptation and Business Continuity Planning	8	6.8
Infrastructure and Housing SAP	IH.1 Housing adaptation measures: To enhance the resilience of housing assets, homeowners, and the services that they depend on (e.g., water, electricity) to hurricanes, flooding, and drought.	14	95.5
	IH.2 Roads adaptation measures: To ensure that roads and drainage systems can withstand future impacts associated with flooding, hurricanes, extreme heat, and SLR	8	1.3
	IH.3 Wastewater adaptation measures: Protect public health and the environment by ensuring	7	56.6

Thematic Area	Output	No. of Activities	Est. Cost (USD million)
	adequate wastewater treatment and disposal systems that can withstand future flood impacts.		
	IH.4 Energy adaptation measures: To enhance the resilience of Antigua and Barbuda's domestic energy supply to hurricane events, droughts, flooding, and rising temperatures.	4	4.1
Food Security SAP	FD.1 Enabling environment strengthened to support local food production through legislation and plans.	6	2.2
	FD.2 Governmental and civil coordination mechanisms enhanced.	4	2.4
	FD.3 Climate and food system data collection and research supported to inform the agricultural and fisheries sectors	1	0.2
	FD.4 Innovative technologies and practices mainstreamed to promote the climate-resilience of the fisheries sector.	4	9.5
	FD.5 Innovative technologies and practices mainstreamed to promote the climate-resilience of the agricultural sector.	9	19.2
	FD.6 Private investment and Public-Private Partnerships (PPPs) promoted to encourage the sustainability of climate-resilient interventions.	4	14.7
	FD.7 Training and awareness-raising facilitated to promote local production.	5	1.1
	FD.8 Funding mechanisms mobilized to finance food security resilience interventions.	3	3.9
Tourism SAP	T.1 Implementation of climate-resilient measures in response to a changing climate enhanced	12	16.9
	T.2 Strengthened Partnerships for Resilience Building in the Tourism Sector	4	1.1
	T.3 Evidence-based decision-making enhanced through innovation	12	16.8
	T.4 Sustainable financing mechanism for resilience building in the tourism sector established and resourced.	8	3.5
	T.5 Enabling environment to support disaster risk management and climate change adaptation strengthened	9	2.2

Thematic Area	Output	No. of Activities	Est. Cost (USD million)
Culture SAP	C.1 Cultural Heritage and Historical Sites Sectoral Adaptation Plan	13	9.0
St. John LAP	LAPSJ.1 Improved protection from wind damage and impacts from storm surges along the St. John's Harbour through the implementation of offshore and nearshore protective infrastructure.	3	0.7
	LAPSJ.2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion.	3	1.2
	LAPSJ.3 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges.	7	14.3
	LAPSJ.4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses	3	0.8
	LAPSJ.5 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding	21	48.2
	LAPSJ.6 Improved solid waste management practices within at-risk communities	3	0.6
	LAPSJ.7 Expanded water storage capacity	11	19.6
	LAPSJ.8 Increased uptake of renewable energy technologies by businesses and households	7	1.4
	LAPSJ.9 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	11	16.4
	LAPSJ.10 Established enabling environment for the expansion of and investment in the Blue Economy Sector in St. John City	4	0.8
Jolly Harbour LAP	LAPJH1 Improved protection from wind damage and impacts from storm surges through the implementation of offshore and nearshore protective infrastructure.	3	2.0
	LAPJH.2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion.	7	1.0
	LAPJH.3 Improved critical infrastructure and buildings with reduced susceptibility to impacts	7	1.0

Thematic Area	Output	No. of Activities	Est. Cost (USD million)
	from hurricanes and storm surges in coastal communities such as Jolly Harbour, Bolans and Johnson's Point.		
	LAPJH.4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses	3	0.4
	LAPJH.5 Increased capacity of drainage infrastructure within Jolly Harbour, and along Valley Road to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding	6	0.8
	LAPJH.6 Improved solid waste management practices within at-risk communities in Jolly Harbour, Bolands, Jennings, and Johnsons Point.	3	0.4
	LAPJH.7 Expanded water storage capacity	9	1.2
	LAPJB.8 Increased uptake of drought risk insurance schemes by local farmers	2	0.5
	LAPJH.9 Increased uptake of renewable energy and climate-smart technologies by businesses and households in the Jolly Harbour to Johnsons Point area.	5	1.2
	LAPJH.10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	8	7.8
	LAPJH.11 Established enabling environment for the expansion of and investment in the Blue Economy Sector in the Jolly Harbour to Johnsons Point Area	4	0.6
Airport/Fitches Creek LAP	LAPAF.1 Improved protection from wind damage and impacts from storm surges through ecosystem maintenance and the implementation of offshore and nearshore protective infrastructure	8	14.2
	LAPAF.2 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges.	8	1.0
	LAPAF.3 Reduced interruption of essential services through alternative energy and water supply	5	1.0

Thematic Area	Output	No. of Activities	Est. Cost (USD million)
	LAPAF.4 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce incidence of localized flooding	7	1.0
	LAPAF.5 Increased capacity to handle extreme precipitation events through nature-based solutions	2	0.3
	LAPAF.6 Improved solid waste management practices within at-risk communities	2	0.3
	LAPAF.7 Expanded water storage capacity	5	5.7
	LAPAF.8 Reduced damage to coastal critical infrastructure	2	13.3
	LAPAF.9 Increased uptake of renewable energy technologies by small businesses and households	2	0.6
	LAPAF.10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	5	13.6
	LAPAF.11 Decreased building damage and losses from rising sea levels	4	0.7
	LAPAF.12 Established enabling environment for the expansion of and investment in the Blue Economy Sector	4	1.2
	Total	341	497.3

4.6. NAP Prioritization of SAPs and LAPs

The methodology prioritizing the outputs is based on four criteria (implementation timeline, financing amount, impact potential, and alignment with national priorities). To reflect the importance of each indicator, outputs are first prioritized or filtered based on their timing for implementation, then the financing gap, then their impact potential and finally, their alignment with national priorities.

The evaluation criteria are as follows:

1) Timeline: The outputs are evaluated based on the number of years needed for their implementation from all their individual activities or measures and based on the earliest start date and the latest end date for each output based on the best available estimates. This defines a time window during which each output needs to be executed. Longer timelines rank higher in the list, while shorter timelines rank lower. For example, if an output has a timeline of five

years versus a seven-year output, the one with the longest timeline is chosen first, then the one with the shortest timeline.

2) Financing gap: For this criterion, the outputs are evaluated against the estimated amount of financing needed in USD million.
3) Impact potential: The outputs are assessed based on their potential to make a significant contribution to a share of the total A&B population using the number of potential beneficiaries. Outputs with higher impact potential receive higher scores, and those with limited impact get lower scores.
4) Alignment with National Priorities: The outputs are analysed to determine how well they align with the country's strategic objectives and priorities; the score can range from one (1) to five (4) with four being the highest alignment with national priorities. Outputs that closely align with national goals receive higher scores, while those that are less relevant get lower scores.

Once the evaluations are complete, the final list of prioritized outputs is created based on the results from the different evaluation criteria scores and using the custom sorting function built in Microsoft Excel.

Table 19 shows the ranking for all the fifty-five (55) outputs from the SAPs and LAPs and based on the four criteria as explained above. The top three outputs based on the prioritization are:

1. IH.1 Housing adaptation measures: To enhance the resilience of housing assets, homeowners, and the services that they depend on (e.g., water, electricity) to hurricanes, flooding, and drought.
2. IH.4 Energy adaptation measures: To enhance the resilience of Antigua and Barbuda's domestic energy supply to hurricane events, droughts, flooding, and rising temperatures.
3. FD.5 Innovative technologies and practices mainstreamed to promote the climate-resilience of the agricultural sector.

Table 19: SAPs and LAPs Prioritization of Outputs

Thematic Area	Output	Priority Rank
Wholesale and Retail SAP	WR.1 Physical Adaptation and Policy Planning for Wholesale & Retail	9
	WR.2 Climate-proofing Wholesale & Retail Buildings	47
	WR.3 Financing and Financial Instruments for Adaptation	45
	WR.4 Training, Capacity Building and Knowledge Transfer for Climate Adaptation and Business Continuity Planning	52
Infrastructure and Housing SAP	IH.1 Housing adaptation measures: To enhance the resilience of housing assets, homeowners, and the services that they depend on (e.g., water, electricity) to hurricanes, flooding, and drought.	1
	IH.2 Roads adaptation measures: To ensure that roads and drainage systems can withstand future impacts associated with flooding, hurricanes, extreme heat, and SLR	55

Thematic Area	Output	Priority Rank
	IH.3 Wastewater adaptation measures: Protect public health and the environment by ensuring adequate wastewater treatment and disposal systems that can withstand future flood impacts.	7
	IH.4 Energy adaptation measures: To enhance the resilience of Antigua and Barbuda's domestic energy supply to hurricane events, droughts, flooding, and rising temperatures.	2
Food Security SAP	FD.1 Enabling environment strengthened to support local food production through legislation and plans.	54
	FD.2 Governmental and civil coordination mechanisms enhanced.	5
	FD.3 Climate and food system data collection and research supported to inform the agricultural and fisheries sectors	44
	FD.4 Innovative technologies and practices mainstreamed to promote the climate-resilience of the fisheries sector.	4
	FD.5 Innovative technologies and practices mainstreamed to promote the climate-resilience of the agricultural sector.	3
	FD.6 Private investment and Public-Private Partnerships (PPPs) promoted to encourage the sustainability of climate-resilient interventions.	46
	FD.7 Training and awareness-raising facilitated to promote local production.	6
	FD.8 Funding mechanisms mobilized to finance food security resilience interventions.	53
Tourism SAP	T.1 Implementation of climate-resilient measures in response to a changing climate enhanced	11
	T.2 Strengthened Partnerships for Resilience Building in the Tourism Sector	50
	T.3 Evidence-based decision-making enhanced through innovation	48
	T.4 Sustainable financing mechanism for resilience building in the tourism sector established and resourced.	49
	T.5 Enabling environment to support disaster risk management and climate change adaptation strengthened	51
Culture SAP	C.1 Cultural Heritage and Historical Sites Sectoral Adaptation Plan	17
St. John LAP	LAPS.1 Improved protection from wind damage and impacts from storm surges along the St. John's Harbour through the implementation of offshore and nearshore protective infrastructure.	35

Thematic Area	Output	Priority Rank
	LAPS.2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion.	23
	LAPS.3 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges.	13
	LAPS.4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses	33
	LAPS.5 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding	8
	LAPS.6 Improved solid waste management practices within at-risk communities	35
	LAPS.7 Expanded water storage capacity	10
	LAPS.8 Increased uptake of renewable energy technologies by businesses and households	21
	LAPS.9 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	12
	LAPS.10 Established enabling environment for the expansion of and investment in the Blue Economy Sector in St. John City	32
Jolly Harbour LAP	LAPJB.1 Improved protection from wind damage and impacts from storm surges through the implementation of offshore and nearshore protective infrastructure.	20
	LAPJB.2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion.	30
	LAPJB.3 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges in coastal communities such as Jolly Harbour, Bolans and Johnson's Point.	28
	LAPJB.4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses	40
	LAPJB.5 Increased capacity of drainage infrastructure within Jolly Harbour, and along Valley Road to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding	31
	LAPJB.6 Improved solid waste management practices within at-risk communities in Jolly Harbour, Bolands, Jennings, and Johnsons Point.	41
	LAPJB.7 Expanded water storage capacity	22

Thematic Area	Output	Priority Rank
	LAPJB.8 Increased uptake of drought risk insurance schemes by local farmers	39
	LAPJB.9 Increased uptake of renewable energy and climate-smart technologies by businesses and households in the Jolly Harbour to Johnsons Point area.	24
	LAPJB.10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	18
	LAPJB.11 Established enabling environment for the expansion of and investment in the Blue Economy Sector in the Jolly Harbour to Johnsons Point Area	38
Airport/Fitches Creek LAP	LAPAF.1 Improved protection from wind damage and impacts from storm surges through ecosystem maintenance and the implementation of offshore and nearshore protective infrastructure	14
	LAPAF.2 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges.	26
	LAPAF.3 Reduced interruption of essential services through alternative energy and water supply	27
	LAPAF.4 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce incidence of localized flooding	29
	LAPAF.5 Increased capacity to handle extreme precipitation events through nature-based solutions	43
	LAPAF.6 Improved solid waste management practices within at-risk communities	42
	LAPAF.7 Expanded water storage capacity	19
	LAPAF.8 Reduced damage to coastal critical infrastructure	16
	LAPAF.9 Increased uptake of renewable energy technologies by small businesses and households	37
	LAPAF.10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels	15
	LAPAF.11 Decreased building damage and losses from rising sea levels	34
	LAPAF.12 Established enabling environment for the expansion of and investment in the Blue Economy Sector	25

CHAPTER 5: MONITORING, EVALUATION AND LEARNING FOR ADAPTATION

5. Overview of Monitoring & Evaluation

The NAP's Monitoring, Evaluation, Learning (MEL) Framework takes into consideration the individual adaptation actions prioritized through the NAP preparation process and is based on the NAP technical guidelines:[31]

1. Monitoring of adaptation actions in Antigua and Barbuda,
2. Reviewing the NAP process to assess progress, effectiveness, and gaps,
3. Iteratively updating the national adaptation plan,
4. Promoting outreach on the NAP process, and
5. Reporting on progress and effectiveness

The MEL Framework incorporates the process of collecting, analysing, and using data for the purpose of measuring whether adaptation actions are being implemented according to plan (monitoring). Monitoring of adaptation is an ongoing process of collecting data and documenting information to determine progress made against stated plans. Monitoring should reveal whether activities lead to the achievement of outputs and planned targets. Monitoring is, therefore, useful for identifying issues during implementation to provide feedback needed by decision-makers. It looks at measurable changes linked to inputs, processes, and outputs. The processes of review, assessment, and learning is key to monitoring.

The Framework links the monitoring process with that of evaluation. Evaluation of adaptation should further assess the management and impact of adaptation actions to determine if they are having the desired results. The Framework promotes reporting of findings to multiple stakeholders. To uphold the principles of transparency and accountability, it promotes the sharing of lessons, knowledge, and best practices (learning) for continuous improvement of adaptation efforts. Learning will be generated from implementation experiences and inform decision-making, ongoing adaptation, and future planning efforts.

Monitoring and evaluation are distinguished mainly in terms of their purpose, the time periods when they are done, why they are done, what they measure and who is involved. Monitoring is conducted continuously to gather information on implementation status at a given time, or over time. It involves identifying data needs, collecting, and analysing data, and using that data in relation to activities, processes, outputs, and progress towards meeting outcomes. Based on the information gathered, the results are used for decision-making, to solve implementation problems and to make corrective changes.

Contrastingly, the focus of evaluation is on assessing design of policies, strategies, plans and interventions; as well as the implementation process, outputs, outcomes, and impacts achieved. At its core, evaluation provides insight on what works well, what has not worked, what needs to change, and gives structured insight into the overall performance. Evaluation provides needed evidence to allow for corrective actions to be taken when needed. Both processes, however, do allow for the modification of existing plans based on lessons learned.

[31] https://unfccc.int/files/adaptation/cancun_adaptation_framework/application/pdf/naptechguidelines_eng_high__res.pdf

5.1. National Adaptation Plan Monitoring, Evaluation and Learning Framework

Antigua and Barbuda has in place a Nationally Determined Contributions (NDC) Implementation Plan with identified adaptation indicators and a Monitoring, Reporting and Verification (MRV) System for assessing climate adaptation actions and interventions. This presented an opportunity to align the Monitoring, Evaluation, Learning (MEL) Framework for the NAP with the adaptation actions and indicators of the NDC Implementation Plan and the MRV System as well as the climate relevant indicators listed in Antigua and Barbuda's 2021 Voluntary National Review (VNR) for the Sustainable Development Goals (SDGs). This effort will support building adaptive capacity and resilience as well as integrating climate change into national policies, strategies, and planning.

The objectives of the NAP MEL Framework are to:

i. measure the effectiveness of adaptation policies, plans, and interventions in a changing climate,
ii. identify how adaptation interventions reduce vulnerability and improve Antigua and Barbuda' ability to prepare and respond to climate change at the national, sectoral, and local levels,
iii. Generate knowledge, lessons, and best practices to inform future policy making,
iv. Enable the integration of MEL into national, sectoral, and local adaptation planning processes, and
v. Fulfil reporting obligations of the Government of Antigua and Barbuda in line with international reporting commitment and processes, particularly Nationally Determined Contributions, National Communications, Adaptation Communications, Biennial Transparency Reports and Sustainable Development Goals (SDGs).

Institutional Arrangements

The DOE is primarily responsible for coordinating the implementation of the National Adaptation Plan. The DOE is an accredited National Implementing Entity to the Adaptation Fund (AF) and a direct access Accredited Entity (AE) to the Global Environment Facility (GEF), and therefore is in a position to coordinate the implementation of multilateral environmental agreements (MEAs) in the country as well as climate finance. These agreements pertain to inter alia climate change, biodiversity, and land degradation. Antigua and Barbuda's context as a small island developing state (SIDS) necessitates streamlining of its institutional structures. The government, therefore, aims to strategically build capacity for MEAs in one agency (i.e., the DoE) to provide enhanced accountability and coordination across all agencies and stakeholders.

In accordance with its mandate, the DOE coordinates multistakeholder technical and oversight committees. A key coordination committee is the country's Technical Advisory Committee (TAC). The TAC currently consists of over 15 members from Government, as well as NGO and private sector representatives. The Project Management Committee (PMC) is a high-level oversight

committee based within the DOE that is appointed by the Cabinet of Antigua and Barbuda. This committee was primarily established to provide financial, policy and administrative oversight. The PMC facilitates interagency coordination and monitoring of national-level activities. This management structure has a long-lasting impact on the institutionalization of the national climate change adaptation and mitigation process as well as building capacity. The DOE's Project Management Unit (PMU) and the Monitoring Evaluation and Data Management unit (DMU) also have critical roles to play in tracking and assessing adaptation progress.

Various government ministries and agencies also have responsibility for the implementation and monitoring and evaluation of the NAP within their respective ministries and agencies and in the context of national development.

- Antigua and Barbuda's **Ministry of Finance** (MOF) also serve as the National Designated Authority (NDA) to the Green Climate Fund, while the DOE serves as a co-signatory for the GCF's No-Objection Procedure. The MOF is responsible for: (i) verifying whether adaptation policies and proposed actions are aligned to national priorities, (ii) identifying potential financial risks associated with climate change projects; ii) designing financial risk assessment criteria; and iii) ensuring that climate change projects progressing to the implementation phase are approved according to the specified criteria and that the relevant consultations have been undertaken.

- The **Ministry of Foreign Affairs** chairs the National Coordinating Mechanism (NCM), which provides a forum for the political coordination of the country's engagement with multilateral funds. Antigua and Barbuda's Ambassador for Climate Change presents annual reports on both past and future engagements to the Minister of Foreign Affairs.

- The Government's main institutional mechanism for overseeing the implementation of the 2030 Agenda is the **Ministry of Foreign Affairs**. Additionally, all government ministries and agencies are responsible for the alignment of government policies and key programmes with the global agenda to facilitate not only implementation but also more effective monitoring and evaluation.

- The **Statistics Division**, as the country's National Statistics Office is the agency responsible for the compilation of Official Statistics, which some of the SDG indicators fall under. As repository of official statistics, the Division plays a vital role in the coordination and generation of these statistics in accordance with international standards that govern official statistics and guidelines for the compilation of SDG indicators. Currently, the country's Statistical Office is leading the process of creating mechanisms for data mining for the SDG indicators deemed applicable to the country's monitoring and evaluation framework for SDG implementation.

- Cabinet established a **national SDG Committee** whose membership is representative of the three pillars of sustainable development and is chaired by the Director of International

Trade who in turn reports to a Cabinet Subcommittee on the Sustainable Development Goals which is chaired by the Minister of Foreign Affairs. The Committee guides Antigua and Barbuda's advancement of the SDGs. The SDG Committee has also been tasked with developing and implementing a comprehensive communications and stakeholder engagement strategy for advancing a more inclusive and participatory pathway to the nation's development.

This institutional structure will support the MEL system in monitoring and assessing national and sectoral climate change adaptation actions in a more strategic way. The NAP prioritizes monitoring at the national and sectoral level. Its design is based on identifying the priority adaptation actions from within the produced adaptation plans and selection of indicators. These indicators are linked to the six priority NAP sectors. The identified adaptation indicators and associated actions will be useful for:

- Assessing impacts, vulnerability, risks, and resilience (people, communities, sector, infrastructure, among others)
- Assessing adaptation policy and strategic frameworks
- Informing the design for adaptation interventions
- Assessing maladaptation and bad practices
- Informing decision-making and future adaptation policies and plans
- Mainstreaming adaptation planning in development processes
- Tracking adaptation achievements
- Communicating adaptation progress
- Informing international climate change negotiations
- Monitoring and evaluating funding for adaptation funding.

5.2. Norms and Standards of the NAP M&E System

The NAP MEL System is designed to meet the following norms and standards:

1. **Transparency and Accountability**—Improve responsiveness and reporting on progress and/or results to multiple stakeholders, including but not limited to other public sector agencies, citizens, the private sector, non-governmental organizations, civil society, partner organizations, donors, and beneficiaries of interventions.

2. **Track and Improve Performance**— Tracking progress in adaptation planning against plans and recommend actions to improve performance for the effective delivery of results. Performance information is key to learning if country policies, strategies and actions are on track or at risk; investigate the reasons why performance has lagged and to explain the causes of any deviation during implementation.

3. **Learning**—contribute to learning at multi-levels through the sharing of lessons learned, best practices and knowledge. Lessons learnt on what works and what does not work can be valuable. Feeding information back into national systems and agencies and to the

adaptation cycle to avert mistakes and identify successful strategies for replication. These lessons can inform decisions on operations, policy, or strategy.

4. **Communication**—promote effective communication among different stakeholders thus facilitating a better understanding of the project design, implementation, and challenges. The data and information gained from M&E provides evidence to demonstrate results reporting that highlights achievements on various levels. Information and analysis of findings are useful for ploughing information back into regular planning, scaling up of interventions, resource allocation, and budgeting.

5. **Empowerment of Stakeholders**— A strong participatory approach for adaptation helps to develop and strengthen the MEL system. It also enhances capacity of stakeholders and oversight processes. Article 7.5 of the Paris Agreement, speaks to Parties acknowledging "that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate".

   The MEL system for adaptation will create opportunities that (i) encourage stakeholder buy-in; (ii) increase the level of meaningful stakeholder participation in tracking adaptation progress and commitments; (iii) facilitate access to data and information; (iv) promote opportunities for stakeholders to enhance their skills for planning and implementing future climate actions; (v) improve the sustainability of interventions; (vi) facilitate sharing of local and scientific knowledge sharing relevant for adaptation; (vii) uptake and replication of lessons learned; (viii) strengthen development; and (viii) enhance implementation of adaptation solutions to problems faced on the ground.

6. **Gender Integration**–Within the MEL Framework gender will be addressed in a measurable way. It will provide valuable insight on the effectiveness of adaptation action and support. Focus will also be placed on understanding inequalities, power dynamics and gender and social relations. The Framework will consider the impact of gender on target populations and intersections with gender relations and gender equality. It integrates gender into the conceptual framework, logic model, indicators, and data gathering, analysis and use. This is in keeping with the country's commitment to achieving **Sustainable Development Goal 5: Gender Equality** by promoting contributions by men and women to climate change adaptation to ensure they are recognized and valued; and assessing efforts to reduce gender inequalities and promote opportunities for effective empowerment for women.

   As part of gender-sensitive monitoring, gender relationships will be acknowledged at multiple levels and seek to reduce and eliminate, rather than exacerbate or intensify gender inequalities. It, therefore, must not look at just the roles and functions of women

within the context of any interventions, but also examine how the roles of women and men determine the relationships between men and women, and the impacts of such relationships on social, economic, and environmental sustainability. Gender sensitive monitoring will also consider gender specific outputs, progress on gender specific elements, disaggregated data collection, and collection of data on attitudes and behaviours that reflect gender norms.

For evaluation, the MEL system will promote a gender sensitive approach in measuring the impact of outcomes that relate to gender specific programming, identifying elements that address gender inequalities, using data to demonstrate progress and impact, and using gender disaggregated data to understand the gender-differentiated impacts of climate change and adaptation efforts.

To have an effective gender-sensitive MEL system both qualitative and quantitative data will be used to measure the impact on gender relations, address the different needs of men and women, and assess impacts on their well-being. The system will also consider differential access and control over resources, role of women in decision-making, gender differences in vulnerability and coping strategies.

5.3. Data, Information, and Knowledge Management

Adaptation planning in Antigua and Barbuda has suffered from inadequate data – data that is outdated, inaccurate, or poor in quality, which results in high uncertainty in the adaptation solutions proposed to date. Despite constraints, Antigua and Barbuda continues to make strides towards enhancing its data repository and institutional systems needed for climate action.

The M&E system will drive the process of collecting, analysing, and using data to measure whether climate change adaptation responses are implemented according to plan (monitoring) and are yielding the intended results (evaluation) in accordance with national and sectoral priorities. Timely and reliable M&E provides information needed for upholding principles of good governance, accountability, and transparency and ensures compliance with established laws, regulations, standards, and obligations.

To determine if the country is reducing its adaptation gap[32], critical data is and further will be collected across sectors, analysed, and reported on. The national and sectoral level indicators identified in the NAP will be used to track the country's climate change response, inclusive of its adaptation policies, strategies, and actions. Measurement of these indicators will be instructive for answering questions on:

[32] IPCC defines the adaptation gap as "the difference between actually implemented adaptation and a societally set goal, determined largely by preferences related to tolerated climate change impacts and reflecting resource limitations and competing priorities.

- What actions have been taken to help the country, its people, and communities adapt to climate change?
- How have adaptation actions led to a reduction in climate risks?
- Will adaptation efforts likely decrease future climate risks?
- How effective has adaptation planning been mainstreamed into national policies, strategies, and plans and development processes?
- Has loss and damage associated with climate change impacts been averted, minimized, and addressed?
- Does the enabling environment support national adaptation planning as well as sound environmental governance (access to information, access to public participation and access to justice)?

There are diverse methods that will be used to collect data to enable MEL for adaptation. These include but are not limited to surveys, questionnaires, stakeholder interviews, expert observation, focus group discussions, field visits, testimonials, scorecards, review of records, documents, and reports. These data collection methods can range from formal, structured methods to informal, less structured methods. Formal and more structured methods include questionnaires and surveys. Informal, less structured methods include interviews, focus group discussions, and observations. The choice of approach used will influence the results yielded.

A key component of the national M&E system for adaptation includes the Environment Registry. The registry was created as a mandate under Part X: Section 87 of the Environmental Protection and Management Act (EPMA), 2019. It is managed by the Department of Environment and will assist support the monitoring, compliance, reporting, and notification requirements under the multilateral environmental agreements (MEAs) to which Antigua and Barbuda is a party; depositing information related to climate change, biodiversity, land management, pollution, and any other purpose in accordance with the requirements of the EPMA, 2019. The Registry will contain the **EPMA Information System** (a document management system whereby various reports will be uploaded), **Monitoring Reporting and Verification (MRV) System and a place for rosters and notices**. The Environment Registry will be used to monitor and report on mitigation and adaptation actions, support received as well as GHG emissions by sector.

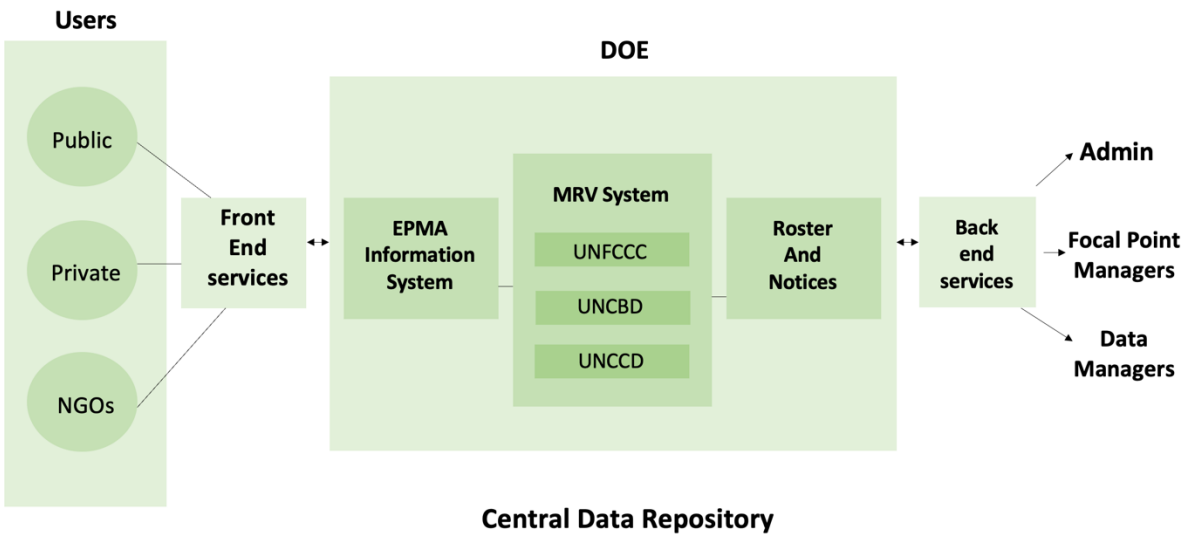

Figure 18: Conceptual Model of the Environment Registry

5.4. National Monitoring, Reporting and Verification System

The UNFCCC Enhanced Transparency Framework demands substantial and immediate progress in the countries' domestic MRV systems and strategic decarbonization planning. This entails moving from often disintegrated and often different methodological approaches in data management to an integrated and robust system. The success of the Paris Agreement hinges on enhanced transparency of action and support, as a critical foundation to making its bottom-up, country-led approach work, as well as building mutual trust and confidence amongst Parties. GEF-CBIT is supporting Antigua and Barbuda in establishing an overarching structure across all sectors that will ensure high quality in its transparency instruments; and create the capacities to respond to UNFCCC's reporting requirements. CBIT's most important contribution will occur by building capacity and setting up systems to collect data and track NDC implementation.

Through the Department of Environment (DOE)—the country's national UNFCCC focal point—Antigua and Barbuda designed a MRV mechanism for the NAP process and related adaptation actions. The components of the MRV system include the methods used to track specific activities and impacts; transparently communicate selected information to national stakeholders and/or the international community; and measures to ensure that selected reported information is accurate and complete as it relates to the MEAs. The climate change MRV system focuses on three main areas:

1. MRV of Adaptation (to include loss and damage tracking and reporting)
2. MRV of Mitigation Actions (to include GHG emissions)
3. MRV of Climate Support (to include climate finance, technology transfers, capacity building)

Table 20: Key components of a national MRV system for Antigua and Barbuda and their relevance to NDC implementation. Adapted from GGGIb, 2020

MRV Component	Relevance to Adaptation
Climate Data and Information	Collate, manage and disseminate data and information related to climate trends, vulnerabilities, impacts, GHG emissions and progress of climate actions.
Mitigation	To assess the progress in reducing GHG emissions and expected future reductions at national and sectoral levels. To also track implementation and effectiveness of mitigation actions to meet NDC targets and capture lessons learned to inform refinement and design of future NDCs and climate actions.
Support and Finance	To track support including finance and resource allocation and flows, technology transfer and capacity building for NDC implementation. This includes tracking of international climate finance, national budgets, private sector climate finance etc. to improve the overall transparency of climate finance flows, and to assess if the financing needs are being met and identify new financing requirements. The country has developed an initial fit-for-purpose methodology for tracking domestic and international climate finance flows in Antigua and Barbuda under a UNFCCC Needs Based Financing Project.
Adaptation	To track implementation effectiveness of adaptation actions taken to build climate resilience at the national and sectoral levels. This includes responses to loss and damage. To also track implementation and effectiveness of adaptation actions to meet NDC targets and capture lessons learned to inform refinement and design of future NDCs and climate actions.
Wider Impacts	To track co-benefits of NDC implementation activities e.g., contributions to Sustainable Development Goals, national development priorities, other multilateral environmental agreements (MEAs)

The MRV System is responsive to the 2019 EPMA, including Part VI – Environmental Management and Monitoring and Part X, sections 85–87. In this regard, it supports not only the implementation of climate change action, but also environmental management in general and the tracking of indicators for multilateral environmental agreements (MEAs). Regulations to support an MRV Framework are included as part of the 2021 Paris Agreement Regulations to the 2019 EPMA, at Part V paragraphs 49–53. The system pulls together various elements of MEA reporting and access to information requirements.

The national MRV System will track the progress of achieving Antigua and Barbuda's national adaptation goals and outcomes. It is expected that the MRV system will enhance Antigua and Barbuda's capability to collect, analyse, and report on data that is key to decision making processes. This MRV system will also ensure that data is collected periodically and is easily accessible when reports to international conventions need to be produced. Furthermore, the existence of this system will allow Antigua and Barbuda to easily compare data across a time series, and to accurately track adaptation indicators as well as on the NDC targets and other national objectives.

The Paris Agreement established universal and harmonised MRV requirements for tracking progress and effectiveness of implementation of climate actions, including mitigation, adaptation, and support (e.g., finance and resources) utilised by countries to meet their NDC targets. The system will enable the country to meet the Paris Agreement requirements on transparency and reporting. It includes coverage of MRV of Adaptation (as well as loss and damage tracking and reporting), MRV of Climate Support (to include climate finance, technology transfer and capacity building). The MRV system supports Antigua and Barbuda's efforts towards the Global Goal Adaptation (GGA) by tracking outcomes related to various strategies and plans, including[33]:

i. Outcomes that formed the focus for the 2015 Intended Nationally Determined Contribution (iNDC 2015),
ii. The updated 2021 NDC and associated emission reduction strategies,
iii. The NAP,
iv. Antigua and Barbuda's Climate Finance Strategy developed from the report on the *Assessment and Overview of Climate Finance Flows: Antigua and Barbuda 2014- 2017*, and
v. Associated strategies around the transition of the workforce from fossil fuel-based energy systems to renewable energy systems.

5.5. Measuring Progress on Implementation of Adaptation Actions

Measuring and monitoring adaptation progress are integral processes of the MEL system. The M&E system for adaptation will monitor and analyse climate change adaptation responses to determine if commitments are being met. It will also seek to enhance transparency and accountability— which are two key elements of good governance. Transparency is important for measuring, reporting and verification of climate change actions. Given that the climate crisis has a wide reach and affects multiple groups of stakeholders in varying ways, there is a need to ensure accountability for commitments and actions. Without measuring and monitoring of adaptation progress, it would be difficult to improve our climate change response. Adaptation tracking in the MEL system will involve measuring and monitoring adaptation in political systems, socioeconomic and environmental policies, and actions. There will also be a focus on feedback and learning.

33 Goodwin, Justin. GGGI. 2021. Antigua and Barbuda Climate Change Monitoring Reporting and Verification (MRV) system framework

The Biennial Transparency Report (BTR) will provide support in developing and implementing a monitoring and evaluation plan for adaptation actions building on findings from the previous outputs and on the NDC outcomes. It will also capture information related to averting, minimizing, and addressing loss and damage associated with climate change impacts. Given the importance of knowledge management, the cooperation, good practice, experience, and lessons learned from this process will be documented.

5.6. NAP Theory of Change

The theory of change (TOC) of adaptation maps is a set of interrelated adaptation pathways with each pathway showing the required results in a logical relationship with a hierarchical order.[34] The performance of adaptation will be tracked at the national level and for sectors highlighted in the NAP and SAPs and other priority sectors within the NDCs and the country's GCF Country Programme.

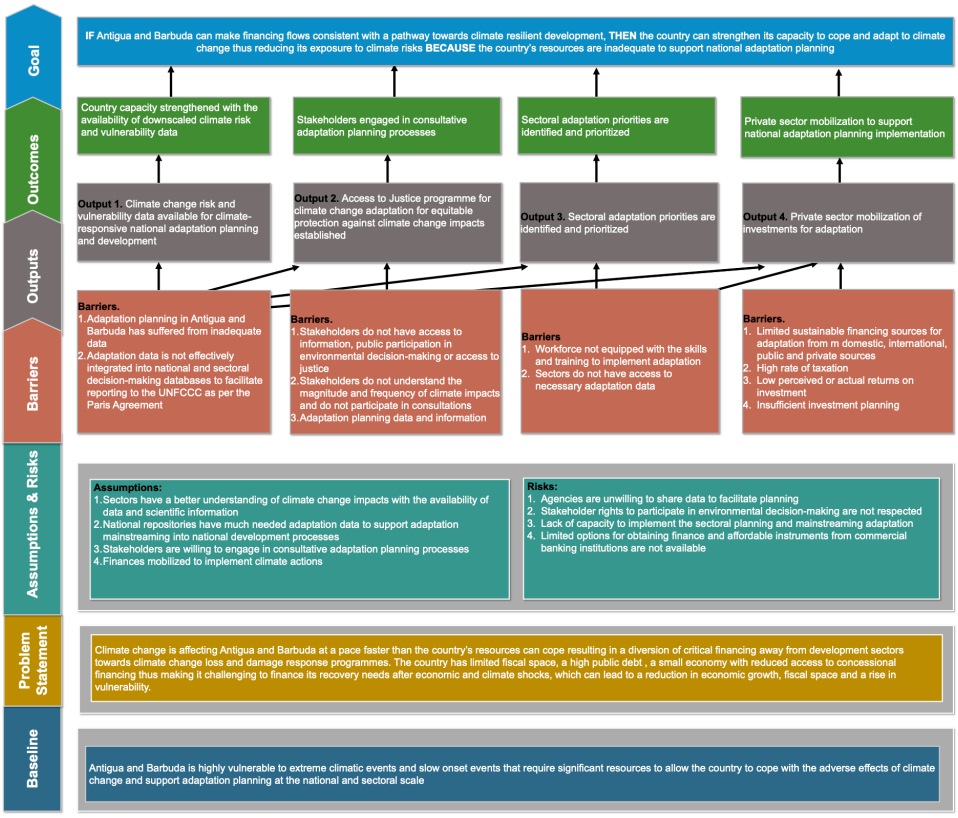

Figure 19: NAP Theory of Change

[34] Global Environmental Facility Medium Term Review Guidelines

5.7. Evaluation of Adaptation Actions

Within the MEL Framework, evaluation serves as a systematic and objective assessment of the effectiveness of the NAP process and its implementation in reducing the country's vulnerability and building national resilience. Evaluation for adaptation can provide critical information on the country's climate change adaptation policies, strategies programmes and projects. It will also be instructive in determining whether adaptation efforts have increased rather than reduce both current and future vulnerability to natural hazards. Thus, leaving marginalised and vulnerable groups, communities, sectors, and ecosystems worse off. The **Intergovernmental Panel on Climate Change's (IPCC)** Third Assessment Report defines maladaptation as "an adaptation that does not succeed in reducing vulnerability but increases it instead" (McCarthy *et al.*, 2001: 990).

> *Maladaptive Actions/Maladaptation Actions that may lead to increased risk of adverse climate-related outcomes, including via increased greenhouse gas (GHG) emissions, increased or shifted vulnerability to climate change, more inequitable outcomes, or diminished welfare, now or in the future. Most often, maladaptation is an unintended consequence. -* ***Intergovernmental Panel on Climate Change in its Sith Assessment Report, 2023***

Evaluation findings then can guide planning and decision-making. Evaluation assesses achievements on a specific criterion, which includes a determination of the relevance, efficiency, effectiveness, impact, and sustainability of results. A key feature of evaluation is the inclusion of before—and—after comparisons. It is conducted at key points in the implementation phase (e.g., mid-term and terminal) to enable an in-depth analysis of whether ongoing or completed activities achieved planned results.

5.8. Framing of the Evaluation Scope

Evaluation of the NAP process is a key phase of the adaptation cycle. This type of assessment can help in understanding support received for the development of the NAP, data or information gaps, stakeholder involvement in the development processes, and capture data and evidence generated to inform future adaptation policies and practices. The table below outlines an evaluation criterion with key evaluation questions for the NAP process.

Table 21: Evaluation criteria and questions relevant to the implementation process

Adaptation Plan Evaluation	
Evaluation Criteria	**Indicative Questions**
Evaluation criteria and questions relevant to the implementation process	
Country capacity strengthening	• Is accurate and detailed data and scientific information available to inform national adaptation planning? • Have data been collected and compiled to support adaptation planning and response at sectoral scales? • Have adaptation data been integrated into enhanced national decision-making databases and reporting to the UNFCCC as per the Paris Agreement?
Engagement of Stakeholders in consultative adaptation planning processes	• Have sectors and stakeholders been involved in adaptation planning and how have they implemented actions? • Have approved legislation, regulations and procedures enabled private sector and civil society to meaningfully participate in environmental decision-making and in implementing climate actions? • How has knowledge, lessons learned, and best practices been transferred and used for the benefit of the OECS sub-region, CARICOM region, and internationally?
Sectoral adaptation priorities	• Have sectors improved their level of resilience and are better able to respond effectively to climate change risks?
Mobilization of Private sector in adaptation planning	• How have resources been mobilized to support adaptation planning? • How involved is the private sector in sustainable financing and making investments for adaptation? • How has human capital been enhanced to implement adaptation through certification and qualifications?

The evaluation of whether the NAP responds to the relevant impacts, risks, vulnerabilities, and resilience needs will be guided by a list of six evaluation criteria from the Development Assistance Committee (DAC) of the Organisation for Economic Co-operation and Development. This criterion can be adapted to include additional criteria for assessment. An evaluation criterion supports consistent, high-quality evaluation within a common framework, and is a standard used as the basis for evaluation judgement. This criterion provides a normative framework with which to assess a specific intervention. Each of the six international evaluation criteria stated in the table below is summarised by a broad evaluation question, which illustrates its overall meaning.

Table 22: Evaluation criteria and questions relevant to Adaptation Plan Effectiveness

Adaptation Plan Evaluation Evaluation Criteria	Indicative Questions
Evaluation Criteria and Questions Relevant to Adaptation Plan Effectiveness	
Relevance	• Is the intervention consistent with country needs, global priorities, and donors' policies? • How well is country ownership reflected in the governance, coordination, and consultation mechanisms?
Coherence	• How well does the intervention fit? • To what extent does the intervention compliment other on-going initiatives (by stakeholders, donors, governments) on climate change adaptation efforts?
Efficiency	• How well are resources being used? A measure of how economically resources/inputs (funds, expertise, time, equipment, etc.) are converted into results.
Effectiveness	• Is the intervention achieving its objectives? • How effective has the country been in establishing financial mechanisms to advance its adaptation priorities.
Impact	• What positive and negative primary and secondary long-term effects are produced, whether directly or indirectly, intended or unintended? • How do intended and/or unintended effects contribute to overall adaptation?
Sustainability	• Can the results continue after the project ends? • What is the likely impact? • How does the NAP contribute to building resilience to climate change impacts? • Will the benefits last?

The evaluation criteria may also include the following:

Equity	• To what degree has the intervention reduced or perpetuated inequalities, and how equitably benefits were accrued to vulnerable groups? • Have vulnerable groups such as women, youth, persons with disability, minorities, and other potentially marginalized groups or locations been included during implementation?
Adaptive Management	• To what extent has the intervention supported the use, development, or diffusion of innovative practices, tools, or technologies to improve or accelerate climate change adaptation? • Have the project's interventions been innovative to unlock additional financing?

Scalability	• How can climate change adaptation intervention be increased or replicated at a broader scale, as well as in other contexts? • What contribution was made to build resilience to climate change impacts and Antigua and Barbuda's disaster risk reduction response in the face of climate variability? • What are the key challenges for replicability and scalability?

5.9. Reporting on Climate Change Adaptation

Different stakeholders and sectors in Antigua and Barbuda will need to understand the magnitude and frequency of climate impacts, to conduct climate vulnerability and risk assessments, identify and fund adaptation priorities, enhance systems and processes, as well as to inform future adaptation implementation and decision making. MEL for adaptation involves the synthesizing of data and generation of information that is relevant and accessible to a variety of stakeholders – from policy makers, business owners, communities, to technicians.

Antigua and Barbuda will primarily be utilizing the following vehicles for reporting and learning on support for adaptation, adaptation progress and other related actions:

- **National Adaptation Plan** – The National Adaptation Plan will assist the country to meet its commitments to the Paris Agreements reporting, transparency, and compliance requirements. It will contribute adaptation information relevant to the global goal on adaptation in the Paris Agreement – to enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change (Article 7.1.).
    - **Progress Report on the NAP**—provides information on Antigua and Barbuda's progress toward adaptation to diverse stakeholders.

- **Adaptation Communications (ADCOMs)**—form part of the suite of adaptation reporting to the UNFCCC. Antigua and Barbuda's first ADCOM captured information on the key climatic drivers and their impacts on the country; national adaptation responses, both planned and ongoing; the adaptation framework in which these responses are situated; and the needs and challenges to be addressed.

Guidance on ADCOMs is presented in UNFCCC Decision 9/CMA13.[35] Its purpose is to:

- Increase the visibility and profile of adaptation and its balance with mitigation.
- Strengthen adaptation action and support for developing countries.
- Provide input to the global stock take.
- Enhance learning and understanding of adaptation needs and actions.

[35] UNFCCC. 2020. FCCC/PA/CMA/2018/3/Add.1. Decision 9/CMA.1 Further guidance in relation to the adaptation communication, including, inter alia, as a component of nationally determined contributions, referred to in Article 7, paragraphs 10 and 11 of the Paris Agreement. https://unfccc.int/sites/default/files/resource/9-CMA.1_English.pdf

The ADCOM as a reporting instrument stems from the Paris Agreement's[36] (PA) Article 7 at paragraphs 10 and 11. ADCOMs feature as part of the Enhanced Transparency Framework (ETF) for action and support, elaborated in Article 13 of the PA, and will inform the Global Stocktake (GS). The GS will track progress towards the Global Goal on Adaptation (GGA), which is *"to enhance adaptive capacity and resilience; to reduce vulnerability with a view towards contributing towards sustainable development and ensuring an adaptation response in the context of the goal of holding average global warming well below 2° C and pursuing efforts to hold it below 1.5°C."*[2] The information presented in the ADCOM also supports reporting for the National Communication and the country's NAP.

- **Nationally Determined Contributions.** Antigua and Barbuda, as one of the most vulnerable countries to the negative impacts of climate change, recognizes the importance of strengthening the global climate change response by enhancing the adaptive capacity and resiliency, and reducing vulnerability. As a result, adaptation information will be reported on in its NDCs. The country as a Party to the Paris Agreement, is expected to submit a Nationally Determined Contribution and revise it every five years. Antigua and Barbuda submitted its first Intended Nationally Determined Contributions (INDCs) in 2015 and communicated its updated NDCs to the UNFCCC in 2021. In the context of the ETF, countries are expected to track and report progress towards achieving their NDCs, and communicate adaptation actions, including good practices, priorities, needs and gaps, to inform the global stock take under Article 14 of the Agreement.

- **Biennial Transparency Report (BTR)**— Antigua and Barbuda is in the process of preparing its first BTR that will comply with the United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement reporting requirements while responding to national development goals. As a signatory to the Paris Agreement, it is expected to submit a BTR including a National Inventory Report every two years starting from December 2024, thus replacing the Biennial Update Reports (BURs). The BTR will highlight efforts by Antigua and Barbuda to strengthen the mainstreaming and integration of climate change into country and sectoral development goals and to enable the country to respond to international environmental obligations by building institutional and technical capacity of government agencies, NGOs, and the private sector.

    - **NDC Tracking Reports—** These reports will be prepared in a common tabular format with information on tracking progress made in implementing and achieving NDC. Preparation of these reports are a requirement of the BTR. As Antigua and Barbuda's NDC features adaptation, the progress update on achievements in adaptation will also be a focus. The data and information compiled in the NDC tracking report will be derived from the Environment Registry platform. Data will be reviewed and validated.

36 United Nations. 2015. Paris Agreement

- **Climate Change Impacts and Adaptation Report—** This report will be produced as part of implementation of the BTR. Data and information contained in the report will be reported from the Environment Registry platform. The report will be validated by the Technical Advisory Committee (TAC) and other relevant stakeholders. The DOE will manage the process of preparing information related to climate change impacts and adaptation.

- **National Communications**: The Guidelines on National Communications for Non-Annex I Parties "encourage" the provision of "information on and, to the extent possible, an evaluation of, strategies and measures for adapting to climate change, in key areas, including those which are of the highest priority." (Paragraph 35 in UNFCCC, 2002). Antigua and Barbuda presented three National Communications, in 2001, 2011 and 2015 respectively, with the 4th National Communication being prepared for submission to the Conference of the Parties to the UNFCCC in fulfilment of its obligations to the Convention under Decision 17 / CP. 8, and other related guidance. The country is obligated to submit its National Communications (NCs) every four years. The 4th National Communications will elaborate in detail the impact of climate change on weather and climate-sensitive sectors. It will also address efforts by Antigua and Barbuda to deepen the mainstreaming and integration of climate change into country and sectoral development goals and to enable the country to respond to international environmental obligations by strengthening the institutional and technical capacity of government agencies, NGOs and the private sector.

- **Voluntary National Reviews** – This report provides critical data and information on progress towards the 2030 Agenda for Sustainable Development. The VNR serves as a platform to review new and emerging challenges such as climate change and efforts to strengthen resilience. The VNR is evidence – and data-based and structured to be analytical.

- **The State of Environment (SOE) Report** – Antigua and Barbuda through its Department of Environment is mandated to release a SOE Report every two years under its Environmental Protection and Management Act, 2019 under Part X, Section 89. This report provides information about environmental and social conditions, trends and pressures for the country, and the surrounding seas. The SOE reporting process is useful for effective environmental and sustainable development planning by examining the current condition of environmental indicators influenced by national, regional, and global pressures. The SOE report can be used in the following ways:
  - *National Environment Sector Planning*: Integrate findings into National Environmental Management Strategies (NEMS) and National Sustainable Development Plans (NSDPs). The SOE Report identifies gaps and priorities that can be included into National Environmental Management Strategies (NEMS) and National Sustainable Development Plans (NSDPs).
  - *Multilateral Environmental Agreement Reporting*: Report international obligations under the United Nations environmental conventions.

- *Project Identification*: Serve as a foundation for project development using gaps identified.
- *Cross-Sector Collaboration*: Identify opportunities for interagency collaboration.
- *Sustainable Development Goals Reporting*: Serve as an information source in national reporting by different interest groups.

5.10. Feedback and Learning on Adaptation

There is a connection between effective adaptation and ongoing reflection and learning. Promoting feedback and learning on adaptation involves analysing M&E data to learn from implementation experiences and informing decision-making, ongoing adaptation, and planning for future initiatives. Learning is a critical and continuous process that occurs throughout this cycle of planning, implementation, monitoring and evaluation, all of which contribute to knowledge creation. An effective M&E system of adaptation facilitates learning and accountability, which are essential elements of results-based management.

Antigua and Barbuda will provide dedicated resources to transfer knowledge and lessons learned on national adaptation planning. To do so the country will:

- Synthesize experiences, best practices and lessons learned and incorporate these into National Communications, the Adaptation Communications and policies, plans, strategies and key reports.
- promote the use of the sub-regional OECS climate resilient Building Code and include findings from the NAP process in the updated Building Code.
- Provide outcomes of national adaptation planning to the Finance Sector (banks and insurance) in the sub-region and via the Eastern Caribbean Central Bank (ECCB) to allow them to make climate resilient financial decisions and where appropriate, provide detailed risk information to the Caribbean Catastrophe Risk Insurance Facility (CCRIF); and
- Share knowledge, lessons learned and best practices at the Conference of Parties, regional exchanges; workshops and expert meetings; training activities.

5.12. Conclusion

As the climate crisis escalates, the Government of Antigua and Barbuda has been bearing the costs of adaptation – recovering from hurricanes, making improvements to infrastructure, adapting to saltwater intrusion, installing desalination and water storage, among other actions. This effort is not unique to Antigua and Barbuda. Climate expenses and recovery activities borne by the Government tend to delay the implementation of developmental priorities. In addition to the Government, the private sector and other stakeholder groups have also had to invest in adaptation planning.

This makes tracking national adaptation planning progress even more crucial. An integral part of monitoring and measuring progress is having quality data. The MEL system will integrate adaptation data generated by the NAP into the national repositories to support adaptation mainstreaming into national development processes. Importantly, it will also synthesize data and information generated making it accessible to a variety of stakeholders – from government agencies, policy makers, business owners, communities, technicians to civil society.

Evaluative evidence can also provide valuable information on what works well or does not work during NAP implementation and provide an assessment of the impact of adaptation actions on sectors, local communities, and ecosystems. Reporting on adaptation progress will be a key feature of the system, so that there is: (i) enhancement of the effectiveness and transparency of the enabling environment for adaptation; and (ii) improvement in planning, decision making, accountability, and communication. Feedback and learning from planning, implementation, monitoring and evaluation processes can help in lowering the risk of maladaptation. In the long-term, effective adaptation approaches can enhance adaptive capacity, strengthen resilience, and reduce vulnerability to climate change (Article 7.1.).

Appendix

Appendix 1: National Adaptation Plan Project Results Tracker

Component	Outcome	Deliverable	Indicator
Country capacity strengthened	1.1. Accurate and detailed data and scientific information is available to inform national adaptation planning	1.1.1 Preliminary data compiled (delivery: every 6 months and final at 18 months)	1.1. Data compiled every six months
	1.2. Country capacity is strengthened in adaptation planning methodologies	1.2.1. Guidelines, including instructional videos, for conducting climate assessments	1.2. Number of people trained in climate change adaptation planning in the private and public sector. Guidelines, including instructional videos, for conducting climate assessments and SIAs produced
	1.3. Information is accessible via a countrywide climate change risk and vulnerability map	1.3.1. NAP Chapter 1	1.3 NAP Chapter 1 (GIS baseline assessment) including a Climate Change Risk and Vulnerability MAP
	1.3 Adaptation data is integrated into enhanced national decision-making databases and reporting to the UNFCCC as per the Paris Agreement	1.4.1.A: Report on adaptation data in multi-agency information system accessible to the public 1.4.1.B: Information and data for the transparency mechanism of the Paris Agreement is peer reviewed and information is provided for the National Communication Biennial Update Reports (BUR), Adaptation Communication and general compliance reporting under the Convention	1.4. Report on Adaptation data in Multi-Agency Information System accessible to the public Information and data for the transparency mechanism of the Paris Agreement is peer reviewed and information is provided for the National Communication, Biennial Update reports (BUR), Adaptation Communication general reporting under the Convention.
Component 2: Stakeholder engaged in	2.1. Stakeholders are engaged in consultative	2.1.1. Approved regulations and procedures for the Access to Justice	2.1. Approved regulations and procedures for the

consultative adaptation planning processes	adaptation planning processes	programme and public links to information	Access to Justice programmed and public links to information
	2.2. Adaptation priorities are developed and continuously updated	2.2.1.A: Endorsed National Adaption Plan for Antigua and Barbuda 2.2.1.B: Draft Adaptation Communication to the UNFCCC	2.2. Endorsed National Adaptation Plan for Antigua and Barbuda Draft Adaptation Communication to the UNFCCC
	2.3. Knowledge and lessons learned are transferred regionally and internationally	2.3.1. Report on the transfer of national adaptation planning lessons learned in the OECS sub-region and globally.	2.3. Report on the transfer of national adaptation planning lessons learned in the OECS sub-region and globally
Component 3: Sectoral adaptation priorities	3.1. Enabling legal environment for multi-sector adaptation planning	3.1.1.A: Enactment of EPMA Regulations providing enabling legal environment for national adaptation planning 3.1.1.B: Operational and technical procedures for the implementation of the regulations included in the SIRF Fund procedures	3.1. Enactment of EPMA Regulations providing enabling legal environment for national adaptation planning Operational and technical procedures for the implementation of the regulations included in the SIRF Fund procedures
	3.2. Adaptation Plans for three sectors	3.2.1. 3 Sector Vulnerability Risk Assessment and Adaptation Plans, including marketing material for popularizing the plans	3.2. 3 Sector Vulnerability Risk Assessment and Adaptation Plans, including marketing material for popularizing the plans
	3.3. NGOs and private sector Adaptation Plans	3.3.1. Up to 6 Vulnerability Risk Assessment and Adaptation Plans (NGO and private sector)	3.3. Up to 6 Vulnerability Risk Assessment and Adaptation Plans (NGO and private sector)
	3.4. NAP Strategic Impact Assessments fulfil legal, financial and planning requirements	3.4.1. 18-22 Strategic Impact Assessments meet national legal requirements for the NAP and produce localized resilience action plans and investment strategies across assets, sectors, gender, and social impacts	3.4. The Strategic Impact Assessment Framework was completed.
Component 4: Private sector mobilization	4.1. Private sector resources are mobilized to support NAP implementation	4.1.1.A: NAP chapter on sustainable financing for adaptation	4.1. NAP chapter on sustainable financing for adaptation

		4.1.1.B: Private sector funding proposal, including SIAs to implement adaptation priorities	Private sector funding proposal, including SIAs, to implement adaptation priorities
	4.2. Enhanced human capital to implement adaptation through certification and qualifications	4.2.1. Over 50 public and private sector professionals (50% female) are trained from short term to medium (certificates) and long term (master's level)	4.2. Over 50 public and private sector professionals (50% female) are trained from short term to medium (certificates) and long term (master's level)

Appendix 2: Preliminary Stakeholder Consultation Stakeholder List

No.	Name of Organizations and Agencies
1.	Antigua and Barbuda Association of Persons with Disabilities
2.	Antigua and Barbuda Investment Authority
3.	Antigua and Barbuda Transport Board
4.	Antigua Public Utilities Authority
5.	BAU Panel
6.	Barbuda Council
7.	Barbuda Go
8.	Bureau of Standards
9.	Caribbean Water Treatment
10.	Carisun Renewable Energy
11.	Central Board of Health
12.	Central Housing and Planning Authority
13.	Community Development Division
14.	Contractor's Association
15.	CSO (Civil Society Organization)
16.	Development Control Authority
17.	Environmental Awareness Group
18.	Fisheries Division
19.	Forestry Division
20.	GEF/SGP (Global Environment Facility/ Small Grants Programme
21.	Gilbert Agricultural and Rural Development Center
22.	Invasive Alien Species Project Coordinator
23.	MEPA Trust (Zero Waste Antigua Barbuda and MEPA Trust)
24.	MET Office
25.	Ministry of Finance
26.	Ministry of Health, Wellness, and the Environment
27.	Ministry of Housing and Lands
28.	Ministry of Public Works
29.	Ministry of Tourism
30.	Ministry of Works and Housing
31.	National Housing and Urban Renewal Authority
32.	National Office of Disaster Services
33.	National Parks Authority
34.	National Solid Waste Management Authority
35.	Plant Protection Unit
36.	St. John's Development Corporation
37.	Statistics Division
38.	The Be Foundation
39.	The Coco Point Fund
40.	Transport Board
41.	UNOPS (United Nations Office for Project Services)
42.	Water-Energy-Food Nex
43.	West Indies Oil Company (WIOC)

Annex A – Prioritisation scores for each output

Thematic Area	Output	Implementation timeline (Years)	Cost (USD million)	Impact potential (No. of Beneficiaries)	Alignment with priorities ((1 – Highest/ 4 – Lowest)
Wholesale and Retail SAP	WR.1	10	31.3	15,666	2
	WR.2	6	24.0	15,666	2
	WR.3	8	1.4	15,666	2
	WR.4	4	6.8	15,666	3
Infrastructure and Housing SAP	IH.1	12	95.5	24,174	1
	IH.2	4	1.3	93,763	2
	IH.3	10	56.6	93,763	1
	IH.4	12	4.1	93,763	2
Food Security SAP	FD.1	4	2.2	93,763	3
	FD.2	11	2.4	93,763	3
	FD.3	10	0.2	93,763	3
	FD.4	11	9.5	93,763	2
	FD.5	11	19.2	93,763	2
	FD.6	7	14.7	93,763	2
	FD.7	11	1.1	93,763	3
	FD.8	4	3.9	93,763	1
Tourism SAP	T.1	10	16.9	24,750	1
	T.2	6	1.1	24,750	1
	T.3	6	16.8	24,750	3
	T.4	6	3.5	24,750	2
	T.5	5	2.2	24,750	2
Culture SAP	C.1	10	9.0	93,763	2
St. John LAP	LAPSJ.1	10	0.7	54,655	1
	LAPSJ.2	10	1.2	54,655	2
	LAPSJ.3	10	14.3	54,655	1
	LAPSJ.4	10	0.8	54,655	2
	LAPSJ.5	10	48.2	54,655	1
	LAPSJ.6	10	0.6	54,655	2
	LAPSJ.7	10	19.6	54,655	1
	LAPSJ.8	10	1.4	54,655	2
	LAPSJ.9	10	16.4	54,655	1
	LAPSJ.10	10	0.8	54,655	3

Thematic Area	Output	Implementation timeline (Years)	Cost (USD million)	Impact potential (No. of Beneficiaries)	Alignment with priorities ((1 – Highest/ 4 – Lowest)
Jolly Harbour LAP	LAPJH.1	10	2.0	862	1
	LAPJH.2	10	1.0	862	2
	LAPJH.3	10	1.0	862	1
	LAPJH.4	10	0.4	862	2
	LAPJH.5	10	0.8	862	1
	LAPJH.6	10	0.4	862	2
	LAPJH.7	10	1.2	862	1
	LAPJH.8	10	0.5	862	2
	LAPJH.9	10	1.2	862	2
	LAPJH.10	10	7.8	862	1
	LAPJH.11	10	0.6	1,815	3
Airport/Fitches Creek LAP	LAPAF.1	10	14.2	1,815	2
	LAPAF.2	10	1.0	1,815	1
	LAPAF.3	10	1.0	1,815	1
	LAPAF.4	10	1.0	1,815	1
	LAPAF.5	10	0.3	1,815	3
	LAPAF.6	10	0.3	1,815	2
	LAPAF.7	10	5.7	1,815	2
	LAPAF.8	10	13.3	1,815	2
	LAPAF.9	10	0.6	1,815	2
	LAPAF.10	10	13.6	1,815	1
	LAPAF.11	10	0.7	1,815	3
	LAPAF.12	10	1.2	1,815	3

Appendix 3: Snapshots from Stakeholder Engagement Activities

Geographic Information Systems (GIS) Training

Truck load of mosquito traps for distribution to local communities

Department of Environment Stakeholder Engagement and mosquito trap distribution

Appendix 4: Implementation Plans for the three (3) Local Area Plans

Table 21: The ten (10) outcomes and associated outputs for the St. John's City LAAP 2023-2033

Output	Activities	Description	Deliverables
Outcome 1 Improved protection from wind damage and impacts from storm surges along the St. John's Harbour through the implementation of offshore and nearshore protective infrastructure			
Output 1.1 Coastal engineering study to evaluate and recommend the most feasible coastal and offshore protection measures commissioned	**Activity 1.1.1** Conduct a coastal engineering study to determine the feasibility of different coastal and offshore protection measures for the St. John's waterfront area spans the Antigua and Barbuda Port Authority, Heritage Quay Complex and the Antigua Cruise Port. **Activity 1.1.2** Consult with stakeholders to get feedback and buy-in for the project. **Activity 1.1.3** Develop action/implementation plan and strategy document based on final recommendations	This initiative will involve the development of an implementation plan and strategy document for an integrated coastal protection program for Saint John's City. These protection measures will aid in reducing exposure to wave erosion and mitigating impacts from storm surges and coastal inundation.	1. Technical reports from coastal engineering study 2. Workshop notes and reports 3. Approved contracts and TORs 4. Establishment of coastal zone management and planning processes that build climate resilience
Outcome 2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion			
Output 2.1 Restoration of seagrass bed	**Activity 2.1.1** Mapping and remote sensing of existing seagrass bed noting critical ecological features. **Activity 2.1.2** Conduct marine assessment and feasibility study to determine viability for seagrass replanting. **Activity 2.1.3** Commission replanting of seagrass bed at approved sites in the St.	This initiative will involve understanding the benthic environment off the coast of St. John's City to determine the viability for replanting of the seagrass bed in the outer harbour regions of St. John's.	1. Baseline study and rehabilitation plan for seagrass bed and accompanying TOR 2. Technical reports from mapping and remote sensing exercise 3. Establishment of coastal zone management and planning processes

	John's Harbour in collaboration with local stakeholder organizations		that build climate resilience
Outcome 3 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges			
Output 3.1 Approval of the revised building code which accounts for the growing threats posed by hurricanes, increased flood risks, and drought resilience	**Activity 3.1.1** Obtain final governmental approval of the revised building codes. **Activity 3.1.2** Revisions/strengthening of existing legislation (EPMA, the Physical Planning Act 2003) and the National Physical Development Plan (NPDP) to ensure the use of the revised codes is mandated by law in new developments. **Activity 3.1.3** Identify and procure resources and training needed to implement and enforce the use of the updated building code	This initiative is already underway and involves the approval of the revised national building code for Antigua and Barbuda to accommodate for more extreme climate events. It also involves legally mandating its use and strengthening the capacity to enforce its use in new developments.	1. Approved national building code
Output 3.2 Renovation of existing critical facilities such as emergency shelters, schools, health and transport facilities that are at risk from wind damage and coastal flooding. Special attention to establishments and infrastructure located in the coastal zone including major harbourfront complexes such as Heritage Quay, Redcliffe Quay,	**Activity 3.2.1** Develop an inventory of existing facilities and identify facilities that require renovation along the waterfront. **Activity 3.2.2** Renovate selected facilities in line with revised national building code requirements	This initiative will build on existing activities to identify and renovate existing critical facilities in St. John's City to build resilience to hurricane and storm impacts.	1. Relevant policy documents, MOUs etc. 2. Implementation plan and guidelines for upgrading existing facilities. 3. Inventory of all critical facilities and their resource needs

Point Wharf and the Markets			
Output 3.3 Power lines and communication networks in at-risk low-lying locations (namely, Greys Farm, Pointe, and Green Bay) relocated underground to protect against wind and flood damage. Also applies to localized sections of the city and commercial district including Church Street, Dickenson Bay Street, Market Street, Newgate Street and South Street	**Activity 3.3.1** Mapping locations of most vulnerable powerlines and related communication infrastructure to wind damage **Activity 3.3.2** Consult with Public Works and APUA on options to protect this infrastructure when placing underground	This initiative is intended to build resilience in the energy and telecommunication sectors by placing power lines and communication infrastructure underground where they are less exposed to climatic risks.	1. Flood and hurricane hazard maps for road and communication infrastructure 2. Detail road and communications network infrastructure map and implementation plan 3. Financial reports and audits 4. MOUs and other policy documents
Outcome 4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses			
Output 4.1 Feasibility Assessment for the establishment of a climate risk insurance scheme	**Activity 4.1.1** Conduct a feasibility study with local stakeholders. **Activity 4.1.2** Develop a parametric-based climate risk insurance scheme	This initiative is aimed at building resilience in the local farming, fishing, hotel and small business sectors through the provision of a suitable climate risk insurance mechanism. This risk-transfer mechanism will provide tailored financial assistance to those in key vulnerable sectors in the event of a natural disaster.	1. Completed feasibility study. 2. Tailored parametric-based climate insurance instruments
Output 4.2 Sensitization on the new climate or hurricane risk insurance scheme that fosters the uptake for the	**Activity 4.2.1** Plan and execute sensitization sessions/workshops	This initiative is aimed at sensitizing local stakeholders about the benefits of the insurance scheme with the hope of gaining useful feedback and buy-in.	1. Sensitization strategy document 2. Workshop notes and reports

farming, fisheries, resort and local business sectors			
Outcome 5 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding			
Output 5.1 Expanded and improved network of drains, canals, and waterways throughout St. John's City	**Activity 5.1.1** Conduct a study to determine the volume and peak rate of runoff. **Activity 5.1.2** Conduct a study to determine how wide drains, canals and waterways can be expanded within their existing location. **Activity 5.1.3** Develop terms of reference for a competitive bidding process. **Activity 5.1.4** Contract local construction/engineering company to expand drains, canals and waterways	This initiative will involve the identification and expansion of existing drains, canals, and waterways throughout the city.	1. Technical reports 2. Completed and signed contracts and TORs 3. Improved stormwater infrastructure that is climate resilient 4. Financial reports and audits 5. M&E reports
Output 5.2 Construction of a central sewerage system to better manage sewage waste throughout the city	**Activity 5.2.1** Conduct a study to determine the required capacity of the sewer system. **Activity 5.2.2** Develop terms of reference for a competitive bidding process. **Activity 5.2.3** Contract a local engineering company to design the system for the City. **Activity 5.2.4** Contract construction entity to construct a central sewer system for the St. John's City local area	This initiative will entail the design and construction of a central sewer system for St. John's City. Currently, the area does not have a central sewer system which often leads to sewage ending up in drains and ultimately the sea.	1. Technical reports 2. Completed and signed contracts and TORs 3. Final design drawing of sewerage system 4. Construction of central sewer system 5. Financial reports and audits 6. M&E reports
Output 5.3 Retrofitting the existing coastal road network	**Activity 5.3.1** Survey existing roads for evidence of deterioration and/or damage and identify roads	This initiative will involve the construction of drains and culverts at certain sections of the roadway to channel and	1. A technical report documenting high-risk sections of the roadway.

spanning Villa, Perry Bay and Grey's Farm, to protect against future flood impacts. Attention should be given to key transport infrastructure as well, such as the West Bus Station Terminal	that typically flood during rainfall events. **Activity 5.3.2** Evaluate and test different erosion-control techniques such as embankments that resist washing out, rubber liners and reduced slopes	divert flood waters away from the road infrastructure.	2. Road rehabilitation plan and guidelines document 3. Financial reports and audits
Output 5.4 Improving the capacity of the Ministry of Public Works to undertake regular clean-up and drain rehabilitation work in the city	**Activity 5.4.1** Conduct a needs assessment of the Ministry of Public Works to identify resource needs and other gaps. **Activity 5.4.2** Use results from needs assessment to develop a resource mobilization plan for the Ministry	This initiative will focus on strengthening the capacity of the Ministry of Public Works to carry out regular clean-up and rehabilitation work throughout the city. This will entail the provision of more equipment and personnel to conduct these activities.	1. Needs Assessment report and resource mobilization plan. 2. Maintenance plan for drainage clearing
Output 5.5 Installation of drain covers and metal barrier for existing drainage network	**Activity 5.5.1** Assessment or audit of existing drainage network **Activity 5.5.2** Installation of drain covers	These activities are aimed at preventing the build-up of solid waste material in the existing drainage network.	1. Technical reports 2. Completed and signed contracts and TORs 3. Assessment/Audit Results of existing drainage network 4. Project Reports 5. Financial reports and audits
Output 5.6 Strategy developed to establish an underground drainage network in flood-prone sections of the city such as Gray's Farm, the Point Community, the Lower North Street area, Green Bay, the Perry Bay Main Road, and	**Activity 5.6.1** Conduct a study to determine the feasibility of the proposed action and make site-specific recommendations. **Activity 5.6.2** Develop terms of reference for a competitive bidding process. **Activity 5.6.3** Contract local construction/ engineering company to design and construct an underground drainage system for the St. John's	This initiative will entail the construction of an underground drainage system for St. John's City to reduce the risk of water overflowing drains and causing flooding of roads.	1. Technical reports 2. Completed and signed contracts and TORs 3. Construction of underground drainage system 4. Financial reports and audits 5. M&E reports

the Lower Market Street area	City local area on a phased basis prioritizing at-risk location		
Output 5.7 Implemented a computer database system that monitors and evaluates drainage issues, including leaks to manage their status in real-time and used across various governmental entities to manage infrastructure	**Activity 5.7.1** Research and procure the most suitable system to monitor and evaluate drainage issues. **Activity 5.7.2** Conduct training led by the technology provider to learn about the system and how to use its features. **Activity 5.7.3** Implement a system and develop a database to manage data. **Activity 5.7.3** Design on-site data collection procedures for regular field site visits	This activity will provide a digital system that will monitor and evaluate drainage issues like leakages. It will include building a database that can be used to collect, manage, and monitor drainage systems across St. John's City.	1. Implementation plan 2. Installation of IT infrastructure forming coordination between different Ministry of Works personnel for documentation and recording of drainage issues
Outcome 6 Improved solid waste management practices within at-risk communities			
Output 6.1 PR campaign around best practices for household solid waste management	**Activity 6.1.1** Develop a communication strategy	This initiative will entail a series of PR campaigns (television, radio, and other media) to educate and sensitize the general public about the importance of solid waste management.	1. Media campaign strategy document and plan (media coverage of activities) 2. Education toolkit (school field trips, primary and secondary school demonstrations) 3. Electronic news bulletin to highlight local action
Output 6.2 City-wide recycling services are provided for businesses and residences to collect plastics, metals, and other forms of solid waste	**Activity 6.2.1** Consult with waste facilities and the Ministry of Health, Wellness and the Environment (DoE, National Solid Waste Authority) about establishing acceptance criteria for plastics, metals materials and other forms of solid waste. **Activity 6.2.2** Explore options for partnering with	This activity will develop a framework for expanding recycling services in the St. John's City local area.	1. MOUs and other relevant policy documents 2. Recycling system that provides waste disposal services

	private sector partners to develop recycling services for the area		
Outcome 7 Expanded water storage capacity			
Output 7.1 Construction of at least one additional desalination/RO plant	**Activity 7.1.1** Conduct a study to determine the remaining water demand needs for St. Johns City and surrounding areas. **Activity 7.1.2** Use the results from the study to determine the number and/or increase in capacity of RO plants needed	This activity is intended to increase the water production capacity for the area through the commissioning and construction of at least one additional RO plant or increasing the capacity of the existing plant.	1. Technical reports 2. Financial reports and audits
Output 7.2 Develop measures to encourage local businesses and hotels to invest in micro-scale desalination technologies to reduce the pressure at the municipal level	**Activity 7.2.1** Provide tax and customs duty relief to incentivize local businesses and hotels to invest in microscale desalination technologies	This initiative is intended to facilitate the decentralization of water production to reduce the pressure at the municipal level.	1. Technical reports and relevant policy documents
Output 7.3 Put measures in place to reduce non-revenue water losses from the existing water piping network	**Activity 7.3.1** Conduct a survey to identify areas that require intervention. **Activity 7.3.2** Develop a rehabilitation and upgrade plan for the water sector. **Activity 7.3.3** Commission rehabilitation work on existing water pipes **Activity 7.3.4** Explore options for piloting the smart metering system in the area	This activity will primarily entail the replacement of old degraded pipelines with new ones to reduce leakage. This will also involve the installation of smart metering systems that can better account for water distribution within the water piping network.	1. Technical reports 2. Rehabilitation and upgrade plan for the water sector 3. Implementation of pilot projects for the smart metering system 4. M&E reports
Output 7.4 Implementation of new initiatives to increase the use of greywater, especially in the	**Activity 7.4.1** Conduct sensitization campaign to educate the public on the benefits of greywater usage. **Activity 7.4.2** Explore	This activity will promote the storage and use of grey water to aid in water conservation.	1. Sensitization strategy document 2. MOUs and partnership agreements

commercial and tourism sectors	potential partnerships with regional organizations such as the Caribbean Water and Wastewater Association (CWWA) and Global Water Partnership Caribbean (GWPC) to pilot greywater use		
Output 7.5 Provision of water storage facilities to residents in vulnerable households in at-risk communities such as Grey's Farm and Pointe to increase resilience to drought hazards	**Activity 7.5.1** Survey at-risk communities to determine and map households that need water storage systems. **Activity 7.5.2** Provide water storage devices to the most vulnerable households identified from the community water survey and inventory exercise	Water storage devices will be provided to the most vulnerable households in at-risk communities to improve their ability to store water for household consumption.	1. Community household survey and inventory document 2. Project implementation document
Outcome 8 Increased uptake of renewable energy technologies by businesses and households			
Output 8.1 Incentivize the uptake of solar energy	**Activity 8.1.1** Survey homeowners/tourists and local businesses on willingness to install solar energy systems. **Activity 8.1.2** Evaluate affordability and financing options for different solar energy technologies	This initiative will develop incentive packages to encourage persons to install solar systems at the local scale.	1. A survey report and feasibility study 2. Incentives program designed and implemented under the coordination of relevant Government agencies
Output 8.2 Establishing urban greening projects aimed at regulating local urban microclimates	**Activity 8.2.1** Survey homes, buildings, and other properties to determine the potential for installing green roofs, rain gardens, and infiltration basins. **Activity 8.2.2** Identify locations that can be used as green areas. **Activity 8.2.3** Mandate the use of green infrastructure in new developments (e.g., use of grasscrete in parking spaces and hedges instead	This initiative will seek to promote urban greening and sustainability projects such as green roofs and tree planting activities to reduce the urban heat island effect and increase surfaces for infiltration across the city.	1. A survey report and feasibility study 2. Incentives program designed and implemented under the coordination of relevant Government agencies

	of concrete walls etc.) **Activity 8.2.4** Promote ongoing tree planting initiative. **Activity 8.2.5** Conduct an assessment to determine fossil fuel usage in the city		
Outcome 9 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels			
Output 9.1 Expand and elevate the port to reduce the risk of coastal inundation and loss of prime coastal lands. Should include the following facilities: Heritage Quay, Redcliffe Quay and Point Wharf	**Activity 9.1.1** Conduct a comprehensive coastal assessment of the port and surrounding areas. **Activity 9.1.2** Use results to develop a proposal for addressing any climate-related risks identified. **Activity 9.1.3** Share proposals with key stakeholders to get feedback and buy-in **Activity 9.1.4** Mobilize resources for executing the project	This activity will involve raising the current level of the St. John's City port facility to accommodate projected increases in mean sea level.	1. Coastal assessment reports for the port 2. Technical reports and plans 3. Completed and signed contracts and TORs 4. Stakeholder consultation notes 5. Financial reports and audits 6. M&E reports
Output 9.2 Establishing a stormwater pumping system for the coast	**Activity 9.2.1** Develop a stormwater master plan for the area. **Activity 9.2.2** Commission the construction of a stormwater pumping system for the St. John city local area comprising stormwater pumping stations, injection wells and other supporting infrastructure	This activity will involve a series of infrastructure projects designed to remove floodwaters from low-lying sections of the city.	1. Stormwater master plan and accompanying reports 2. Completed and signed contracts and TORs 3. Financial reports and audits 4. M&E reports
Output 9.3 Planned coastal retreat (where feasible) for certain key infrastructure and assets. This may include facilities like the Barnes	**Activity 9.3.1** Perform desk review of relevant documents to understand common themes in managed coastal retreat programs in other parts of the world. **Activity 9.3.2** Perform stakeholder validation	This initiative will entail the development of a managed coastal retreat plan for certain sectors, communities and key infrastructures that are located in high-risk zones.	1. Desk study 2. Workshop reports and notes 3. Assessment of the feasibility and implications of managed retreat strategies for vulnerable coastal

Funeral Home or sewage plants that may pose acute health risks to the general population	workshops to evaluate lessons learned and managed retreat scenarios with (residents, tourism and local businesses)		areas of St. John's City
Output 9.4 Promoting future housing and business developments further inland to reduce exposure to projected SLR	**Activity 9.4.1** Identify areas within the city that are at risk and designate them as no-build zones. **Activity 9.4.2** Identify areas inland that are not at risk where future developments can occur. **Activity 9.4.3** Produce planning guidance and expansion restrictions for coastal zone developments	This activity will entail the development of a master plan to manage future coastal development and encourage inland developments for the city.	1. List of no-build zones 2. List of available land that can accommodate the development. 3. Development of policies and incentive mechanisms to build further inland (e.g., tax credits, subsidies)
Outcome 10 Increased enabling environment for the expansion of and investment in the Blue Economy Sector in St. John City			
Output 10.1 Blue economy jobs promoted where feasible to explore benefits from a growing marine resource base	**Activity 10.1.1** Survey local fishermen, tourism and businesses in the area to identify daily activities, and major issues or challenges. **Activity 10.1.2** Consult with statutory bodies within the Ministry of Tourism, Investment and Economic Development (Antigua and Barbuda Tourism Authority, Antigua and Barbuda Investment Authority) to determine the strategy for capitalizing on the Blue Economy **Activity 10.1.3** Perform economic valuation of the St. John's city local area. **Activity 10.1.4** Explore investment opportunities that can help to grow the Blue Economy	This activity will entail setting up the foundation for the development of a viable blue economy for the area.	1. Surveys and other technical reports 2. Training manuals and guidelines 3. Pilot projects based around blue economy initiatives. 4. Economic evaluation report 5. List of potential investors

Table 22: The eleven (11) outcomes and associated outputs for the Darkwood Beach LAAP 2023-2033

Output	Activities	Description	Deliverables
Outcome 1 Improved protection from wind damage and impacts from storm surges through the implementation of offshore and nearshore protective infrastructure			
Output 1.1 Coastal engineering study to evaluate and recommend the most feasible coastal and offshore protection measure commissioned	**Activity 1.1.1** Conduct a coastal engineering study (inclusive of a bathymetry study) to determine the feasibility of different coastal and offshore protection measures for the Jolly Harbour to Johnsons Point local area. **Activity 1.1.2** Consult with stakeholders to get feedback and buy-in for the project. **Activity 1.1.3** Mobilize resources for the project design and commission of the construction for the recommended coastal works (e.g., offshore breakwater system)	This initiative will involve the feasibility and design study as well as the construction of the recommended coastal works (e.g., offshore breakwater structures to assist in reducing wave erosion and mitigating impacts from storm surges).	5. Technical reports from coastal engineering study (inclusive of feasibility and bathymetric studies) 6. Workshop notes and reports 7. Approved contracts and TORs 8. Several newly constructed recommended coastal protective measures (e.g., offshore breakwaters) 9. Financial reports and audits 10. Establishment of coastal zone management and planning processes that build climate resilience
Outcome 2 Enhanced and rehabilitated marine ecosystems that provide greater coastal protection from storm surge and wave erosion			
Output 2.1 Restoration of degraded wetlands /mangroves in the vicinities of Darkwood Beach, Turner's Beach and the Valley Church Bay areas	**Activity 2.1.1** Mapping and remote sensing of mangrove/wetland identifying areas of degradation. **Activity 2.1.2** Conduct hydrological assessment for wetland/ mangrove ecosystems in the area **Activity 2.1.3** Initiate project to replant mangroves guided by previous studies. **Activity 2.1.4** Establish baselines and monitoring and evaluation plan for biodiversity and carbon sequestration in mangroves and wetlands	These activities will characterize the wetland/ mangrove ecosystem and its hydrology within the Jolly Harbour to Johnsons Point local area to guide the appropriate restoration activities. These will be supported by protection measures to assist in rehabilitating the degraded mangroves/wetlands.	4. Technical report outlining results of the mapping exercise and hydrological assessment. 5. M&E Plan/Framework for evaluating biodiversity and carbon sequestration. 6. Mangrove/Wetland Rehabilitation Plan

Output	Activities	Description	Deliverables
Output 2.2 Restoration of seagrass bed in the nearshore zone along Jolly Harbour, Ffryes Beach to Fort Johnston's Point	**Activity 2.2.1** Mapping and remote sensing of existing seagrass bed noting critical ecological features. **Activity 2.2.2** Conduct marine assessment and feasibility study to determine viability for seagrass replanting. **Activity 2.2.3** Commission replanting of seagrass bed at approved sites in collaboration with local stakeholder organization	This initiative will involve understanding the benthic environment off the coast of Jolly Harbour to Johnsons Point to determine the viability for replanting of the seagrass beds.	1. Baseline study and rehabilitation plan for seagrass bed and accompanying TOR 2. Technical reports from mapping and remote sensing exercise 3. Establishment of coastal zone management and planning processes that build climate resilience
Outcome 3 Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges in coastal communities such as Jolly Harbour, Bolans and Johnson's Point			
Output 3.1 Approval of the revised building code which accounts for the growing threats posed by hurricanes, increased flood risks, and drought resilience.	**Activity 3.1.1** Obtain final governmental approval of the revised building codes. **Activity 3.1.2** Revisions/strengthening of existing legislation (EPMA, the Physical Planning Act 2003) and the National Physical Development Plan (NPDP) to ensure the use of the revised codes is mandated by law in new developments. **Activity 3.1.3** Identify and procure resources and training needed to implement and enforce the use of the updated building code	This initiative is already underway and involves the approval of the revised national building code for Antigua and Barbuda to accommodate more extreme climate events. It also involves legally mandating its use and strengthening the capacity to enforce its use in new developments.	2. Approved national building code
Output 3.2 Renovation of existing critical facilities such as emergency shelters, schools and health facilities that are at risk from wind damage and coastal	**Activity 3.2.1** Develop an inventory of existing facilities and identify facilities that require renovation. **Activity 3.2.2** Renovate selected facilities in line with revised national building code requirements	This initiative will build on existing activities to identify and renovate existing critical facilities in Jolly Harbour to Johnsons Point to build resilience to hurricane and storm impacts.	4. Inventory of all critical facilities and their resource needs 5. Relevant policy documents, MOUs etc. 6. Implementation plan and guidelines for upgrading existing facilities

Output	Activities	Description	Deliverables
flooding (include health centers in Bolans and Johnson's Point, the Ffryes Beach RO Plant, Jolly Harbour Gas Station, St. Mary School and Valley Church).			
Output 3.3 Power lines and communication network along Valley Road and in Jolly Harbour and Bolans relocated underground to protect against wind and flood damage	**Activity 3.3.1** Mapping locations of most vulnerable power lines and related communication infrastructure to wind damage and storm surge impact **Activity 3.3.2** Consult with Public Works and APUA on options to protect this infrastructure when placing underground	This initiative is intended to build resilience in the energy and telecommunication sectors by placing powerlines and communication infrastructure underground where they are less exposed to climatic risks.	5. Flood and hurricane hazard maps for road and communication infrastructure 6. Detail road and communications network infrastructure map and implementation plan 7. Financial reports and audits 8. MOUs and other policy documents
Outcome 4 Increased uptake of climate/ hurricane risk insurance schemes by local farmers and fishers, and businesses			
Output 4.1 Feasibility Assessment for the establishment of a climate risk insurance scheme	**Activity 4.1.1** Conduct a feasibility study with local stakeholders. **Activity 4.1.2** Develop a parametric-based climate risk insurance scheme	This initiative is aimed at building resilience in the local farming, fishing, hotel and small business sectors through the provision of a suitable climate risk insurance mechanism. This risk-transfer mechanism will provide tailored financial assistance to those in key vulnerable sectors in the event of a natural disaster.	3. Completed feasibility study 4. Tailored parametric-based climate insurance instruments
Output 4.2 Sensitization on the new climate or hurricane risk insurance scheme that fosters the uptake for the farming, fisheries, resort and local	**Activity 4.2.1** Plan and execute in sessions/workshops	This initiative is aimed at sensitizing local stakeholders about the benefits of the insurance scheme with the hope of gaining useful feedback and buy-in.	3. Sensitization strategy document 4. Workshop notes and reports

Output	Activities	Description	Deliverables
business sectors			
Outcome 5 Increased capacity of drainage infrastructure within Jolly Harbour, and along Valley Road to better channel stormwater, improve solid waste management and reduce the incidence of localized flooding			
Output 5.1 Expanded and improved network of drains, canals, and waterways throughout Jolly Harbour to Johnsons Point	**Activity 5.1.1** Conduct a study to determine the volume and peak rate of runoff. **Activity 5.1.2** Conduct a study to determine how wide drains, canals and waterways can be expanded within their existing location. **Activity 5.1.3** Develop terms of reference for a competitive bidding process. **Activity 5.1.4** Contract local construction/engineering company to expand drains, canals and waterways	This initiative will involve the identification and expansion of existing drains, canals, and waterways throughout the local area.	6. Technical reports 7. Completed and signed contracts and TORs 8. Improved stormwater infrastructure that is climate resilient 9. Financial reports and audits 10. M&E reports
Output 5.2 Retrofitting at-risk sections of Valley Road (e.g., the segment in the vicinity of the Darkwood Pond) to protect against future flood impacts and coastal erosion	**Activity 5.2.1** Survey existing roads for evidence of deterioration and/or damage and identify roads that typically flood during rainfall events. **Activity 5.2.2** Evaluate and test different erosion-control techniques such as embankments that resist washing out, rubber liners and reduced slopes	This initiative will involve the construction of drains and culverts at certain sections of the roadway to channel and divert flood waters away from the road infrastructure.	7. Technical report documenting high-risk sections of the roadway. 8. Road rehabilitation plan and guidelines document 9. Financial reports and audits
Outcome 6 Improved solid waste management practices within at-risk communities in Jolly Harbour, Bolans, Jennings, and Johnsons Point			
Output 6.1 PR campaign around best practices for household solid waste management in Jolly Harbour, Bolans, Jennings, and Johnsons Point	**Activity 6.1.1** Develop a communication strategy	This initiative will entail a series of PR campaigns (television, radio, and other media) to educate and sensitize the general public about the importance of solid waste management.	4. Media campaign strategy document and plan (media coverage of activities) 5. Education toolkit (school field trips, primary and secondary school demonstrations) 6. Electronic news bulletin to highlight local action

Output	Activities	Description	Deliverables
Output 6.2 Recycling services are provided for businesses and residences to collect plastics, metals, and other forms of solid waste	**Activity 6.2.1** Consult with waste facilities and the Ministry of Health, Wellness and the Environment (DoE, National Solid Waste Authority) about establishing acceptance criteria for plastics, metals materials and other forms of solid waste. **Activity 6.2.2** Explore options for partnering with private sector partners to develop recycling services for the area	This activity will develop a framework for expanding recycling services in the Jolly Harbour to Johnsons Point local area.	3. MOUs and other relevant policy documents 4. Recycling system that provides waste disposal services
Outcome 7 Expanded water storage capacity			
Output 7.1 Develop measures like tax incentives to encourage local businesses and resorts to invest in micro-scale desalination technologies to reduce the pressure of other desalination plants in the area	**Activity 7.1.1** Provide tax and customs duty relief to incentivize local businesses and hotels to invest in microscale desalination technologies	This initiative is intended to facilitate the decentralization of water production to reduce the pressure at the parish and national levels.	3. Technical reports and relevant policy documents
Output 7.2 Put measures in place to reduce non-revenue water losses from the existing water piping network	**Activity 7.2.1** Conduct a survey to identify areas that require intervention. **Activity 7.2.2** Develop a rehabilitation and upgrade plan for the water sector. **Activity 7.2.3** Commission rehabilitation work on existing water pipes **Activity 7.2.4** Explore options for piloting the smart metering system in the area	This activity will primarily entail the replacement of old degraded pipelines with new ones to reduce leakage. This will also involve the installation of smart metering systems that can better account for water distribution within the water piping network.	2. Technical reports 3. Rehabilitation and upgrade plan for the water sector 4. Implementation of pilot projects for the smart metering system 5. M&E reports
Output 7.3	**Activity 7.3.1** Conduct a	This activity will promote the	5. Sensitization strategy

Output	Activities	Description	Deliverables
Implementation of new initiatives to increase the use of greywater in business and tourist establishments along the local area	sensitization campaign to educate the public on the benefits of greywater usage. **Activity 7.3.2** Explore potential partnerships with regional organizations such as the Caribbean Water and Wastewater Association (CWWA) and Global Water Partnership Caribbean (GWPC) to pilot greywater use.	storage and use of grey water to aid in water conservation.	document 6. MOUs and partnership agreements
Output 7.4 Provision of water storage system to residents in vulnerable households in Bolans, Jennings, and Johnsons Point to assist during times of drought	**Activity 7.4.1** Survey at-risk communities to determine and map households that need water storage systems. **Activity 7.4.2** Provide water storage devices to the most vulnerable households identified from the community water survey and inventory exercise	Water storage devices will be provided to the most vulnerable households in at-risk communities to improve their ability to store water for household consumption.	3. Community household survey and inventory document 4. Project implementation document
Outcome 8 Increased uptake of drought risk insurance schemes by local farmers			
Output 8.1 Setting up a climate or drought risk insurance scheme tailored for local farmers	**Activity 8.1.1** Explore options with private sector partners to set up a tailored drought risk insurance scheme. **Activity 8.1.2** Conduct a feasibility study with local farmers to determine their willingness to participate in the program (this should be done in tandem with a sensitization campaign on the benefits of a risk insurance scheme)	This initiative is aimed at building resilience in the local farming sector through the provision of a drought risk insurance mechanism. This risk-transfer mechanism will provide much-needed financial assistance to the sector during periods of prolonged drought.	3. Completed feasibility study. 4. Tailored drought risk insurance instruments
Outcome 9 Increased uptake of renewable energy and climate-smart technologies by businesses and households in the Jolly Harbour to Johnsons Point area			
Output 9.1 Incentivize the uptake of solar	**Activity 9.1.1** Survey homeowners/tourists and local businesses on	This initiative will develop incentive packages to encourage persons to install	7. Survey report and feasibility study 8. Incentives program

Output	Activities	Description	Deliverables
energy	willingness to install solar energy systems. **Activity 9.1.2** Evaluate affordability and financing options for different solar energy technologies	solar systems at the local scale.	designed and implemented under the coordination of relevant Government agencies
Output 9.2 Implementation of projects to facilitate technology transfer in the agriculture sector to build resilience to drought and heat impacts (e.g., water storage, hydroponics and drought-resistant crops)	**Activity 9.2.1** Agricultural survey in the area to identify resource and technology needs. **Activity 9.2.2** Training and capacity building initiatives around climate-smart agricultural practices **Activity 9.2.3** Pilot projects aimed at demonstrating the usefulness of different forms of technology e.g., rainwater harvesting, drought tolerant crops etc.	This activity will facilitate farmer training in climate-smart agricultural practices and the transfer or piloting of various technologies and innovations to build climate resilience in the sector.	5. Agricultural survey 6. Training manuals 7. Project implementation plans and M&E reports
Outcome 10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels			
Output 10.1 Expand, reinforce and/or elevate the road network to reduce the risk of coastal inundation and loss of prime coastal lands	**Activity 10.1.1** Conduct a comprehensive coastal assessment of the coastline within the local area (can be split into sections to focus on the various issues like coastal erosion, beach erosion, and coastal flooding in various areas within the local area) **Activity 10.1.2** Use recommendations from the studies to develop targeted projects. **Activity 10.1.3** Mobilize resources for executing these projects	This activity will entail understanding the coastal dynamics of the coastal zone within the area and using the information to guide works along Valley Road to address existing coastal issues and future challenges that may be caused by the projected increases in mean sea level.	6. Coastal inundation hazard maps 7. Feasibility study 8. Completed and signed contracts and TORs 9. Financial reports and audits 10. M&E reports
Output 10.2 Coastal engineering study that evaluated and recommended the most feasible	**Activity 10.2.1** Conduct feasibility and bathymetric study to determine the appropriate recommendation for coastal	This initiative will involve the construction of the appropriate coastal works for the area which might include sea walls and dykes	1. Technical reports from feasibility and bathymetric studies 2. Workshop notes and reports

Output	Activities	Description	Deliverables
coastal and offshore protection measure commissioned followed by implementation	protection works and placement and design of these (e.g., sea walls and dykes) **Activity 10.2.2** Consult with stakeholders to get feedback and buy-in for the project. **Activity 10.2.3** Mobilize resources for the project and commission the construction of protective coastal works (e.g., sea walls and dykes)	designed to prevent coastal inundation from rising sea levels.	3. Approved contracts and TORs 4. Several newly constructed coastal protective works (e.g., sea wall defences and dykes) along the coastline 5. Financial reports and audits
Output 10.3 Planned coastal retreat for certain key infrastructure and assets where feasible	**Activity 10.3.1** Perform desk review of relevant documents to understand common themes in managed coastal retreat programs in other parts of the world. **Activity 10.3.2** Perform stakeholder validation workshops to evaluate lessons learned and managed retreat scenarios with (residents, tourism and local businesses)	This initiative will entail the development of a managed coastal retreat plan for certain sectors, communities and key infrastructure that are located in high-risk zones.	1. Desk study 2. Workshop reports and notes 3. Assessment of the feasibility and implications of managed retreat strategies for vulnerable coastal areas of Jolly Harbour to Johnsons Point
Outcome 11 Established enabling environment for the expansion of and investment in the Blue Economy Sector in the Jolly Harbour to Johnsons Point Area			
Output 11.1 Blue economy jobs promoted where feasible to explore benefits from a growing marine resource base	**Activity 11.1.1** Survey local fishermen, tourism and businesses in the area to identify daily activities, and major issues or challenges. **Activity 11.1.2** Consult with statutory bodies within the Ministry of Tourism, Investment and Economic Development (Antigua and Barbuda Tourism Authority, Antigua and Barbuda Investment Authority) to determine the strategy for capitalizing on the Blue Economy **Activity 11.1.3** Perform	This activity will entail setting up the foundation for the development of a viable blue economy for the area.	1. Surveys and other technical reports 2. Training manuals and guidelines 3. Pilot projects based around blue economy initiatives. 4. Economic evaluation report 5. List of potential investors

Output	Activities	Description	Deliverables
	economic valuation of the Jolly Harbour to Johnsons Point local area. **Activity 11.1.4** Explore investment opportunities that can help to grow the Blue Economy		

Table 23: The twelve (12) outcomes and associated outputs for the St. John's City LAAP 2023-2033

Output	Activities	Description	Deliverables
Outcome 1 Improved protection from wind damage and impacts from storm surges through ecosystem maintenance and the implementation of offshore and nearshore protective infrastructure.			
Output 1.1: The use of enforcement officers to deter illegal dumping within the NEMMA to preserve the storm surge barrier functions of the mangroves and wetlands along Fitches Creek Bay	**Activity 1.1.1** Perform surveillance activities to protect mangroves/wetlands and maintain stream channel integrity	Create monitoring protocols that strengthen the sustainable management of the NEMMA.	11. Enhanced institutional capacity for surveillance and enforcement
Output 1.2 Maintenance cleaning programme for the NEMMA established to reduce garbage that is affecting the storm surge barrier integrity of mangroves along Fitches Creek Bay	**Activity 1.2.1** Establishment of waste management standards for proper disposal of household garbage	Create waste disposal quality standards for household disposal of garbage.	1. A comprehensive management plan for mangrove/wetland monitoring
Output 1.3 Enforced coastal setback recommendations along Shoal Bay and Dutchman Bay	**Activity 1.3.1** Maintain a database of vulnerable buildings and critical infrastructure where the impacts of sea level rise are being observed. **Activity 1.3.2** Installing weather gauge station to monitor rainfall, wind speed, and sea level rise. **Activity 1.3.3** Revisions to EPMA and Physical Planning Act, and National Physical Development plan	Perform spatial analysis to evaluate the number of buildings and critical infrastructure exposed to different SLR scenarios. Installation of weather gauge stations to create local records that measure weather and climatic conditions to guide coastal setback recommendations. Revisions to legislation and guiding planning documents provide the requirements for building behind the coastal setback	1. Establishment of coastal zone management and planning processes that build climate resilience

Output	Activities	Description	Deliverables
	to include coastal setback recommendations	line	
Output 1.4 Restoration of degraded mangroves/wetlands along Fitches Creek Bay	**Activity 1.4.1** Mapping and remote sensing of mangrove/wetland extend noting critical ecological features. **Activity 1.4.2** Rehabilitate degraded stream channels. **Activity 1.4.3** Establish baselines and monitoring and evaluation plan for biodiversity and carbon sequestration in the mangrove areas	Identify the cause of mangrove/wetland degradation and determine solutions to ensure areas can provide ecosystem services under changing climate.	1. Strengthened awareness of the value and importance of mangroves in the Fitches Creek Bay area 2. Rehabilitation plan for mangroves affected by illegal dumping
Outcome 2: Improved critical infrastructure and buildings with reduced susceptibility to impacts from hurricanes and storm surges.			
Output 2.1 Storm proofing power grid (e.g., installing flood barriers) for Camp Blizzard Reverse Osmosis Plant, and the Shell Beach Reverse Osmosis Plant	**Activity 2.1.1** Consult with RO operators, APUA and Ministry of Works on already-existing efforts to storm proof power grids. **Activity 2.1.2** Perform feasibility study for regional grid stations. **Activity 2.1.3** Retrofit existing or constructing new flood barriers	Perform spatial analysis to evaluate the number of buildings and critical infrastructure exposed to different storm surge scenarios. Discussions (interviews) with stakeholders involved in power supply to understand what is currently being done to protect power grids from hurricanes and tropical storms. Preliminary exploration of installing isolated electric power systems that do not have to connect to the national grid. Fix existing flood barrier systems if damaged or deteriorating. Install new flood barriers for vulnerable critical infrastructure that need	7. Flood barrier systems installed and used to protect key vulnerable critical infrastructure

Output	Activities	Description	Deliverables
		protection but do not have it.	
Output 2.2 Approval of the revised building code which accounts for the growing threats posed by hurricanes, increased flood risks, and drought resilience	**Activity 2.2.1** Identification of hurricane building retrofitting measures. **Activity 2.2.2** Revisions/strengthening of existing legislation (EPMA, the Physical Planning Act 2003), National Physical Development Plan (NPDP) and newly proposed OECS building code (2020) **Activity 2.2.3** Identify and procure resources, and training needs to implement updated building code	Understand already-existing efforts to retrofit buildings for hurricane damage. Improve building code to create buildings that are resilient to hurricane wind damage. Identify financial and material resources to implement different hurricane building code measures. Train existing and hire new personnel to install and enforce measures	4. Capacity to implement hurricane-proof building code
Output 2.3 Secure power lines and communication network to protect against wind and flood damage	**Activity 2.3.1** Maintain a database of locations where power lines and communication infrastructure have been affected by hurricane/storm related wind damage. **Activity 2.3.2** Consult with Public Works and APUA on options to protect this infrastructure when placing underground is not an option due to high flood risk	Perform spatial analysis to evaluate the number of power lines and related communication infrastructure exposed to different wind speed scenarios. Consult with relevant stakeholders to determine the benefits and challenges of placing power lines and communication network underground	1. A select number of power lines and communication systems that are wind and flood proof
Outcome 3 Reduced interruption of essential services through alternative energy and water supply			
Output 3.1 Decentralized power and water supplies to reduce operational reliance on centralized power and water systems	**Activity 3.1.1** An analysis of socio-economic conditions, willingness-to-pay and affordability of decentralized water and power supplies. **Activity 3.1.2** Documentation and description of costs and	An analysis that assesses to what extent renewable energy and rainwater-based water collection can be implemented across households. Estimate costs of implementing a system that generates water	3. Implementation plan and guidelines for stabling decentralized interventions

Output	Activities	Description	Deliverables
	benefits for solar-energy efficient electricity and freshwater cogeneration system (e.g., costs of batteries, green roofs) **Activity 3.1.3** Survey of persons with cisterns and solar panels	desalination and electricity production using solar energy. Count the number of persons/households that have cisterns and solar panels already installed at their residence	
Output 3.2 Disaster risk management plan formulated detailing mitigation, preparedness, response and recovery to build resilience to essential services	**Activity 3.2.1** Mapping locations of all essential services (emergency shelters, fire department, police department, hospitals/health centres, power stations) **Activity 3.2.2** Consult with local disaster coordinators and APUA to identify issues and challenges	Create a map that delineates locations of all essential services and measuring the distance to such services. In discussion with local disaster coordinators and APUA, determine current disaster planning efforts and issues for creating a coordinated disaster plan.	7. Draft disaster plan to reduce risk across different sectors from extreme weather events
Outcome 4 Increased capacity of drainage infrastructure to better channel stormwater, improve solid waste management and reduce incidence of localized flooding			
Outcome 4.1 Drainage clearing programs with expanded and improved network of drains, canals and waterways throughout Airport/Fitches Creek area including Piggotts	**Activity 4.1.1** Consult with residents and local businesses in area to identify common areas of flooding and observations of clogged drains. **Activity 4.1.2** Consult with Solid Waste Management Authority, Department of Environment, and Ministry of Works to assess needs and financial costs to clear drainage points	Perform spatial analysis to evaluate inland flooding risk across Piggott's and Fitches Creek. Discussions with residents and local businesses to understand their experiences with inland flooding and what they think the cause is. Discussions with stakeholders involved in drainage maintenance to develop a clearing strategy.	5. Maintenance plan for drainage clearing
Output 4.2 Retrofitting the existing road network particularly along St. George's Drive, Burma Rd, and Jabberwock Rd to protect against	**Activity 4.2.1** Survey existing roads for evidence of deterioration and/or damage **Activity 4.2.2** Evaluate and test different erosion-control techniques such as embankments that resist washing out, rubber liners	Site visits to vulnerable roads to observe and document cracks, washed out sections, erosion, and assess asphalt durability and strength. Install and experiment with different erosion-control techniques for roads that	5. Engineering methods that protect existing roads when they are flooded

Output	Activities	Description	Deliverables
future flood impacts	and reduced slopes	cannot be elevated.	
Output 4.3 Implemented computer database system that monitors and evaluates drainage issues, including leaks to manage their status in real-time and used across various governmental entities to manage infrastructure	**Activity 4.3.1** Survey number and types of computers, internet routers, software, cable systems and wireless networks **Activity 4.3.2** Consult with APUA and IT persons at ministries (Public works) about major challenges and issues **Activity 4.3.3** Design on-site data collection procedures for regular field site visits	Create a document that provides an overview of existing IT infrastructure. Discuss with relevant IT and road maintenance stakeholders about installing and coordinating a centralized database system. Develop data collection procedures that can be entered and recorded into a database system.	1. Installation of IT infrastructure forming coordination between different Ministry of Works personnel for documentation and recording of drainage issues
Outcome 5 Increased capacity to handle extreme precipitation events through nature-based solutions			
Output 5.1 Expand green infrastructure such as rain gardens, tree lines, green roofs, infiltration basins	**Activity 5.1.1** Survey homes/buildings/properties to determine potential for installing green roofs, rain gardens, and infiltration basins. **Activity 5.1.2** Promote installation of green infrastructure through incentives	Evaluate how different green infrastructure measures can be designed and implemented. Encourage the installation of green infrastructure through offering grants, development incentives, rebates and installation financing and utility fee discounts.	11. Incentives program designed and implemented under the coordination of relevant Government agencies (Department of Environment, Development Control Authority)
Outcome 6 Improved solid waste management practices within at-risk communities			
Output 6.1 PR campaign around best practices for household solid waste management	**Activity 6.1.1** Develop communication strategy	Enhance public awareness and influence behaviour change on disposing of waste so that it does not negatively affect drainage.	7. Media campaign (media coverage of activities) 8. Education toolkit (school field trips, primary and secondary school demonstrations) 9. Electronic news bulletin to highlight local action
Output 6.2	**Activity 6.2.1** Consult with	Identify options for	5. Recycling system that

Output	Activities	Description	Deliverables
Provision of recycling services provided for businesses and residences to collect plastics, metals, and other forms of solid wastes	waste facilities and Ministry of Health, Wellness, and the Environment (DoE, National Solid Waste Authority) about establishing acceptance criteria for plastics, metals materials and other forms of solid waste	recycling and composting for different materials and waste.	provides waste disposal services
Outcome 7 Expanded water storage capacity			
Output 7.1 Expanded rainwater harvesting and water catchment/ storage systems for farmers and residents	**Activity 7.1.1** Consult with farmers about local water harvesting and major challenges. **Activity 7.1.2** Identify and survey old, broken or damaged rainwater harvesting systems. **Activity 7.1.3** Install storm-proof rain, grey water and wastewater harvesting systems for small-scale farmers	Interview farmers to gather details about rainwater harvesting practices. Determine rainwater harvesting systems that need repair or replacement. Assist farmers in protecting water harvesting systems.	4. Increase farmer access to rainwater harvesting systems
Output 7.2 Develop measures to encourage local businesses and hotels across the local area to invest in micro-scale desalination technologies to reduce the pressure at the municipal level	**Activity 7.2.1** Select technologies that can be used to pilot small-scale water supply system. **Activity 7.2.2** Identify and select areas within Piggott's/Fitches Creek where small-scale system facilities can be built and operated	Assess capacity and materials to pilot small/community scale water supply systems, specifically evaluate building materials needed and potential to treat water contaminants. Survey land/and or facilities not in use where small/community scale water systems can be installed.	6. Produce small-scale/community-based water supply system
Outcome 8 Reduced damage to coastal critical infrastructure			
Output 8.1 Monitoring programs to	**Activity 8.1.1** Conduct assessments of sargassum influx near both reverse	Determine the extent in which sargassum reaches the properties of RO	5. Management plan for regularly clearing sargassum nearby

Output	Activities	Description	Deliverables
remove sargassum from reverse osmosis plant properties	osmosis plants **Activity 8.1.2** Consult with RO operators, APUA, and Ministry Works on current sargassum clearing efforts and evaluate opportunities and challenges in implementing regular clearing measures	plants. Conduct interviews to understand RO stakeholder experiences with sargassum management and evaluate measures to maintain clearance.	critical coastal infrastructure
Outcome 9 Increased uptake of renewable energy technologies by small businesses and households			
Output 9.1 Incentivized uptake of solar energy	**Activity 9.1.1** Survey homeowners/tourist and local businesses on willingness to install solar energy measures. **Activity 9.1.2** Evaluate affordability and financing options for different solar energy technologies	Determine area stakeholder inclination to install solar energy, specifically determining what factors are influencing stakeholders' disinterest in adopting such measures. Document and explore how much solar technologies would cost household versus tourist property versus local business.	9. Incentive scheme that promotes increased energy efficiency and introduction of solar energy usage on smaller scale
Outcome 10 Improved critical infrastructure and buildings with reduced susceptibility to impacts from higher mean sea levels			
Output 10.1 Elevate the road network and install coastal barriers to accommodate some degree of inundation particularly along St. George's Drive, Burma Road, and Jabberwock Road and AUA campus	**Activity 10.1.1** Conduct feasibility study for road elevation (e.g., make sure raising road does not create backwater flooding) **Activity 10.1.2** Consult with Public Works and local contractors to evaluate different design options	Perform spatial analysis to evaluate the number of roads exposed to flood inundation. Assess which roads will be able to be elevated without causing negative feedback such as backwater flooding which is upstream flooding caused by downstream conditions such as a roadway with a bridge in a floodplain. Use feasibility study to discuss design options for road elevation.	11. Elevated roads in areas that will not cause adverse effects such as upstream flooding

Output	Activities	Description	Deliverables
Output 10.2 Decrease corrosion of water pipes from saltwater intrusion along Burma Road	**Activity 10.2.1** Monitoring and evaluation of coastal land development, water quality, and wetlands **Activity 10.2.2** Regulation of habitat preservation within NEMMA **Activity 10.2.3** Engineering structures for increasing drainage for better flushing of salts from ground surface	Surveillance of sensitive areas that prevent storm surge such as wetland ecosystems. Legislation and policies that delineate protection of habitats within NEMMA to preserve the integrity of wetland ecosystems to control flooding. Explore and implement hard or soft shoreline maintenance interventions as allowed within the NEMMA to lessen saltwater intrusion.	6. Adaptation strategies for saltwater intrusion
Outcome 11 Decreased building damage and losses from rising sea levels			
Output 11.1 Plans for managed retreat/relocation of vulnerable buildings and infrastructure along the coastline	**Activity 11.1.1** Perform desk review of relevant documents to understand common themes in managed retreat programs in other parts of the world. **Activity 11.1.2** Perform stakeholder validation workshop with to evaluate lessons learned and managed retreat scenarios with (residents, tourism, and local businesses)	Desk review will produce scenario profiles most found across review of plans from across the world. Workshop will host speakers from similar circumstances to discuss lessons learned in managing retreat. It will also be a forum for stakeholders to provide feedback on willingness to relocate and various scenarios.	6. Assessment of the feasibility and implications of managed retreat strategies for vulnerable coastal areas of the airport/Fitches Creek area
Output 11.2 Promoting future developments further inland to reduce exposure to projected SLR	**Activity 11.2.1** Consult with DCA to determine how future developments can be encouraged further inland. **Activity 11.2.2** Produce planning guidance for the coastal zones of the airport/fitches creek area	Discuss and evaluate ways future development can be discouraged from the coast and be encouraged more inland. Enforceable policy guidelines that create coastal zones where setbacks must be followed.	1. Development of policies and incentive mechanisms to build further inland (e.g., tax credits, subsidies)
Outcome 12 Established enabling environment for the expansion of and investment in the Blue Economy Sector			

Output	Activities	Description	Deliverables
Outcome 12.1 Expanded opportunities for tourism, local businesses and fishermen within NEMMA for blue economy activities	**Activity 12.1.1** Survey local fishermen, tourism and businesses in area to identify daily activities, and major issues or challenges. **Activity 12.1.2** Consult with statutory bodies within Ministry of Tourism, Investment and Economic Development (Antigua and Barbuda Tourism Authority, Antigua and Barbuda Investment Authority) **Activity 12.1.3** Perform economic valuation of Airport/Fitches Creeks areas that falls within NEMMA boundary. **Activity 12.1.4** Perform assessment of local habitats with Environmental Awareness Group (EAG) and DoE	Qualitatively assess the ways various stakeholders utilize the NEMMA for livelihoods. Discuss with various government entities whose job is to inform national development and economic decisions, to establish local goods and services that can increase sustainable livelihoods for residents depending on the ecosystem within the NEMMA. Evaluate the potential economic gains/value-added to the economy from LAAP area goods and services that fall within NEMMA boundary. Work with local environmental groups and Government to assess the state of habitat for LAAP area falling within NEMMA to determine the sustainability of the Blue Economy.	1. Identifying and testing new sustainable livelihood options

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