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RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT THE EASTERN AND SOUTHERN CARIBBEAN REGIONAL REPORT

Antigua and Barbuda – Barbados – Dominica – Grenada – Guyana
St. Kitts and Nevis – St. Lucia – St. Vincent and the Grenadines
Suriname – Trinidad and Tobago



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Cover photos: Top left: Water spills over sea wall barriers during a heavy storm in Georgetown, Guyana. Photo credit: Vanessa Benn

Top right: A restaurant and apartment building in Christ Church, Barbados, have been affected by recent changes in coastal erosion and beach size and are at risk to additional structural damage. Photo credit: Bruce Kernan

Bottom left: A man and his newborn enjoy the beach in Grenada. Photo credit: Toby Carter

Bottom right: A sea wall in the town of Layou, St. Vincent, was constructed in 2006 with funds from the Caribbean Development Bank. Photo credit: Mike Seager

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RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER I: EASTERN AND SOUTHERN CARIBBEAN REGIONAL REPORT

LIST OF ACRONYMS

BMC	Borrowing Member Countries
CARICOM	Caribbean Community
CATHALAC	Water Center for the Humid Tropics of Latin American and the Caribbean
CCCCC	Caribbean Community Climate Change Centre
CDB	Caribbean Development Bank
CEHI	Caribbean Environmental Health Institute
CIF	Climate Investment Funds
CIMH	Caribbean Institute for Meteorology and Hydrology
DMS	Database Management System
ERC	Enhancing Resilience to Reduce Vulnerability in the Caribbean
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Society for International Cooperation)
GoAB	Government of Antigua and Barbuda
GoB	Government of Barbados
GoG	Government of Grenada
IP	Implementation Plan
MR&E	Monitoring, Reporting, and Evaluation
NGO	Nongovernmental Organization
NOAA	National Oceanic and Atmospheric Administration
OECS	Organization of Eastern Caribbean States
PDU	Project Development Unit
PM	Project Manager
PPCR	Pilot Program for Climate Resilience
SKN	St. Kitts and Nevis
SPCR	Strategic Program for Climate Resilience
SLR	Sea Level Rise
SVG	St. Vincent and the Grenadines
TA	Technical Assistance
T&T	Trinidad & Tobago
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase the Eastern and Southern Caribbean countries' mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase the monthly precipitation. A 1-meter rise in sea level together with a 1-in-100-year storm surge by 2080 is predicted to seriously affect the tourist resorts of the eight island countries and impose costs that would seriously affect the economies of all ten countries. In the island countries where tourism is an important component of the economy, tourism would be most affected by sea level rise (SLR) because tourism infrastructure, especially resort hotels, is located along the coast. Such costs may make these countries less competitive in international tourism, thereby reducing employment and income in this and other related sectors of the economy. Several assessments and reports have demonstrated that certain segments of the population—including resource-dependent, low-income, and indigenous groups, and particularly vulnerable individuals such as children, the elderly, and women—may be more affected financially by these effects of climate change than other segments of the population.

10 principal issues related to reducing the countries' vulnerability and increasing their resilience to climate change emerged from the qualitative data that were collected through interviews and focus group discussions:

- 1) financing for conservation of ecosystems;
- 2) participation in ecosystem conservation;
- 3) planning and regulation for ecosystem conservation;
- 4) data collection, analysis, and use;
- 5) institutional capacity;
- 6) policies, laws, and regulations;
- 7) effect of climate change on vulnerable groups;
- 8) potential for clean energy;
- 9) systems for monitoring threats from the effects of climate change; and
- 10) international, donor-funded climate change projects.

To assist the 10 countries to resolve these issues effectively, we recommend that USAID finance measures to:

- 1) realign their financing priorities toward conservation measures as a means to increase their resilience to the effects of climate change;
- 2) improve the level and effectiveness of participation of resource users and vulnerable groups in the conservation of ecosystems;
- 3) plan and regulate the use of marine protected areas;
- 4) increase their capabilities for collecting, analyzing, and using reliable, current data related to climate change;
- 5) strengthen the capabilities of their public and nongovernmental conservation institutions;
- 6) increase their capacity to formulate and enforce regulations for marine protected areas;
- 7) prepare reliable assessments of the effects of climate change on family units, users of natural resources, and vulnerable groups;
- 8) identify the problems and opportunities related to increasing investment in the production of clean energy;
- 9) strengthen regional cooperation in establishing and monitoring indicators of climate change and its effects; and
- 10) strengthen links between infrastructure projects and the conservation of terrestrial and marine ecosystems.

BACKGROUND AND PURPOSE

Table 1 indicates the total population, area, population density, length of coastline, GDP, GDP per capita, and principal economic activities of the 10 Eastern and Southern Caribbean countries.

Table 1 Country profiles

COUNTRY	POPULATION	AREA (KM ²)	POPULATION DENSITY (PERSONS/KM ²)	LENGTH OF COASTLINE (KM)	GDP US\$ BILLION	GDP/ CAPITA	PRINCIPAL ECONOMIC ACTIVITIES
Antigua & Barbuda	90,156	443	204	153	1.61	18,300	Tourism
Barbados	284,000	430	660	97	7.17	25,800	Tourism & light industry
Dominica	73,286	751	98	148	1.02	14,400	Tourism, medical education, agriculture
Grenada	109,590	344	319	121	1.47	13,900	Tourism, spices, cacao
Guyana	739,903	214,969	3	459	6.26	8,100	Sugar, gold, bauxite, shrimp, timber, and rice
St. Kitts & Nevis	51,134	261	196	135	0.95	16,500	Tourism
St. Lucia	174,000	616	282	158	2.23	13,300	Tourism
St. Vincent & the Grenadines	103,220	389	265	84	1.31	12,000	Tourism, bananas, remittances
Suriname	566,846	163,820	3	386	6.87	12,600	Mining
Trinidad & Tobago	1,225,225	5,128	239	362 km	27.14	20,400	Oil/gas
TOTAL	3,417,360	387,151	-	2,103	56.02	-	-

Source: CIA, 2013

The two largest countries are Guyana (214,969 km²) and Suriname (163,820 km²); together they make up 98 percent of the territory of the 10 countries. Of the eight island countries, Trinidad and Tobago is the largest (5,128 km²) and St. Kitts and Nevis is the smallest (261 km²). The populations of the countries range from Dominica's low of 73,286 to Trinidad and Tobago's high of 1,225,225. The most densely populated country is Barbados with 660 people per square kilometer and the least densely populated are Guyana and Suriname, each with only 3 people per square kilometer. Trinidad and Tobago has the largest GDP (US\$27.14 billion) followed by Barbados (US\$7.169 billion) and Suriname (US\$6.874 billion). Together those three countries have a GDP of US\$41.18 billion, which is 74 percent of the total GDP for the 10 countries. Barbados has the highest per capita income (US\$25,800), followed by Trinidad and Tobago (US\$20,400). Only Guyana has a per capita income of less than US\$10,000. The principal economic activity in the seven small island countries is tourism. Oil and gas production is the principal economic activity for Trinidad and Tobago. Mining is the predominant economic activity in Guyana and Suriname (timber and agriculture are also important parts of the economy of Guyana).

The purpose of this regional report is to provide a comparative summary of the findings in the individual country reports on the vulnerability to climate change of the 10 countries that are covered by the USAID/Barbados and Eastern Caribbean Mission: Antigua and Barbuda, Barbados, Dominica, Grenada, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago. The report will contribute to the preparation of the Mission's strategic plan for 2014–18.

METHODOLOGY

The methodology used to prepare these reports utilized the most current documentation¹ to prepare synopses of the vulnerabilities² each country has to the effects of climate change. Using existing documentation, the predicted effects of changes in climate and sea level on the country's physical infrastructure were summarized. Then data was obtained from documents, key informant interviews, and focus group discussions to establish the existing legal and institutional framework in each country for strengthening their capacity to adapt to climate change. Data collected from 274 key informants during individual interviews, group meetings, and focus group discussions, as well as observations made during field visits to 36 sites in the 10 countries³ provided the basis for identifying priority issues and needed actions for the countries to strengthen their legal and institutional capabilities to respond to climate change.⁴ The needed actions were compared to USAID's capabilities to implement those actions. The most appropriate of the actions for USAID financing were identified.

These reports emphasize issues and actions related to increasing the resilience of the countries' marine and terrestrial ecosystems to climate change. There are several reasons for this emphasis. First, to increase the resilience of natural ecosystems requires the protection and management of biodiversity, which is a policy goal of USAID. Second, currently the countries' response to climate change has emphasized physical infrastructure projects, such as beach reconstruction and protection, expansion of energy, water and sewage systems, and reinforcement of roads and bridges. However, these investments are likely to be lost if the natural ecosystems that surround and affect this physical infrastructure are degraded, making them less able to regulate water flows, stabilize soils on steep slopes, or protect beaches from storm surges. Therefore, to some extent, investment in the construction of physical infrastructure without adequate management of the ecosystems that surround it is futile. Third, the Inter-American Development Bank, Caribbean Bank, and World Bank are already financing physical infrastructure projects, so there is little reason for USAID to duplicate what is already being financed adequately. Fourth, USAID and other parts of the United States government have experience with designing, financing, and implementing projects that are intended to improve the management and protection of natural resources, especially with the support and participation of local people.

¹ The most current documentation included the Climate Change Risk Atlas and its reports on each country that were published in 2012 by the organization CARIBSAVE, the report "Modeling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean" prepared by CARIBSAVE in 2010, as well as the national communications to the UNFCCC, among other documentation found in the bibliographies of each country report.

² USAID uses the terminology of the Intergovernmental Panel on Climate Change (IPCC) for climate change issues. **Vulnerability** is "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes and is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity." **Sensitivity** is "the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli." **Exposure** is "the nature and degree to which a system is exposed to significant climatic variations." **Adaptive capacity** is "the ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences."

³ For a complete list of sites visited in the 10 countries, see Annex G.

⁴ Annex B provides the interview guide which was used for the interviews with informants and to guide focus group discussions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 2 indicates the changes in climate that computer models predict will occur in the 10 countries during the 21st century, the percent of tourism resorts that would be affected by a 1-meter rise in sea level combined with a 1-in-100-year storm surge, and the total costs that are predicted of a 1-meter rise in sea level by 2080.

Table 2 Predicted effects of climate change on the Eastern and Southern Caribbean countries

COUNTRY	MEAN ANNUAL ATMOSPHERIC TEMPERATURE	CHANGE IN YEARLY PRECIPITATION	CHANGE IN SEA SURFACE TEMPERATURE	PERCENT OF TOURISM RESORTS AFFECTED BY A 1-M SLR + A 1-IN-100-YEAR STORM SURGE	TOTAL CAPITAL COSTS OF A 1-M SLR BY 2080 (US\$)
Antigua & Barbuda	+2.4°C to 3.2°C	-31 mm/month to +13mm/month	+0.7°C to +2.8°C	53%	2.7 billion
Barbados	+2.4°C to 3.1°C	-36 mm/month to +12 mm/month.	+0.8°C to +3.0°C	45	1.8 billion
Dominica	+2.4°C to 3 °C	-34 mm/month to +6 mm/month	+0.9°C to 3.0	18	186 million
Grenada	+2.4°C to 3.2°C	-40 mm/month to + 7mm/month	+0.9°C to +3.1°C	38	1.3 billion
Guyana	+1.4°C to 5.0°C	-34 mm/month to + 20 mm/month	n.d.	0	816 million
St. Kitts & Nevis	+2.4°C to 3.2°C	-40 mm/month to +7 mm/month	+0.9°C to +3.1°C	86	2.6 billion
St. Lucia	+0.9°C to 3.1°C	-40 mm/month to + 7 mm/month	+0.9°C to +3.1°C	37	996 million
St. Vincent & the Grenadines	+2.4°C to 3.1 °C	-34 mm/month to +6 mm/month	+0.9°C to +3.0°C	67	1.3 billion
Suriname	+4.8	-61% to +19% per month	+1.0°C to 3.1°C	11	673 million
Trinidad & Tobago	+2.4°C to 3.1°C	-34 mm/month to +6 mm/month	+0.9°C to +3.0°C	n.d.	8.2 billion

An increase of temperature during the 21st century has been predicted for all 10 countries (from a low of +0.9 degree Celsius for St. Lucia to a high of 5.0 degrees Celsius for Guyana). The differences in the temperature predictions between the countries have to do with their geographic size and topography. The predictions of different computer models vary greatly for changes in mean annual precipitation for the countries. The predicted changes in annual precipitation vary from a decrease of 40 millimeters in Grenada, St. Kitts and Nevis, and St. Lucia to an increase of 20 millimeters per year in Guyana. All the computer models predict an increase in the surface temperature of the sea, but some models predict an increase as low as +0.9 degree Celsius while others predict an increase as high as +3.1 degrees Celsius. On the island countries the greatest physical damage to economic assets due to a 1-meter rise in sea level combined with a 1-in-100-year storm surge will be to tourist resorts, since they represent so much investment and are mostly located close to beaches. In St. Kitts and Nevis, 86 percent of the tourist resorts would be affected, and in St. Vincent and the Grenadines, 67 percent would be affected. The total capital cost of a 1-meter rise in sea level by 2080 in the 10 countries is predicted to be US\$20.6 billion to rebuild or relocate infrastructure due to the direct damage as well as lost land-value.

INSTITUTIONAL AND LEGISLATIVE FRAMEWORK

Six prerequisites for increasing resilience to climate change emerged from the qualitative data collected during interviews and focus group discussions: adequate financing, participation, planning and regulation, data, institutional capacity, and policies and legislation. Table 3 indicates a numerical rating of these qualitative data based on the 10 country reports. A rating of one indicates that this prerequisite is seriously inadequate. A rating of two indicates that the country is moderately inadequate with respect to the prerequisite. A rating of three indicates that the country is adequate with respect to the prerequisite.

Table 3 Institutional and legislative structure for responding to climate change

COUNTRY	EVALUATION OF ADEQUACY PRINCIPAL PREREQUISITES FOR RESILIENCE TO CLIMATE CHANGE					
	Financing	Participation	Planning & Regulation	Data	Institutional Capacity	Policies & Legislation
Antigua & Barbuda	2	1	2	2	2	2
Barbados	3	2	3	2	3	2
Dominica	2	2	1	2	2	2
Grenada	2	2	2	2	2	2
Guyana	2	2	2	2	3	3
St. Kitts & Nevis	2	2	2	2	2	2
St. Lucia	2	2	2	2	3	2
St. Vincent & the Grenadines	2	2	2	2	2	2
Suriname	3	1	1	1	2	2
Trinidad & Tobago	3	1	1	2	2	2

Scale of Adequacy: 1 – low; 2 – moderate; 3 – full

The qualitative ratings in Table 3 indicate that all 10 countries have taken some steps to reduce their vulnerability and increase their resilience to climate change. They all finance some actions to achieve these ends, although Barbados, Suriname, and Trinidad and Tobago provide more funds than the other countries. All the countries need to increase the participation of communities in reducing vulnerabilities and increasing resilience to climate change. Barbados has the most advanced and effective land-use planning and regulation system in place; the other countries need to improve this aspect of increasing their resilience. As might be expected, none of the countries have all the data that are required to understand fully the impacts of climate change. Barbados, Guyana, and St. Lucia have the greatest institutional capacity for responding to climate change. Guyana has the most complete policies and legislation for responding to climate change. The other countries all need to pass and implement additional policies, laws, and regulations. In several of the countries, important legislation has been written but never officially approved or implemented.

The principal regional and international institutions involved in reducing the vulnerability and increasing the resilience of the 10 countries are the **Caribbean Community (CARICOM)**, which has or plans to establish an **Oversight Committee on Climate Change**, a **Council of Trade and Economic Development**, and a **Regional Commission on Climate Change**. CARICOM also has established the **Caribbean Community Climate Change Centre (CCCCC)**, which coordinates the region's response to climate change, works on effective solutions, and provides related policy advice and guidelines. **CARIBSAVE** is a private, international NGO that has prepared numerous studies on climate change throughout the Caribbean. The **World Bank**, the **Caribbean Development Bank**, and the **Inter-American Development Bank** finance actions to reduce vulnerability to climate change in the 10 countries, although they finance few actions to increase

resilience to climate change through improved protection and management of ecosystems. The **University of the West Indies** does important research related to the degree of climate change and its effects.

IMPACTS OF DEVELOPMENT PROJECTS

The principal development project that is affecting the seven island countries' resiliency to climate change where tourism is the largest economic activity is the construction of tourism facilities. Most tourism facilities are close to beaches and therefore are vulnerable to a rise in sea level and storm surges. A second principal development activity on these same islands is the construction of houses for permanent and part-time residents. Much of this construction is on steep slopes or close to beaches, and vulnerable to a rise in sea level and more intense weather events. This construction also can increase the rate of soil sedimentation and pollution into surrounding marine areas, thereby reduce the resiliency of marine ecosystems, especially reefs and beds of sea grass, to changes in climate.

By contrast, exploitation of natural resources is more important than tourism to the economies of Trinidad and Tobago, Guyana, and Suriname. The infrastructure and population of Guyana and Suriname, however, are concentrated along the coast, mostly below sea level, and are protected by sea walls. Further development in these coastal zones, therefore, will further increase the vulnerability of these two countries to climate change.

IMPACTS OF ONGOING PROJECTS ON CLIMATE CHANGE VULNERABILITY

The USAID website describes the USAID program for global climate change for Barbados and the six Eastern Caribbean countries as follows:

“The USAID climate change program assists the six countries of the Organization of Eastern Caribbean States (OECS) and Barbados with adaptation measures to mitigate the effects of climate change. Based on an analysis of regional needs, supported by two broad stakeholder workshops held in St. Lucia and Barbados, two critical areas were identified as requiring special attention: coastal zone management and resilience, and freshwater resources management. Funding is provided to relevant government agencies to ensure that climate change is better integrated into national development planning. The private sector, nongovernmental organizations, and local communities will be integrated into the process to ensure that they are prepared for and able to adapt to the impacts of climate change. The ability of small, vulnerable island states to address these challenges in advance through appropriate adaptive actions will prove much more cost-effective than dealing with future environmental damage. Developing the region's capacity for data collection and prediction capabilities are key components of USAID's strategy. These efforts are supported by raising stakeholder awareness of climate change and adaptation in order to strengthen the long-term viability of small island communities”(<http://www.usaid.gov/global-climate-change>).

USAID is financing the **Reducing Risk to Human and Natural Assets Resulting from Climate Change Project** (RRACC) with US\$10.5 million. The project seeks to

“enhance the overall, long-term capacity of the OECS region to respond to climate change, while strengthening the near-term resilience of Member States to climate change impacts through concrete, on-the-ground actions” in the six independent OECS Member States by “(1) reinforcing the policy, legislative, and institutional framework that the region needs as a foundation for effective adaptation, (2) direct, targeted actions that improve the management of freshwater and coastal resources, (3) supporting the development of critical climate change information needs, and (4) developing and

implementing a comprehensive education programme on Climate Change and Variability” (<http://www.oecs.org/racc-news/20-first-oecs-climate-change-project-launched>).

Data were not available to permit an evaluation of the effectiveness of this project. See Annex E for a description of the ongoing activities under this project.

The **Italian Development Cooperation** is funding the **Caribbean Institute for Meteorology and Hydrology (CIMH)** to implement the **Enhancing Resilience to Reduce Vulnerability in the Caribbean Project (ERC)**, which “takes an integrated approach to vulnerability reduction and enhancing resilience to climate change, natural hazards, and poverty through enhanced civil protection”(UNDP, 2012).

The **Climate Investment Fund (CIF)** is funding the **Pilot Project for Climate Resilience (PPCR)**, which is intended to strengthen the policy, legal, and institutional framework for addressing the effects of climate change and which includes a range of proposed actions throughout the Caribbean region, including the “revamping of the land use or spatial planning legislation in the Caribbean to incorporate climate change resilience and the development of new land codes/practices and guidelines” (CIF, 2013).

To improve the management of marine protected areas and increase the resilience of rural economies to the effects of climate change, the German government recently began funding the **Caribbean Aqua-Terrestrial Solutions Project (2013–17)**, which is being implemented by the **Caribbean Environmental Health Institute (CEHI)** and the **GIZ**. The project aims to “improve the management of coastal resources and the conservation of the marine biodiversity of the Caribbean island states,” and “enhance the adaptive capacity of rural economies and natural resources to climate change” (CEHI, 2012).

The **World Bank** and **CARICOM** financed and implemented the **Adaptation to Climate Change in the Caribbean (ACCC) Project** between 2001 and 2004, which was designed to continue activities started under the **Caribbean Planning for Adaptation to Climate Change Project (PCU, 2011)**. The ACCC created the **Caribbean Community Climate Change Centre (CCCCC)**; prepared a guide for environmental impact assessments; drafted a public education and outreach strategy; and implemented pilot water, agriculture, and health projects throughout the region. Annex E provides a list of other projects related to preparing for the effects of climate change in the Caribbean.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

PRIORITY ISSUE 1: FINANCING FOR THE CONSERVATION OF ECOSYSTEMS

If effective measures are not taken to increase the country’s resilience to climate change through such improved management and protection of forests, watersheds, and marine ecosystems, the result could be monetary costs to the economies of the 10 countries. The international competitiveness of most of the island countries’ principal economic activity—tourism—depends on effective, long-term management and protection of their ecosystems, especially watersheds and near-shore marine ecosystems, such as reefs, mangroves, and sea grass beds. The water supplies for human consumption and agriculture depend on protection of watersheds and replenishment of aquifers to prevent salt-water intrusion. Even so, most of the 10 countries are not providing adequate financing for the actions required to protect and manage their natural ecosystems adequately. A priority action to reduce the 10 countries’ vulnerability and increase their resilience to climate change, therefore, is to *provide sufficient, regular, and timely financing for its public and private conservation institutions*.

The countries do not necessarily lack sufficient funds to adequately finance their public and private conservation institutions. Rather, their funding priorities are generally skewed toward large infrastructure projects, such as airports, roads, buildings, and beach reconstruction, because these are the priorities of not

only the politicians, but of the people who elect them and often of politically influential business people. The priorities of government leaders and business people must change if adequate and reliable financing is to become available to conservation institutions. We recommend, therefore, that USAID finance measures that would assist the countries to ***realign their financing priorities toward conservation measures as a means to increase their resilience to the effects of climate change.***

PRIORITY ISSUE 2: PARTICIPATION IN ECOSYSTEM CONSERVATION

Terrestrial and marine protected areas are a source of resilience to climate change in all 10 countries. Many people, such as farmers and fishermen, live around and within these ecosystems, make decisions that affect them, and know a great deal about their history and characteristics. Likewise, while vulnerable groups, including low-income, resource-dependent communities, women, youth, and marginalized indigenous groups, are often more affected by the effects of climate change, they are frequently only marginally involved in making decisions related to the use of natural resources. Therefore, a needed action is to ***establish clear policies and methodologies for increasing the participation of resource users and vulnerable groups in the management and protection of terrestrial and marine ecosystems.***

USAID has many years of experience and the institutional means to provide technical assistance and training for increasing participation of resource users and vulnerable groups in the protection and management of natural ecosystems. We recommend, therefore, that USAID finance actions to assist one or more of the 10 countries to formulate and implement the policies and methodologies required to ***improve the level and effectiveness of participation of resource users and vulnerable groups in the conservation of ecosystems.***

PRIORITY ISSUE 3: PLANNING AND REGULATION FOR ECOSYSTEM CONSERVATION

Land- and marine-use planning and regulation are basic requirements to reduce all 10 countries' vulnerability and increase their resilience to the effects of climate change. Suriname, Trinidad and Tobago, and St. Lucia almost completely lack land-use plans and regulations and most of the countries lack building codes. A needed action, therefore, for all 10 countries is to ***increase capabilities for planning and regulating the use of marine and terrestrial areas.*** It is noted that all 10 countries have less ability to plan and regulate the use of marine areas than terrestrial areas.

In Southeast Asia, USAID is currently working with six countries in the Coral Triangle, one of the most marine biodiverse regions in the world, to support the establishment and strengthening marine protected areas (USAID, n.d.) and could share this experience with the 10 countries. We recommend, therefore, that USAID finance actions to assist one or more of the 10 countries to ***improve their capacity to plan and regulate the use of marine protected areas.***

PRIORITY ISSUE 4: DATA COLLECTION, ANALYSIS, AND USE

To plan and implement effective actions to reduce their vulnerability and increase their resilience to the effects of climate change requires the 10 countries to be able to collect, analyze, and use reliable, up-to-date data about natural ecosystems. Currently, however, much of the data related to climate change in the 10 countries is being collected only sporadically, is not being analyzed well, and is not being used as the basis for writing and implementing legislation, or for determining the funding priorities of public budgets. Therefore, a needed action to increase the 10 countries' ability to reduce their vulnerability and increase their resilience to climate change is to ***improve their collection, analysis, distribution, and use of data about natural ecosystems.***

The United States has many public and private institutions with excellent capacity for collecting, analyzing, and using data related to the effects of climate change on natural ecosystems. We recommend, therefore, that USAID finance actions to assist the 10 countries to ***increase their capabilities for collecting, analyzing, and using reliable, current data related to climate change.***

PRIORITY ISSUE 5: INSTITUTIONAL CAPACITY

Institutional capacity to plan, implement, monitor, and evaluate the management of terrestrial and marine ecosystems is a prerequisite for decreasing the vulnerability of the 10 countries to the effects of climate change. Aspects of institutional capacity for marine areas include the ability to coordinate effectively with other government and private institutions, utilize research, increase income from tourism, and regulate use of marine resources. None of the 10 countries have strong institutional capacity for reducing their vulnerability and increasing their resilience to climate change, although each country has its own institutional problems to resolve and overcome. A needed action to reduce the vulnerability and increase the resilience of the 10 countries to the effects of climate change, therefore, is to ***strengthen their institutional structures***.

Since each of the 10 countries has its own institutional needs, we recommend that USAID finance actions to ***strengthen the capabilities of public and nongovernmental conservation institutions***.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS

Well-conceived, effective policies, laws, and regulations must underlie efforts to conserve the 10 countries' ecosystems as a principal way to reduce their vulnerability and increase their resilience to climate change. All of the 10 countries have some policies, laws, and regulations related to reducing their vulnerability and increasing their resilience to climate change, but in none of them are these policies, laws, and regulations sufficiently comprehensive to enable their public and private institutions to be fully effective in managing and protecting natural ecosystems. A needed action to reduce vulnerability and increase resilience to climate change, therefore, is to ***complete and improve policies, laws, and regulations that are required to permit fully effective management and protection of ecosystems***.

The formulation, approval, and implementation of policies, laws, and regulations is generally a highly political activity, as indicated by the fact that in several of the 10 countries' draft laws designed to improve or broaden environmental protection have never been approved or implemented. The potential for USAID to assist countries to draft policies, laws, and regulations that will not be implemented is therefore high. In general, therefore, we recommend that USAID not finance actions related to the development of new, nation-wide policies, laws, and regulations that are needed to respond to climate change. USAID could, however, avoid such political pitfalls by bringing lessons learned and resources developed from other parts of the world⁵ to support the development and implementation of regulations for specific marine areas in the Eastern and Southern Caribbean region. Therefore, we recommend that USAID finance actions to increase the country's capacity to ***formulate and enforce regulations for marine protected areas***.

PRIORITY ISSUE 7: EFFECT OF CLIMATE CHANGE ON VULNERABLE GROUPS

Informants provided relatively little data relevant to the effect of climate change on vulnerable groups. A thorough, reliable study of this issue would require more time and data than were available for the writing of this report. However, the document **"Social Equity Considerations in the Implementation of Caribbean Climate Change Adaptation Policies"** summarizes the effects of climate change on vulnerable groups. It notes,

"Climate change issues facing the Caribbean cannot be framed only as an environmental issue because it has substantial impacts on social, financial, cultural, and traditional systems as well. Often, it is only when framed in these latter terms that climate change issues connect to the daily lives of the most vulnerable—poor, women, children, elderly, and marginalized groups. Data showed there are factors unique to each gender in vulnerability and livelihoods." The report also notes "recent literature suggests that vulnerable groups will be subjected to multiple, simultaneous problems, including food insecurity, wide-spread loss of employment and production due to abandonment of

⁵ USAID's program in the Coral Triangle, for example, has worked successfully with six countries to support the development, implementation, and enforcement of regulations for MPAs to address climate change vulnerabilities (USAID, n.d.).

low-lying areas, high risks of health hazards and large-scale eco-migration, as a consequence of climate change ... Resource-dependent, low-income communities are constrained in their capacity to adapt and climate change will increasingly be a key contributor to morbidity, mortality, and continued poverty.”

Furthermore, an informant stated,

“It is clear that women are much more vulnerable yet are often overlooked. Many mothers have to care for their children on their own, which makes them more vulnerable. However, there are cultural differences among the countries. For example, when the hurricane hit St. Lucia, it affected men more than women because they lost their ability to provide for their families. Likewise, in Guyana after the floods, although both men and women had lost their livelihoods, it was the men that started drinking. The women were more resilient because they had the motivation to rebuild. This is a combination of the expected norms and also the perception of risk. Men did not realize that they were at high risk and were less able to adapt.”

These comments make it clear that a needed action to reduce the vulnerability and strengthen the resilience of the 10 countries to the effects of climate change is to ***prepare reliable assessments of the effects of climate change on family units, users of natural resources, and vulnerable groups.***

PRIORITY ISSUE 8: POTENTIAL FOR CLEAN ENERGY

Stakeholders interviewed as part of this assessment were asked to identify the major vulnerabilities to climate change in the region. No stakeholders identified the energy sector as a priority vulnerability to address in the region. However, several reports suggest that the region’s dependence upon fossil fuel imports for electricity generation increases countries’ economic vulnerability to international price shocks.

With the exception of Trinidad and Tobago and Suriname, the countries considered in this study have little or no oil, natural gas, or coal resources and rely heavily upon imported petroleum for energy production. According to Loy (2007), around 90 percent of the Caribbean region’s commercial energy supply comes from imported petroleum, which accounts for more than US\$4 billion of government spending per year. Developing renewable energy sources would reduce this economic vulnerability while simultaneously mitigating greenhouse gas emissions by reducing thermal energy production with fossil fuels. Loy also states that despite the Eastern and Southern Caribbean’s significant potential for wind, solar, hydropower, and geothermal energy, as of 2007 renewable energy only accounted for about 3 percent of all electricity generated in the region. No evidence of more recent renewable energy development at a significant scale has been identified in the region. Policy (subsidies for petroleum in particular), financing, capacity, research, and awareness barriers are the principal reasons for the slow development of the clean energy sector in the region.

In general, barriers to the increased use of renewable energy can be removed by: (1) developing and implementing national energy sector policy and legal frameworks; (2) conducting and completing feasibility studies for renewable energy development; (3) diversifying electricity utilities and distributors in some countries by ending de-facto monopolies on energy generation and supporting the development of renewable energy utilities; and (4) by putting in place incentives for clean-energy production and consumption technologies and disincentives for fossil fuel use. Removing the barriers to increased investment in the production of clean energy could help reduce economic vulnerability to international gas and oil price shocks, reduce vulnerability to disruptions in the supply chain leading to energy shortages, and contribute to the mitigation of climate change by the region. A needed action is, therefore, ***to remove and reduce the barriers to the development of clean energy in the Caribbean.***

USAID has experience supporting the deployment of small-scale clean-energy production. Due to time and resource limitations, we were unable to evaluate the feasibility of specific actions that USAID might support

to assist in overcoming the barriers to increased investment in the production of clean energy in the 10 countries. We therefore recommend that USAID finance actions to ***identify the problems and opportunities related to increasing investment in the production of clean energy.***

PRIORITY ISSUE 9: SYSTEMS FOR MONITORING THREATS FROM THE EFFECTS OF CLIMATE CHANGE

The data from documents and interviews indicate that the 10 countries have not established their own systems of indicators for the effects of climate change or methods for monitoring such indicators.⁶ Rather, the countries are relying almost entirely on joint, regional actions, generally supported by international organizations, to collect or collate data related to climate change. For example, the United Nations Development Programme (UNDP) supports the collection of data related to climate change financially and technically and CARIBSAVE, an international NGO, receives funds from various international financing organizations to carry out regional and country-specific monitoring of climate change indicators.⁷ Given the small size of most of the Eastern Caribbean countries it seems reasonable for them to cooperate, with the support of international organizations, to define and monitor adaptation and impact indicators jointly with the assistance of such organizations as the UNDP and CARIBSAVE rather than establishing their own autonomous system for monitoring indicators. A needed action, therefore, is to ***continue and strengthen cooperation between 10 countries in establishing and monitoring indicators of climate change and its effects.***

Limitations of time and data did not permit us to identify those specific actions which USAID could finance that would assist the 10 countries to carry out this needed action. We recommend, therefore, that USAID ***strengthen regional cooperation in establishing and monitoring indicators of climate change and its effects.***

PRIORITY ISSUE 10: INTERNATIONAL DONOR-FUNDED CLIMATE CHANGE PROJECTS

Time and resource limitations did not permit a complete investigation and analysis of the current status of donor-funded climate change projects or an evaluation of how these projects are addressing vulnerabilities or could be improved. In general, however, large, international, donor-funded projects appear to be providing financing predominately for the reconstruction or construction of physical infrastructure, such as roads, airports, beaches, ports, and water and sewage systems. By contrast, international donors appear to be giving few funds and attention to reducing the country's vulnerability to the effects of climate change by strengthening the resilience of their natural ecosystems. In Barbados, for example, the Inter-American Development Bank has lent more than US\$60 million over the last two decades for the construction of infrastructure to rehabilitate beaches that are important for tourism. Yet fishing and tourist boats off those same beaches continue to drag their anchors through the coral reefs that provide natural protection for those same beaches. Given the institutional objectives of the large international funders and those who formulate government policies, however, it seems likely that the current emphasis of donor-funded climate change projects on financing large infrastructure projects will continue. Therefore, a needed action to assist the Eastern and Southern Caribbean countries to reduce their vulnerability and increase their resilience to the effects of climate change is to ***integrate the protection and management of ecosystems fully into infrastructure projects.***

We thus recommend that in its programming of funds for assisting 10 countries, USAID ***strengthen the links between infrastructure projects and the conservation of terrestrial and marine ecosystems.***

⁶ The countries, however, do collect data that are relevant to climate change. For example, all the countries collect some weather data, mostly at airports for use in their operation. The countries monitor supplies of water in order to know how much water is available for drinking and irrigation. As part of their management of natural areas, some countries monitor the condition of vegetation.

⁷ In fact, the CARIBSAVE reports provided much of the information in these reports.

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ANNEX A: TERMS OF REFERENCE FOR THE RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENTS

STATEMENT OF WORK

Eastern and Southern Caribbean Regional
Tropical Forest and Biological Diversity Analysis and
Rapid Climate Change Vulnerability Assessment
for
USAID/Barbados and Eastern Caribbean's
Regional Development Cooperation Strategy (2013–17)

I. BACKGROUND

The U.S. Agency for International Development (USAID) is a major partner in the U.S. Government's assistance efforts in the eastern and southern Caribbean region. Since 2005, USAID/Barbados and the Eastern Caribbean (BEC) has managed more than \$125 million in assistance designed to achieve a wide-ranging set of development results including: strengthening systems responding to HIV/AIDS, supporting improvements in the economic enabling environment, reforming juvenile justice systems and education policies, advancing country responses to climate change, enhancing democracy and accountable governance, and creating opportunities for youth. Throughout its operations, USAID/BEC has stressed the importance of reliable performance information to support effective and informed decision-making.

As part of the documentation for the new five-year Strategic Plan, USAID/Barbados and Eastern Caribbean is required by Sections 118 and 119 of the Foreign Assistance Act to update the existing analysis of tropical forests and biological diversity in the eastern and southern Caribbean, a region comprised of the following 10 countries:

1. Antigua and Barbuda,
2. Barbados,
3. Dominica,
4. Grenada,
5. Guyana,
6. St. Kitts and Nevis,
7. St. Lucia,
8. St. Vincent and the Grenadines,
9. Suriname, and
10. Trinidad and Tobago.

In addition, USAID/BEC intends to take advantage of the technical and programmatic synergies between tropical forest and biological diversity and climate change to conduct rapid climate change vulnerability assessments for all of the ten partner countries in the Mission's portfolio. The regional assessment will include the compilation, review, analysis and synthesis of existing information on tropical forests and biological diversity and climate change across the eastern and southern Caribbean, coupled with corroboration and feedback from key stakeholders. A list of reference documents is appended to the SOW.

Summary of relevant parts of FAA Sec 118 and 119:

From Sec 118 Tropical Forests:

(e) COUNTRY ANALYSIS REQUIREMENTS. Each country development strategy statement or other country plan prepared by the Agency for International Development shall include an analysis of—

- (1) the actions necessary in that country to achieve conservation and sustainable management of tropical forests, and*
- (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified.*

From Sec 119 Endangered Species:

(d) COUNTRY ANALYSIS REQUIREMENTS. Each country development strategy, statement or other country plan prepared by the Agency for International Development shall include an analysis of—

- (1) the actions necessary in that country to conserve biological diversity, and*
- (2) the extent to which the actions proposed for support by the Agency meet the needs thus identified.*

II. STATEMENT OF WORK

Through the Global Environmental Management Support (GEMS) contract, an Assessment Team will conduct an Eastern and Southern Caribbean Regional Country Analysis on Tropical Forest and Biological Diversity and Assessment on Climate Change Vulnerability (ESCRAA) of Antigua and Barbuda, Barbados, Dominica, Grenada, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago.

The ESCRAA will be comprised of two discrete activities and specific discrete deliverables for each activity. One is a Tropical Forest and Biological Diversity Analysis (consistent with FAA Sections 118 and 119), and the other is a rapid assessment of vulnerability to climate change in each of the ten countries supported by USAID/BEC.

In conducting work under this contract, it is expected that the Assessment Team will engage and include input, technical contributions, and other pertinent experience and information from relevant local stakeholders. These stakeholders will be selected in accordance with their knowledge of topics within the scope of the two assessments, generally including mid to high level officials and employees of, partner governments, NGOs, civil society organizations, academic institutions, religious leaders, employers, international and local donors, United Nations Agencies, intergovernmental organizations (e.g., the Organization of Eastern Caribbean States (OECS), CARICOM) and other public or private individuals and organizations active in working and/or supporting initiatives to address climate change. Special attention should be paid to opinion makers, youth, and women to the extent possible.

A. Tropical Forest and Biological Diversity Analysis (FAA Sections 118 and 119) occurred simultaneously with the Rapid Regional Climate Change Vulnerability Assessments.

B. Rapid Regional Climate Change Vulnerability Assessment. The Contractor will conduct a rapid overall review of the current situation involving vulnerability to climate change and challenges related to adaptation, clean energy, and Sustainable Landscapes in each of the ten countries of the eastern and southern Caribbean covered by USAID/BEC: Antigua and Barbuda, Barbados, Dominica, Grenada, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago. This analysis will require the Contractor to:

1. Compile information related to, and describe level climate change vulnerability and resilience in each country, as well as the anticipated impact of climate change (including levels of certainty/uncertainty). This assessment will cover the current status and trends, at both the country and regional levels. Existing quantitative and geographic information will be considered, but a specific quantitative assessment or geographic model is not planned as part of this assessment.
2. Describe adaptation and mitigation activities, and the factors affecting country and regional adaptive capacity, including the principal climate/related threats in each country and any impediments to effective management of those risks/threats in each of the ten indicated countries, and identify commonalities, if any exist, across the eastern and southern Caribbean region.
3. Review on a country and regional basis the current institutional infrastructure for the management of climate change, including a description of major organizations, both public and private, which have a role in this process. Identify the status and management of key ongoing projects to deal with climate change per country. Interview key personnel of key institutions.
4. Review the legislative basis, both national and relevant regional (i.e. Regional international agreements and/or standards set by the Organization for Eastern Caribbean States (OECS), CARICOM, etc.), related to climate change, in each of the ten countries (including the ratification of international treaties and agreements, and the effectiveness of national implementation).
5. Identify priority actions necessary to successfully adapt to climate change and reduce vulnerability in each of the ten countries and by regional institutions (i.e., OECS, CARICOM, 5 Cs, etc.). Identify and recommend which actions may be most cost effective and easiest for USAID/BEC to implement.
6. Identify the extent to which the actions proposed for support and ongoing GCC adaptation actions by USAID/BEC meet the needs thus identified, and recommend any further actions not described or outlined in existing or planned projects. Analyze the effects of USAID/ BECs entire proposed strategy (FY 2013 – FY 2017) on climate change in each of the ten identified countries. Regional impacts should also be identified. In particular, the Mission's proposed program areas should be carefully reviewed. This analysis will be contingent upon USAID/BEC providing a written description of "actions proposed for support", including their geographic scope, early on during assessment and field work activities.

III. TIMING, SCHEDULE, USAID/BEC ENGAGEMENT, PROGRESS REPORTING AND DELIVERABLES

Completion Deadline. The existing strategic plan for USAID/BEC (2013-2017) aims to increase partner countries ability to adapt to climate change. The ESCRAA will re-examine and expand upon research done to inform the existing strategic plan and support the development and implementation of the Mission's Regional Development Cooperation Strategy (RDSCS) for FY 2013-2017. ESCRAA deliverables should be completed in time to inform and contribute to the draft RDSCS, due by the end of September 2013. USAID/BEC anticipates the creation of a specific Development Objective (DO) to address the region's vulnerabilities to climate change.

In order to meet RDSCS deadlines, the ESCRAA must conclude on or about July 19, 2013.

Schedule. USAID anticipates a schedule similar to the following, to be finalized in the workplan (see "deliverables," below):

- A. Desk review of assessments and other materials available and development of a draft assessment tool; initial teleconferences with USAID/BEC staff; preparation of draft report sections in conjunction with local partners, based on secondary information (3-4 weeks)
- B. Meet with USAID/BEC in Bridgetown, Barbados and conduct Barbados assessment field work (1.5 weeks).
- C. Travel to each of the remaining nine countries covered by the Mission (Antigua and Barbuda, Dominica, Grenada, Guyana, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, and Trinidad and Tobago), to conduct assessments. (Two concurrent field teams each covering 4-5 countries for approximately a week each, plus a one-week break period.)*
- D. Post-fieldwork out-briefing with USAID/BEC and team meetings in Barbados to compare results and coordinate analysis. (0.5 weeks)
- E. Deliverable preparation/finalization and remote consultations with USAID/BEC (4 weeks)

To meet the completion deadline, this schedule requires initiating desk review work o/a 1 April.

Note: USAID does not anticipate that all members of the Team will be required for the entire estimated ~16 week performance period.

Mission engagement/USAID commitments. USAID/BEC staff will assist the Team with suggesting organizations and individuals for participation in the assessment, introductions, and arranging meetings. The Mission may also offer advice as to accommodation and travel options for the Team.

Note: The organizations and individuals identified by the Mission should not be considered to be an all-inclusive list of those that should inform the assessment or be consulted by the Team.

USAID acknowledges that timely and successful completion depends on USAID:

- Obliging USAID/BEC buy-in funds to GEMS on a timeline consistent with the work schedule/ completion deadline.
- Providing timely feedback on draft deliverables, and making USAID/BEC staff members available for the kick-off and end-briefing
- Facilitating stakeholder contacts as described above

Progress Reporting and Mission Supervision. The USAID/BEC supervisor (activity manager) for this activity will be Walter Doetsch (Director, General Development Office) or his designee.

The Assessment Team and/or the GEMS Team Leader/designee, as appropriate, is expected to be in regular contact with the USAID/BEC activity manager to advise of and resolve any questions or issues that may arise.

Verbal status updates, in person or by teleconference, will be held with the Mission upon request throughout the project, and are not expected to last more than 30 minutes.

Deliverables. GEMS will submit the following deliverables for this activity.

1. **Workplan.** GEMS will submit a draft workplan no later than 15 working days after OAA obligation of the USAID/BEC buy-in to GEMS. The draft workplan must (1) cover the entire period of performance, including a timeline for drafting and finalizing all deliverables; (2) include a data collection and drafting plan; and (3) provide detailed outlines for the 2 below-specified deliverables. The work plan is subject to review and approval by the COR.

2. **Report: Regional and Country-Specific Tropical Forest and Biological Diversity Analyses consistent with FAA Sections 118 and 119.** This report will contain one regional and 10 country-specific tropical forest and biological diversity analyses, fulfilling the requirements set out in section II.A of this SOW.

Note that the expected length of each country-specific assessment within the regional report is expected to be approximately 10 pages.

3. **Report: Regional and Country-Specific Climate Change Vulnerability Assessment.** This report will contain one regional and 10 country-specific climate vulnerability assessments, documenting the requirements set out in section II.B of this SOW.

Note that USAID does not anticipate the regional or country-specific climate change vulnerability reports to be longer than 3-4 pages.

For both deliverables 2 & 3:

- Draft reports will be submitted on/about the last working day of Week 13. USAID will return comments at the beginning of week 15, and GEMS will submit revised, final reports 10 working days after receipt of USAID comments. (I.e. the end of week 16, if USAID provides comments as scheduled.) Final timing for these milestones will be established by the workplan.
- The regional analysis/assessment chapter of each report should follow the same general format as the country-specific analyses. It should include a comparative summary of the findings in each country and regionally, and describe commonalities and inconsistencies (if possible) among the countries assessed. As the regional analysis represents an abridged synthesis summary of the ten constituent reports, USAID/BEC anticipates that the regional report will be significantly shorter than the country-specific analyses.
- **Attachment II** to this SOW presents a detailed, recommended outline for both reports with suggested content for each section. The work plan will establish the final outlines.

IV. TEAM COMPOSITION, COORDINATION AND QUALIFICATIONS

To enable the ESCRAA to be completed by deadline and with adequate time for desk research and preparation to make the most of field time, GEMS is expected to field two sub-teams which, following the initial assessment in Barbados, will undertake the remaining 9 country assessments concurrently. Each team would spend an average of one week per country, each visiting 4-5 countries. Each team will undertake *both* the biodiversity/tropical forest analyses and the climate vulnerability assessments for the countries they cover.

The sub-teams are expected to have 3 members, **including at least one in-region (and, as practicable, host country) expert**. Each team must include both strong biodiversity/tropical forest and climate change expertise.

To assure coordination and consistency:

- There will be an overall lead for biodiversity/tropical forests analysis and an overall lead for climate vulnerability assessment. These leads will have responsibility for integration and consistency of the respective reports, and for assuring consistency of the field work across the 2 sub-teams. These technical leads will each also serve as the operational lead for one of the sub-teams.
- The sub-teams, represented at least by their leaders, will jointly (1) participate in kick-off meetings with USAID/BEC; (2) undertake the first country assessment in Barbados; and (3) convene briefly after the country assessment field work to debrief and coordinate production of the final report

- Beyond logistics support, GEMS must provide home-office technical backstopping to assure coordination of the teams, and consistency and quality control of the resulting reports.

All team members must be fluent in English, including speaking, reading and writing. *(Note: GEMS should make arrangements for Dutch language support for work to be conducted in and regarding Suriname, if needed.)*

V. GENDER CONSIDERATIONS

This assessments, and any surveys, studies, and reports used to support the findings, must include gender-disaggregated data, where feasible. As far as practicable in various locations and as applicable to the analyses/assessments conducted, the Contractor shall include specific assessments of perceptions, attitudes, and values of women and men and the impact of activities on both women and men in target areas.

The Contractor shall pay attention to – and highlight – gender-based constraints and issues in connection to the conduct of all deliverables. The contractor should identify gender trends that materialize from evaluations and assessments.

ANNEX B: FOCUS GROUP/INTERVIEW QUESTIONNAIRE

- A. Status and Data
 - a. What do we know about the status of coral reefs and fish? What do we know about the status of forest resources? Status of freshwater resources?
 - b. Who is collecting data on these topics?
 - c. What are the gaps in data on biological diversity?
 - d. Are there any examples of community participation, monitoring, and evaluation on these topics?
- B. Adaptation and Biodiversity Conservation Measures
 - a. What biological (vegetation, reef, or forest management) or social (education or training) climate change adaptation actions have been taken? What has worked well? What has not worked well? What should be done?
 - b. What actions have been taken to address the threats/hazards to biodiversity? What has worked well? What has not worked well? What should be done?
- C. Capabilities to Implement Conservation and CC Adaptation Measures
 - a. What institutions are working on climate change adaptation?
 - b. What institutions are working on conservation and resource management issues?
 - c. What is the institutional capacity?
 - d. How are these organizations coordinating between themselves and with civil society/communities?
 - e. What needs to be improved/changed in these institutions?
 - f. What policies/laws/regulations need to be improved or established?
 - g. How are policies, laws, and regulations currently being implemented/enforced?
 - h. What financing exists to implement CC adaptation measures?
 - i. What financing exists to implement biodiversity conservation and/or sustainable resource management schemes?
- D. Decision-making
 - a. How are decisions made about CC adaptation projects, conservation, and natural resource management?
 - b. What kind of role do communities or community members have in decision-making about the use of natural resources, conservation, and adaptation?
 - c. How are communities consulted? What ability do communities have to influence decision makers and/or advocate for projects that meet their needs?
 - d. What interests decision-makers? How do you get decision-makers to support this kind of work?
- E. Priority Actions for USAID Financing
 - a. What would be most useful for USAID to finance?
 - b. How should USAID implement its projects? At what geographic scale?
 - c. With what institutions should USAID work to implement its projects?

ANNEX C: BIO-SKETCHES OF TEAM MEMBERS

Team Leader: Forestry and Climate Change Specialist: Bruce Kernan has a master's degree in forest science from Yale University, School of Forestry and Environmental Studies, and a Masters of Professional Studies from Cornell University in natural resources management and policy, as well as a forestry technician's degree from the New York State Ranger School, College of Forestry and Environmental Science, State University of New York. He has lived in Ecuador since assigned there as a USAID Foreign Service Officer in 1983, when he was the project officer for the Forestry Sector Development Project and the Integrated Rural Development Project, and is intimately familiar with Andes and Amazonian culture and ecosystems. He was the USAID Regional Environmental Advisor for South America from 1994 to 1998. He has prepared numerous environmental assessments, project evaluations, and project designs for USAID. He has demonstrated his assessment and management skills as a successful team leader for more than 30 teams of consultants, including for the preparation of FAA 118 and 119 studies for USAID in Mexico (2013), Bolivia (2013, 2002), Panama (2010), Paraguay (2009), El Salvador (2009), Colombia (2008), Ecuador (2006), and Peru (2004). Kernan is a United States citizen and has been Sun Mountain's senior tropical forestry and climate change advisor since July 2011.

Senior Climate Change Vulnerability Specialist: Dean Pallen holds a master's degree in community development from Carleton University and an honors degree in political philosophy with a minor in economics from the University of Western Ontario. He has developed specialization and experience in a broad range of areas, including rural and community environmental planning, environmental impact assessment, and sustainable development with a strong focus on economic related issues. Pallen began working on the issue of climate vulnerability and climate change adaptation around the year 2000 when he acted as the climate change resource person for the CIDA in the elaboration of climate change programs for the agency's Africa and Americas divisions. He worked for DFID, the Aga Khan Foundation, and the United Nations Development Programme in the elaboration of policies and project activity related to reducing climate vulnerability and the promotion of climate adaptation strategies. He has evaluated a number of projects with climate change components, including UNDP's Caribbean Risk Management Initiative (2008) and, in 2012, its regional environment program for the Caribbean and Latin America, including its disaster risk-reduction activity. Pallen is a Canadian citizen and occasionally works with the Cadmus Group.

Environmental Management and Economic Anthropology Specialist: Scott Solberg, executive director of SMTN, has more than 34 years of experience in agricultural systems, natural resource management, and risk management, program design, implementation, and evaluation, as well as in adult learning, diffusion of innovation, and technology transfer. He has worked within the NGO community designing and implementing USAID-financed agricultural, food, and livelihood security and economic growth projects for more than 17 years, and another 15 years with private organizations. For SMTN, he has led more than 120 environmental, risk management, climate change adaptation, and/or development projects and training initiatives in Latin America, Asia, and Africa, of which 64 have been USAID environmental compliance/ESDM- focused. Solberg also has been highly involved in creating new strategies, management, and field tools to promote organization-level environmental management behavior change. Solberg holds master's degrees in agricultural development and in community development (emphasis in NGO management). He is near completion of a Ph.D. in administration of environmental and risk management systems.

Climate Vulnerability Specialist: Yolanda Alleyne, Ph.D., is a chartered town planner with a doctor of philosophy in natural resources studies from Lincoln University in New Zealand. With more than 25 years of planning experience, she has been a part-time lecturer with the Centre for Environmental and Resource Management Studies (CERMES) in the Faculty of Science and Technology, University of the West Indies (UWI), and a visiting lecturer with the Centre for Management Development, UWI. She has extensive knowledge of land-use planning and development issues, trends, and policies in the Caribbean and has been

involved in integrated development planning processes that seek to resolve or reduce climate change vulnerability issues in the context of small developing states. She has been a member of consulting teams involved in the preparation of several environmental assessments (strategic, environmental, and social), hazard mitigation policy and planning, the review of environmental legislation, the assessment of institutional capabilities, integrated regional planning assessments, workshop facilitation, and delivery of environmental training workshops. She has provided consulting services in several Caribbean states and is currently co-principal and managing director of Ecoisle Consulting Inc., a dynamic physical planning and natural resources management firm.

USAID Regulation 216 and Environmental Management Specialist: Mike Seager is the technical coordinator at Sun Mountain International and has extensive experience in USAID Regulation 216 environmental compliance processes and procedures. He has developed and reviewed more than twenty Initial Environmental Examinations (IEEs), Environmental Mitigation and Monitoring Plans (EMMPs), Environmental Assessments (EAs), and Pesticide Evaluation Reports and Safer Use Action Plans (PERSUAPs) for USAID-funded international development programs in Latin America and the Caribbean, Africa, and Asia. He was a key team member for the 2013 Tropical Forest and Biodiversity Assessment in Mexico. Seager has worked with the USAID/DCHA bureau to develop guidance on budgeting for environmental impact management components of Title II food assistance programs, and has provided direct backstopping services to the USAID/DCHA Bureau Environmental Officer (BEO) for the past two years, performing technical reviews for environmental compliance documentation submitted under the DCHA US\$2 billion portfolio. He also led a two-year initiative to improve environmental management and monitoring and evaluations systems for a multi-year USAID development program in Haiti and developed environmental management systems for three emergency response/recovery programs following the 2010 earthquake in Haiti. He graduated from Connecticut College with a degree in international relations with a focus on international environmental policy.

Environmental and Disaster Response Specialist: Simon Lobach is a Geneva-based consultant with a focus on environmental economics. Having lived and worked in Brazil and Cuba, Lobach is currently contracted by UNEP to implement green-economy projects in the Caribbean and Mozambique. He previously worked in different positions for both the Dutch and the Brazilian governments. He holds a master's degree in international affairs from the Graduate Institute for International and Development Studies in Geneva. He performed research on long-term strategies and environmental investments in post-disaster humanitarian operations. He also gained undergraduate degrees in history and in Latin American studies from Leiden University (Netherlands).

ANNEX D: PHOTOS



The Hastings Waterfront Improvement Project was completed in 2009 by the Government of Barbados' Coastal Zone Management Unit and included the construction of this boardwalk and several jetties, as well as beach re-vegetation. Photo credit: Bruce Kernan



Geo-textile tubes have been placed to break waves and protect planted mangrove seedlings as part of the EU-funded Guyana Mangrove Restoration Project in East Coast Demerara. Photo credit: Vanessa Benn



This low-lying area of Georgetown, the capital of Guyana, contains the majority of the shipping ports, as well as dense commercial and residential coastal development. Photo credit: Vanessa Benn



Trash and debris collects at a storm water drainage outlet on Bequia Island, St. Vincent and the Grenadines (SVG), 50 m from the shoreline. Photo credit: Mike Seager



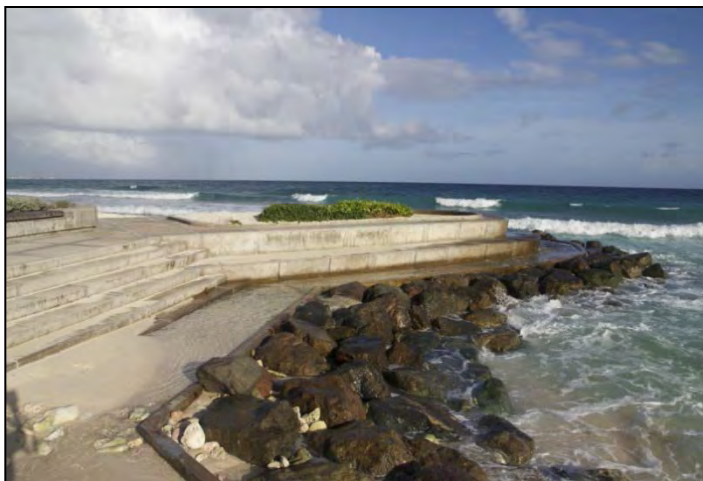
Coral reefs are important habitat for several commercially important fish in SVG, and provide a barrier against wave energy during tropical storms and hurricanes. Photo credit: Kay Wilson, Indigo Dive, SVG



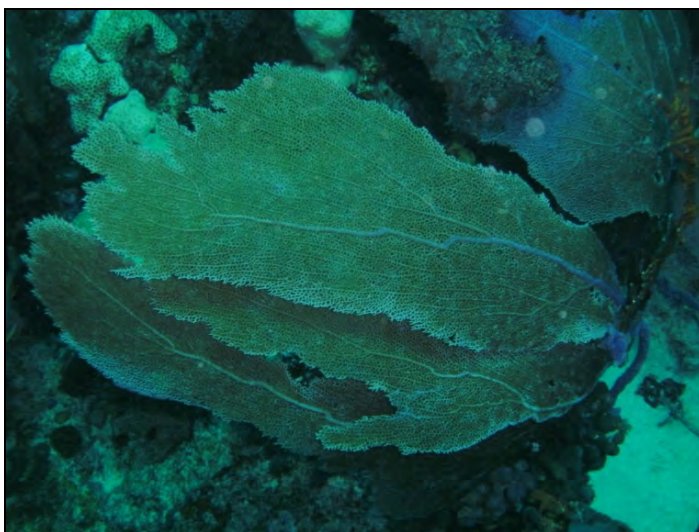
Hillside development and clearing of natural vegetation has led to soil erosion, sedimentation of natural drainage channels, and damage to near-shore coral reefs in Bequia (SVG). Photo credit: Mike Seager



The Woburn mangrove restoration project in Grenada. Original habitat was destroyed by hurricanes and pressure from pollution from an upstream rum distillery as well as construction debris dumping. Photo credit: Toby Carter



A concrete and granite jetty constructed by the Barbados CZMU in 2009 is part of the Hastings Waterfront Improvement Project. The boardwalk nourishes beaches and protects infrastructure from storm surge. Photo credit: Mike Seager



A purple fan coral shows signs of bleaching off the coast of Bridgetown. With the anticipated increase in sea surface temperatures resulting from climate change, coral bleaching is a major threat to the health of reef ecosystems. Photo credit: Charles Hernick



A non-functional sluice gate has prevented sea water from entering this canal that feeds into the Graeme Hall Nature Reserve in Barbados, negatively impacting mangrove ecosystems. Photo credit: Bruce Kernan

ANNEX E: ONGOING CARIBBEAN REGION CLIMATE CHANGE PROJECTS

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
Regional Framework for Achieving Development Resilient to Climate Change (2009–15)	<p>The Regional Framework defines CARICOM's strategic approach for coping with climate change and is guided by five strategic elements and some 20 goals designed to significantly increase the resilience of the CARICOM Member States' social, economic, and environmental systems. It provides a roadmap for action by Member States and regional organizations over the period 2009–15, while building on the groundwork laid by the CCCCC and its precursor programs and projects in climate change adaptation.</p> <p>The strategic elements of the framework are as follows:</p> <ol style="list-style-type: none"> 1. Mainstreaming climate change adaptation strategies into the sustainable development agendas of CARICOM states. 2. Promoting the implementation of specific adaptation measures to address key vulnerabilities in the region. 3. Promoting actions to reduce greenhouse gas emissions through fossil fuel reduction and conservation, and switching to renewable and cleaner energy sources. 4. Encouraging action to reduce the vulnerability of natural and human systems in CARICOM countries to the impacts of a changing climate. 5. Promoting action to derive social, economic, and environmental benefits through the prudent management of standing forests in CARICOM countries. 	All CARICOM countries and regional institutions	This framework was completed through funding from the Commonwealth Fund for Technical Cooperation. It was completed and approved by the CARICOM Heads of Government Meeting in Georgetown, Guyana, in 2009. It has since been published by the CCCCC and circulated widely. A copy of the document also can be found on the Centre's website at www.caribbeanclimate.bz .
Implementation Plan	The Centre has finalized the Implementation Plan	All CARICOM	The IP is seen as a live document that will undergo biannual

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
<p>(2012–21)</p> <p>Approximately US\$1 million</p>	<p>(IP) to actualize the Regional Framework document. The IP acknowledges that transformational change is essential to deliver the strategic elements and goals of the regional framework.</p> <p>The IP highlights the existing and significant resource and capacity challenges that hold back the region's sustainable development and growth and a more cogent and coordinated approach to assist in resource mobilization and coordination of actions. This program is one such initiative at a comprehensive and coordinated mechanism to addressing climate change impacts in the region.</p> <p>Aims and objectives of the program:</p> <ol style="list-style-type: none"> 1. Expand knowledge and capacities through evidenced adaptation initiatives and strengthen institutions for greater climate security. 2. Scale up delivery of adaptation programs in a range of key vulnerable sectors that are critical for sustained and expanded livelihoods. 3. Support effective national, regional, and international-level climate architecture to deliver climate change/adaptation financing. 	<p>countries and regional institutions</p>	<p>review. It was completed through funding from the Climate Development Knowledge Network (CDKN). The IP was approved at the Heads of Government meeting in Suriname on March 9, 2012, and aspects are being implemented.</p> <p>Two (2) of the core outcomes from the IP are:</p> <ol style="list-style-type: none"> (i) Promote the Three Ones Principle, i.e., One Regional Coordinating Policy Body on Climate Change, (ii) One Plan for Climate Change, and (iii) One Monitoring, Reporting and Evaluation (MR&E) Framework to address climate change in the region. (ii) Embed within the region, and in particular in Ministries of Finance, Physical Planning, and Public Works, a risk-management ethic.
<p>Pilot Program for Climate Resilience (2012–17) – Region Track</p> <p>US\$10.6 million</p>	<p>The Pilot Program for Climate Resilience (PPCR) is executed globally through a number of regional and national programs. In the Caribbean, the Regional Strategic Program for Climate Resilience (SPCR) is being executed for six countries to the tune of US\$10.6 million. The areas of intervention of the regional SPCR are:</p> <ol style="list-style-type: none"> 1. Data availability and analysis; 2. Data exchange, storage and access; 3. Modeling climate change and impacts; and 	<p>Jamaica, Haiti, Dominica, Grenada, Saint Lucia, and St. Vincent and the Grenadines (bilateral), and the CCCCC for the SPCR (regional)</p>	<p>The region is receiving nearly US\$100 million from the Climate Investment Fund (CIF) to carry out Pilot Programmes for Climate Resilience under the national and regional tracks. The Centre will be executing the Regional Track Programme, with implementing entities being the University of the West Indies (UWI), Caribbean Institute for Meteorology and Hydrology (CIMH), the Caribbean Regional Fisheries Mechanism (CRFM), the Caribbean Agricultural and Research Institute (CARDI), and the Caribbean Epidemiological and Health Institute (CEHI).</p> <p>Under separate funding from the CIF, the Centre has received</p>

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	<p>4. Identifying, upscaling, and replicating adaptation measures in key sectors. These will be addressed through the following components:</p> <ul style="list-style-type: none"> Improving geospatial data and management for adaptation planning, SLR and storm surge impact analysis; Consolidating and expanding the regional climate monitoring network and global platform linkages; Downscaling and expanding climate projection models and high-resolution maps; and Applied adaptation initiatives. 		<p>a Technical Assistance (TA) Grant to the tune of US\$150,000, and with its own contributions of US\$30,000, is elaborating an Investment Proposal for the SPCR. This TA involves, inter alia, the hiring of a project manager (PM) and the completion of consultancies on a private-sector study, vulnerable group and gender study, and a communications plan to feed into the Investment Proposal that will detail and cost the activities to be undertaken under the SPCR. The TA is for one year and is currently in its fifth month of execution, with the PM in place and the ToRs for the consultancy about to be approved.</p>
<p>Caribbean Regional Resilience Development Implementation Plan (2011–16) Aries Project £4.95 million</p>	<p>The United Kingdom (UK) is providing up to £4.95 million from the International Climate Fund (ICF), between October 2011 and March 2016, to support a program of priority actions in the Caribbean Community (CARICOM): Regional Framework for Achieving Development Resilient to Climate Change Implementation Plan (IP). This will strengthen the ability of the regional institution to support national-level adaptation as well as Caribbean participation in global negotiations. It also will help some of the most vulnerable communities to withstand the impacts of climate change and variability. Specifically, the program aims:</p> <ol style="list-style-type: none"> To support the implementation arrangements to actualize the IP and to strengthen those institutions that are nationally and regionally influential and mandated to direct climate change actions with enhanced technical capacity to provide high-quality advice, climate change information, training, and mentoring. To strengthen the knowledge base within the 	<p>All CARICOM countries</p>	<p>Under this project there has already been a number of notable accomplishments, including:</p> <ol style="list-style-type: none"> Hiring of a resource mobilization specialist, housed within the Caribbean Development Bank (CDB), whose role is to source climate financing for the region; Work toward developing a portfolio of ready-to-finance investment projects; Hosting of regional negotiators meeting to elaborate on the issues emerging at the negotiating fora and have common CARICOM positions as far as practical; Hosting of meeting for ministers with responsibility for climate change, finance, planning, and the environment so that they are fully conversant with climate change issues; Hiring of a firm (Baastel of Canada), which has commenced work on the development of the MR&E framework for the Implementation Plan; Completing feasibility studies for pilot adaptation interventions in Petite Martinique and Carriacou; Enhancing marine protected areas in Jamaica and Grenada through community engagement and education

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	<p>regional and national financial institutions and planning ministries about climate change impacts for greater inclusion of these risks within development policies, plans and programs, investment planning, and resource allocation decisions.</p> <ol style="list-style-type: none"> 3. To strengthen the management of coastal and marine resources for sustainability while simultaneously bolstering livelihoods. 4. To replicate adaptation interventions and/or embark on new adaptation initiatives. 5. To provide fact-based analyses to strengthen the region's negotiating positions and ensure greater regional cohesion in the negotiating arena. 6. To better position the region to access international resources for priority adaptation initiatives. 		<p>programs, better enforcement regimes, enhanced livelihood strategies, and private-sector involvement.</p>
Caribbean Aqua-Terrestrial Solutions (2013–17)	<ol style="list-style-type: none"> 1. Component 1: Strengthening the capacity of stakeholders through a common institutional framework for integrated coastal management and the strengthening of management of marine protected areas (MPAs) in the Caribbean region. 2. Component 2: Enhancement of capacity for rural land resources management, assessment, and monitoring and piloting innovative approaches, and upscaling of experience and lessons learnt from other initiatives (e.g., management and rehabilitation of natural resources, measures to add value to products from agriculture and fisheries, and measures to link land-based waste/water management systems to marine conservation). 	<p>CEHI, GIZ implementing in Belize, Grenada, Dominica, Guyana, Jamaica, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines</p>	<p>A baseline study has been carried out for Component 2 which articulated the needs and priorities of national stakeholders across the eight target countries with regards to coastal resources management and conservation of marine biodiversity in the Caribbean. It is available for download at http://cehi.org.lc/images/documents/baseline_study_giz_cehi.pdf.</p>

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
<p>Enabling Climate Change Adaptation in Borrowing Member Countries (BMCs)</p> <p>US\$470,000</p>	<p>The Caribbean Development Bank (CBD) provided the Centre with US\$470,000, and the Centre, with matching in-kind contributions, seeks to improve its technical capacity to effectively operationalize the region's climate change strategy and to provide technical support to BMCs to support the development of appropriate climate change responses and improve their access to available climate change financing.</p> <p>According to the TA, the Centre was expected to:</p> <p>(i) Establish a project development unit. This support is part of a wider initiative by the Centre to strengthen its capacity to support its Member States to plan and prepare successful climate change responses. CDB's resources will complement grants from the European Commission and the Australian government for this purpose.</p> <p>Specifically, the CDB project will focus on:</p> <p>(i) Providing the services of a consultant to head the Centre's Project Development Unit (PDU). The PDU will provide technical support for coordination of the IP for the region's climate change strategy and support appropriate climate change responses of its Member States. The PDU also will serve as coordinating mechanism for a regional community of practice, working on climate change adaptation and related issues in member states;</p> <p>(ii) Prepare a pipeline of priority climate change adaptation investment projects for Member States, capable of attracting</p>	<p>All BMC of CARICOM</p>	<p>To date, the PDMU (subsuming the PDU) has been established, and the Centre has received four concept notes and is about to provide its own staff to aid with the enhancement of these concept notes before they can be moved to project development phase.</p>

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	<p>(iii) development financing; and Develop tools and guidance resources to strengthen Member States' capacity to prepare and assess climate-oriented investments and establish enhanced environmental and social assessments processes to facilitate mainstreaming of climate risk-management approaches and adaptation policies and measures in the financial, environment, and planning processes of Member States.</p>		
<p>Database Management System for a Regional Integrated Observing Network for Environmental Change in the Wider Caribbean (2011–13)</p> <p>US\$1.1 million</p>	<p>A regional Non-reimbursable Technical Cooperation Agreement (No. ATN/OC-12554-RG) was signed between the Caribbean Community Climate Change Centre (CCCCC or the Centre) and the Inter-American Development Bank (IDB or the Bank) for the establishment of a Regional Integrated Observing Network for Environmental Change in the wider Caribbean. Under this agreement, the executing agency, the CCCCC, is provided with up to US\$ 600,000 to finance the contracting of consultancy services and procurement of goods necessary for the execution of the program. The Centre is providing counterpart funds in the amount of US\$500,400.</p> <p>The goal of the project is to build regional capacity to respond to the challenges and adverse impact of climate change in the Caribbean. The purpose is to develop a regional, operational database management system (DMS) to facilitate open access to data products useful for observing environmental change in the wider Caribbean, in support of a regional observing network, as a regional public good.</p>	<p>Countries will include Barbados, Belize, Commonwealth of Dominica, Guyana, Jamaica, and St. Lucia. Organizations will include the Caribbean Institute of Meteorology and Hydrology (CIMH), the National Oceanic and Atmospheric Administration (NOAA), and the Water Center for the Humid Tropics of Latin American and the Caribbean (CATHALAC).</p>	<p>The consulting firm, DE Design and Environment of Canada, was contracted to complete components 1, 3, and part of component 4 (sustainability plan). The consultant has just completed its inception report and has had useful engagements with personnel from the Centre, CIMH, UWI, and the government of Jamaica.</p> <p>The ToRs for the two remaining consultancies has been drafted and circulated to the members of the Technical Advisory Committee (TAC) for the project.</p>

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	<p>The components of the project include:</p> <p>Component 1 – Gap Analysis and Regional Plan of Action</p> <p>Under this component, a consulting firm will be contracted to:</p> <ul style="list-style-type: none"> i) conduct a gap analysis of existing geospatial infrastructure, which will include a survey of existing regional and national sensors deployed across the Caribbean, planned deployments, and desired deployments; compilation of potential data sources; and conduct a survey of desired DMS outputs, and ii) develop a regional plan to address identified gaps in hydrographic capacity as well as tidal and geospatial framework. <p>Component 2 – Selection of Database Management System Inputs and Outputs and Conceptual Design</p> <p>Technical assistance will similarly be contracted for activities under this component which provides for:</p> <ul style="list-style-type: none"> i) participating countries' selection of existing and planned data inputs and outputs for the DMS; ii) development of the conceptual design of the DMS, ensuring that sustainability of the system is built into the design; and iii) compilation of data protocols and standards. <p>Component 3 – Creation and Implementation of Database Management System</p> <p>This component provides for the development of a basic, expandable, operational database management</p>		

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	<p>system derived from the enhancement of existing systems at the Caribbean Institute of Meteorology and Hydrology.</p> <p>Activities under this component include:</p> <ul style="list-style-type: none"> i) participating countries' agreement on the characteristics of the system; ii) purchase of computer hardware for the CIMH and participating countries; iii) development and installation of the software program; iv) population of the national databases in four participating countries supported by capacity building in the use and updating of the system; v) training of national specialists in DMS programming and software development intended to facilitate expansion of the system; and vi) testing of the databases after installation. <p>Component 4 – Database Management System Outreach and Sustainability</p> <p>The final component to complete the system introduces measures to ensure the sustainability of the DMS after the life of the regional public good. The consulting firm or university will create a management structure for the operation of the DMS.</p> <p>An education and outreach program involving a broadly used base will be designed and implemented. This program will prescribe the marketing of the DMS, data, data products, and the compiled protocols and standards to potential national, regional, and international users.</p>		

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	A Sustainability Plan will be developed for implementation by the CIMH, which will facilitate continued use and enhancement of the products generated by the program, and which could be used to leverage regional growth and support. This sustainability plan will address financial sustainability, capacity building, further public awareness, and marketing of the program outputs; maintenance and management of the DMS; and development of the Regional Observing Network and a significant product of the program.		
<p>The Global Climate Change Alliance (GCCA) under the 10th EDF Intra-ACP financial framework (2011–14)</p> <p>€8 million</p>	<p>The EU-CARIFORUM Global Climate Change Alliance (GCCA) and the Caribbean Community Climate Change Centre signed an agreement in 2011 to the tune of €8 million aimed at, among other things, strengthening Caribbean states' data-gathering and management capabilities to enable them to cope with economic uncertainty and still provide meaningful emission targets in the near term.</p> <p>The project aims at:</p> <ul style="list-style-type: none"> i) Enhancing the predictive powers of regional climate models and the region's ability to design and implement cost-effective adaptation activities; ii) Improving the climate monitoring, data retrieval, and space-based tools for disaster risk reduction; iii) Refining the vulnerability and risk assessment methodologies that are more contextually relevant and build local capacity to better assess the current and future vulnerabilities and risks of specific states and communities within those states; and 	All CARICOM countries and Cuba and the Dominican Republic	<p>This project was possibly the first to finance activities contained within the Regional Framework for Achieving Development Resilient to Climate Change. It has had some notable achievements, and some that are emerging, to date. These include:</p> <ul style="list-style-type: none"> (i) Completion of training for Caribbean personnel in ensemble climate modeling (ii) Conducting training for Caribbean nationals in the execution of vulnerability and capacity assessments (iii) Purchasing of 37 hydro-meteorological and 13 meteorological stations (iv) Purchase of five coral reef early-warning stations (CREWS) (v) Conducting feasibility analyses for adaptation related projects in Barbados, Belize, and Carriacou (vi) Working with countries to digitize their atmospheric and environmental data (vii) Working with the CDKN risk management project to provide the training aspect of this project

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	iv) Reducing the states' vulnerability to climate change through embarking on adaptation pilots.		
<p>Caribbean Risk Management Project (2012–13)</p> <p>Phase 1: £365,000 Phase 2: £150,000</p>	<p>The Caribbean Risk Management Project builds on the work started by the region in 2003 in the development of Risk Management Guidelines for decision-makers, but is intended to be more attuned to the needs and special circumstances of the region given the prevailing conditions. It also will incorporate the development of new tools and risk-management methodologies.</p> <p>The project will be executed in a phased approach. Phase 1 will be the development of a risk management, web-based tool to guide decision-making (signed for a value of US\$365,931). Phase 2 will provide in-depth training for country decision-makers (to be finance out of GCCA). Phase 3 will undertake detailed risk assessments in selected countries (to be financed). The overall objective is to embed risk assessment into decision-making and management systems across the region in finance and planning as well as other strategic sectors.</p>	Barbados, Belize, Jamaica, and Suriname (with possible replication in other CARICOM countries)	<p>This project is being financed by the CDKN. To date, the consulting firm Acclimatise has completed:</p> <ul style="list-style-type: none"> (i) The communications plan; (ii) The revision of the Risk Management Guidelines (draft); (iii) The Risk Management Framework master document (draft); and (iv) Framework for the development of the online risk-management tool (draft). <p>The Centre is currently in discussions with the CDKN and Australian Agency for International Development (AusAID) to provide funding for Phase 3 of the project. A concept note and proposed budget has already been submitted for their consideration.</p>
<p>The CARIWIG Project (2012–14)</p> <p>£641,095</p>	<p>This project is for a total of £641,095. The CARIWIG project will provide locally relevant information on the weather impacts of climate change for a range of time horizons, training for stakeholder technical staff in the use of such weather information, the development of support networks within the region, and development of partnerships with UK research institutes specializing in the management of a range of hazards and impacts.</p> <p>A web service will be developed to provide this service through the adaptation and provision of leading weather-generator models from the</p>	Institute of Meteorology of Cuba (INSMET), University of Newcastle on Tyne, University of East Anglia, Climate Studies Group of the University of the West Indies (Mona), and the CCCCC	<p>Thus far, this project has hosted a workshop in Jamaica for the key proponents involved. Further, it has:</p> <ul style="list-style-type: none"> (i) Mapped out the policy context; (ii) Conducted a stakeholder requirements assessment; and (iii) Mapped out a climate change scenario of relevance to the Caribbean.

PROJECT	DESCRIPTION	PARTICIPATING COUNTRIES AND/OR INSTITUTIONS	STATUS OF PROGRAM
	EARWIG and the UKCIP09 climate knowledge systems. These weather generator models will be used to provide locally relevant weather projections based on the best available observed data and climate model outputs for the region.		
<p>Australia-Caribbean Collaboration on Climate Change and Coral Reef (2012–14)</p> <p>A\$2.0 million</p>	<p>The project aims to link Australian, Caribbean, and international expertise in climate change adaptation and coral reef management to support CARICOM Member States in addressing some of the key challenges identified in <i>Climate Change and the Caribbean: A regional framework for achieving development resilient to Climate Change (2009–2015)</i>.</p> <p>The project has two overarching objectives:</p> <ol style="list-style-type: none"> 1. Develop a Regional Framework for addressing key challenges for the sustainability of coral reefs associated with climate change, and 2. Build regional capacity through development of a climate change adaptation toolkit for coral reef managers. 	Belize, St. Lucia, and Grenada	The legal instruments for this project have just been signed. Additionally, interviews have been conducted and a project coordinator is about to be hired.

ANNEX F: USAID–FUNDED CLIMATE CHANGE PROJECTS IN BARBADOS AND THE EASTERN CARIBBEAN REGION

COUNTRY	DESCRIPTION	CLIMATE IMPACT	US\$	STATUS
Antigua - Sanderson Estate (Agricultural Station)	At present, vegetable crop production is severely impacted by heavy rainfall and extended periods of drought. The government has requested assistance to build resilience against these impacts at the Sanderson Agri. Station through the establishment of greenhouses.	Drought, periods of heavy rainfall, pests and disease	627,000	A meeting to be scheduled for USAID-OECS with the Min. of Ag, Antigua, to discuss an organic production option.
Barbuda	Barbuda had been experiencing prolonged dry periods, especially in the Highlands area near the main agricultural lands. The Barbuda Council has therefore requested assistance to construct a water catchment and to use a gravity-flow irrigation system to channel the water to farms where greenhouse technology will be applied to increase vegetable output.	Drought and an absence of a reliable supply of water are considered the primary reasons for low agricultural production.	235,000	Environmental requirements satisfied. OECS to award contract.
Dominica	To assist the Gov. of Dominica with the construction of a retaining wall to reduce the community's vulnerability to storm surge and flooding as a result of climate impacts.	Storm surge and flooding are the primary climate impacts identified as a threat to the community of Mero.	91,828	Government revising engineering and technical drawings. A topographical survey being undertaken.
Dominica: Londonderry Agricultural Project	As a means of increasing food security, the GoD has requested the installation of rain water harvesting systems to increase the storage facility and the use of organic matter	<ul style="list-style-type: none"> • Increased intensity and frequency of extreme events – rainfall; • Flood damages and landslides; • Increase in incidences of pests and diseases; • Reduced availability of 	245,000	A revised proposal with EMPR has been approved by USAID. With approval, a contract will be awarded by the OECS.

	and bio-digesters to condition the soil to enhance climate resilience at the farm.	pasture, grasses/forage/fodder for livestock due to low rainfall; • Low crop yield due to reduce rainfall and physical damages due to wind.		
Grenada: Sauteurs	In an effort to promote climate-resilient agriculture, the government has invested in the establishment of a model farm.	Farming activities are being threatened by the unavailability of water during dry periods. Flooding is a threat to a number of low-lying areas.	124,120	Project commenced. A status update will have been provided in the OECS' quarterly report due by the end of April 2013.
Carriacou and Petite Martinique (Grenada)	USAID assistance is being provided to develop a coastal restoration and rehabilitation plan.	Both islands have been experiencing coastal erosion, which have worsened as a result of intense rainfall and storm surges.	280,000	Environmental requirements satisfied. OECS to award contract.
St. Kitts	Government has requested assistance to carry out water audits in the tourism and agricultural sectors to monitor water use and inform new ways of harvesting water.	Rising sea level; changing rainfall patterns; more intense rainfall; the topography of the island increases flash floods	TBD	A status update will have been provided in the OECS' quarterly report due by the end of April 2013.
Nevis	Nevis Island administration has requested assistance with the development of a master plan and an early warning system.	In spite of intense rainfall, Nevis continues to be water scarce; the island experiences flash flooding, which erodes topsoil.	374,962	The assessment has started. A status update will have been provided in the OECS' quarterly report due by the end of April 2013.
St. Lucia	The Government of St. Lucia has requested assistance to build the capacity of WASCO. A site has been selected for the establishment of the GIS project.	In recent years, St. Lucia has experienced severe periods of drought which depleted in the main storage facility on the island, the Roseau Dam; severe landslides and siltation of rivers	288,548	The assessment has started. A status update will have been provided in the OECS' quarterly report due by the end of April 2013.
St. Vincent and the Grenadines (SVG)	This demonstration project targets the establishment of rainwater harvesting for agricultural production and which serves as an emergency supply.	Deforestation, landslides, flooding, and siltation	83,869	Site assessment completed; design drawings to be prepared.
Bequia (SVG)	USAID assistance is being provided to provide potable water to residences in Bequia.	Prolonged drought threatens water availability in Bequia. This is the second phase of the project. The	TBD	Contract is presently out for tender.

		Caribbean Community Climate Change Center (5Cs) funded Phase I.		
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ANNEX G: SITES VISITED BY COUNTRY

Antigua and Barbuda: None

Barbados

1. The Barbados Wildlife Reserve and the Welchman Hall Gully, St. Philip Parish
2. Barbados: Beach stabilization and boardwalk projects within the Folkestone Marine Reserve, St. James Parish
3. The boardwalk and seawall project in Hastings, Christ Church Parish
4. Beach stabilization project at Worthing Beach, Christ Church Parish
5. The Graeme Hall Nature Sanctuary, Christ Church Parish

Dominica

1. GEF SGF project to conserve biodiversity and enable climate change resilience in the coastal village of Calibishie
2. NEWCEPT Community-based Sea Turtle Conservation, Management and Eco-Tourism Project funded by GEF SGF and implemented by North East Wildlife Conservation Environment Protection and Tours
3. Reducing poverty and improving food security and nutrition among Dominica's rural population through sustainable agriculture focused on aquaculture and aquaponics, a project implemented by Dominica Academy of Arts and Sciences and funded by GEF SGF
4. Visit to Dominica Model Village

Grenada

1. Grand Etang National Forest
2. Worburn and Calivigny mangrove restoration projects
3. Sandy Island/Oyster Bed MPA
4. Molinere/Beausejour MPA; Belmont Estate/Grenada Chocolate Cooperative
5. Various coastal sites on the west and north sides of the island

Guyana

1. Kanuku Mountains and Shell Beach, declared protected areas under the Protected Areas Act in October 2011
2. Kaieteur National Park (63,000ha)
3. Iwokrama Forest Reserve (371,000ha)
4. Kanuku Mountain and Shell Beach Protected Areas (~1.0 million ha)
5. Community-owned conservation areas: the Upper Essequibo Conservation Area and the Konashen

St. Kitts and Nevis

1. Central Forest Reserve (to 1000ft asl contour) with interpretive center
2. Fisheries complex built with funds from Japan International Cooperation Agency (JICA)

St. Lucia

1. Central Forest Reserve
2. Parrot Reserve
3. Pigeon Island Historical Park
4. Fond St. Jacques
5. Mankote Mangrove Reserve

St. Vincent and the Grenadines

1. Vermont Nature Trail and Forest Reserve, St. Vincent
2. Richmond Vale Academy and Hiking Center, St. Vincent
3. World Health Organization (WHO) and USAID-supported Smart Hospital project in Georgetown, St. Vincent Island
4. New airport construction site, St. Vincent
5. The South Coast Marine Park, St. Vincent
6. A sea water de-salinization plant, sea wall/boardwalk, and a former wetlands and mangrove site that has been filled in near the airport on Bequia Island
7. The Tobago Keys Marine Park and the Ashton Wetlands, Union Island

Suriname

1. Northern coastal area of Suriname affected by SLR

Trinidad and Tobago

1. Visit to Turtle Watching Project by Environmental Management Agency of Trinidad and Tobago
2. Visit to the Coroni Swamp area, noted for its rich biodiversity, and area of GHG sink project of the University of the West Indies

Rapid Climate Change Vulnerability Assessment

CHAPTER 2: ANTIGUA AND BARBUDA

LIST OF ACRONYMS

APUA	Antigua Public Utilities Authority
AusAID	Australian Agency for International Development
CARDI	Caribbean Agricultural Research and Development Institute
CCCCC	Caribbean Community Climate Change Centre
CCDRM	Canada Caribbean Disaster Risk Management
CIA	Central Intelligence Agency
DCA	Development Control Authority
DFID	Department for International Development
EAG	Environmental Awareness Group
EBM	Ecosystem-Based Management
EIMAS	Environmental Information Management System
GARD	Guild of Agriculture Rural Development Centre
GDP	Gross Domestic Product
GEF	Global Environment Facility
GIS	Geographic Information System
GOAB	Government of Antigua and Barbuda
NGO	Nongovernmental Organization
NODS	National Office of Disaster Services
NPDP	National Physical Development Plan
SIRMM	Sustainable Island Resource Management Mechanism
SIRMZP	Sustainable Island Resource Management Zoning Plan
SLR	Sea Level Rise
SPAW	Special Protected Areas and Wildlife
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFCCD	United Nations Framework Convention to Combat Desertification
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase Antigua and Barbuda's mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation. A 1-meter rise in sea level together with a 1-in-100-year storm surge is predicted to affect 53 percent of its tourist resorts and 100 percent of its airports. A rise in sea level of 1 meter is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$2.8 billion and a rise of 2 meters US\$8.6 billion by 2080, mostly for tourism resorts (CARIBSAVE, 2012) (see Tables 1–3). These costs may make Antigua and Barbuda less competitive to other Caribbean nations in attracting international tourists and thereby cause its economy to create fewer well-paying jobs than otherwise would be possible. In general, it is recognized that the country's natural resources and ecosystems, including freshwater resources, coastal and marine resources, and agricultural lands are impacted by a range of local factors that increase vulnerability to climate variability and sea level rise (SLR). Climate change is therefore one of many drivers of change for its ecological systems and natural resources. Means to strengthen Antigua and Barbuda's resilience to climate change would be to improve its capacity to implement practical projects from which baseline climate change data can be gathered and used to develop adaptive systems. We recommend that USAID assist the government of Antigua and Barbuda to: (1) develop a procedure for the design and implementation of a series of local area plans incorporating demonstration projects for climate change within the established framework of the Sustainable Island Resource Management Mechanism (SIRMM); (2) establish a mechanism for attracting capital to the Sustainable Island Resource Financial Plan on an ongoing basis; (3) develop a program to extend the research and marketing of the use of new varieties of traditional food crops; (4) design and implement a broad-based public education and awareness program for natural resources management and climate change; and (5) develop an implementation framework for a national Coastal Zone Management Unit.

BACKGROUND AND PURPOSE

Antigua has an area of 289 km² and Barbuda has an area of 161 km² for a combined area of 443 km², about 2.5 times the size of Washington, D.C. Antigua has a deeply indented shoreline, with many natural harbors and beaches. Barbuda has a large western harbor; arable land occupies 9 percent of the terrestrial area, permanent crops 2 percent, and other uses 89 percent. As of July 2013, their population was estimated to be 90,156 (CIA, 2013).

This report reviews Antigua and Barbuda's physical and socioeconomic vulnerabilities to climate change, summarizes the institutional and legal structure for reducing those vulnerabilities, identifies the priority actions which are required to increase its resilience, and recommends to the USAID Eastern Caribbean Regional Program which of these measures to finance.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the model-based prediction for changes in temperature, precipitation, sea surface temperature, and tropical storms and hurricanes in Antigua and Barbuda by 2080. Predictions for changes in mean annual temperatures range from +2.4 degrees Celsius to +3.2 degrees Celsius, for monthly precipitation from -31 millimeters to +13 millimeters, and for increases in sea surface temperature from +0.7 degree Celsius and +2.8 degrees Celsius. Hurricanes and tropical storms are predicted to increase in intensity, but without quantification.

Table 1 Predicted climatic effects of climate change by 2080

CLIMATE VARIABLES	PREDICTIONS OF CHANGE BY 2080
Mean Annual Temperature	Increase between 2.4°C to 3.2°C
Yearly Precipitation	-31mm/month to +13mm/month
Sea Surface Temperature	Increase between 0.7°C and 2.8°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

The predicted changes in Antigua and Barbuda's climate could affect its rate of economic growth. An increase in average annual temperature could, for example, raise operational costs of tourism activities. Decreases in precipitation might reduce the quantity and reliability of fresh water. Increases in precipitation, by contrast, might augment soil erosion and thereby cause more sedimentation runoff, which may affect Antigua and Barbuda's coral reefs and sea beds. If sedimentation should impact reef health, reefs would become more susceptible to invasive species, rises in sea level, increases in concentrations of CO₂ in sea water, and higher temperatures of sea water. Changes in temperature and precipitation could threaten agricultural production and vary types and patterns of human diseases. More-intense tropical storms and hurricanes could cause severe damage to tourism physical infrastructure and put human lives at risk.

Table 2 indicates the effects of a SLR of 1 meter, 2 meters, and a 1-meter SLR together with a 1-in-100-year storm surge, if no adaptation measures are implemented.

Table 2 Predicted physical effects of sea level rise (SLR)

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M SLR	2 M SLR	1 M WITH 1-IN-100-YEAR STORM SURGE
Area	2 %	5%	11%
Population	3	6	13
Urban Area	2	5	11

Wetland Area	*	*	*
Agricultural Land	2	5	10
Crop and Plantation	1	4	9
Major Tourism Resorts	10	18	53
Airports	0	100	100
Road Network	2	6	11
Protected Areas	5	8	-
Sea Turtle Nests	12	18	-
Power Plants	0	50	-
Ports	100	100	-

Source: Simpson et al., 2010

A 1-meter rise in sea level would most seriously affect Antigua and Barbuda's ports. A 2-meter rise in sea level would seriously affect its airports, power plants, about a fifth of its tourism resources, and sea turtle nesting sites. A 1-meter rise in sea level combined with a 1-in-100-year storm surge would affect its population, urban area, agricultural land, crop and plantation land, protected areas, road network, more than half of its major tourist resorts, and about 11 percent of its area (CARIBSAVE, 2012).

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1-meter and 2-meter rise in sea level in Antigua and Barbuda. Annual costs capture the ongoing costs to the economy from the impact of SLR damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs of sea level rise (SLR) by 2080

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	340	340
Agriculture	3	2
Industry	2	3
TOTAL	344	345
<i>Capital Costs</i>		
Airports	*	227
Ports	46	84
Roads	2	7
Power Plants	*	309
Property	102	519
Tourist Resorts	1,576	5,711
Dryland Loss	1,024	1,783
Wetland Loss	*	*
TOTAL	US\$2.8 billion	US\$8.6 billion

Source: Simpson et al., 2010

Table 3 indicates that of all Antigua and Barbuda's sectors, the tourism sector would suffer the greatest annual costs from a SLR of 1 and 2 meters, followed distantly by agriculture and industry. The largest capital costs from a 1-meter rise in sea level would be on tourist resorts and drylands. A 2-meter rise in sea level would add substantial capital costs to power plants and property while increasing by almost four times the capital costs to tourism and increasing capital losses to approximately 70 percent.

The predicted physical and economic effects of the potential changes in Antigua and Barbuda's climate indicated in Tables 1, 2, and 3 would be likely to decrease the international competitiveness of its tourism industry by raising its costs and reducing its attractiveness when compared with alternative regional and international tourist destinations. To the extent that there are fewer income opportunities in Antigua and Barbuda over the coming decades, the potential consequences of changes in Antigua and Barbuda's climate could disproportionately decrease the income and welfare of the most vulnerable sections of its population, including youth, women, elderly, and resource-dependent communities.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Ministry of Agriculture, Lands, Housing, and Environment** is comprised of several agencies that can play an important role in combating climate change. Its **Lands Division** is responsible for the reallocation of government resources to residential, agricultural, and industrial uses and consequently has a major role to play in the conversion of land to non-agricultural uses. Additionally, its Land Division is also responsible for the overall management and administration of properties owned by the state. Its **Central Housing and Planning Authority** gives advice on suitable sites, rehabilitates houses in the event of disaster (primarily hurricanes), develops new housing tracts, and redevelops blighted areas. Its **Environment Division** is the focal point for climate change management. This division coordinates many other projects and programs emerging from international environmental conventions as well as funding from a number of international agencies to finance and assist the nation in fulfilling its obligations to international environmental conventions. The division is responsible for the finalization of a **Draft Environmental Management Bill** under which there is a proposal for a **Coastal Zone Management Unit** to undertake the country's integrated coastal zone management. Additionally, the Environment Division provides educational outreach programs through environmental workshops in many local schools, as well as grants to community groups who are interested in environmental issues. The **Fisheries Division** is responsible for the development and management of marine living resources, and has developed some strategies to manage coastal and marine resources using an ecosystem-based management (EBM) approach. Effective ecosystem-based management is intended to reduce Antigua and Barbuda's vulnerability to many pressures and hazards by building its ecosystem's resilience through enabling: consistency in food production, improvements of the tourism product, protection against natural hazards, greater resistance to negative effects of changing climate, and a solid basis for incremental improvement in the overall economy (GOAB, 2009). However, there are several other agencies with legislative mandates for particular elements within the coastal zone and the result is a number of gaps and overlaps in vulnerability and threat management within the coastal zone. The **Forestry Unit** is responsible for wildlife and the conservation and management of the nation's terrestrial biological diversity. The **Development Control Authority** (DCA) is responsible for regulating the use and development of all lands. The DCA is a quasi-governmental agency which carries out the functions outlined in the **Physical Planning Act** (2003). There is no **National Climate Change Committee** in Antigua and Barbuda.

Climatic data is collected for agricultural purposes at several **Government Agricultural Stations**. Meteorological stations are located at Dunbars Experiment Station, Cotton Division, Cades Bay Pineapple Station, and the Caribbean Agricultural Research and Development Institute in Antigua.

The **Antigua Public Utilities Authority** (APUA) carries out water conservation projects in schools and through the media to educate and train individuals about water conservation practices.

The main NGOs involved in climate change management include: **Environmental Awareness Group** (EAG), the **Guild of Agriculture Rural Development Centre** (GARD), and **Bendels Community Group**.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

Tourism is Antigua and Barbuda's principal industry, thus construction of hotels and housing along the coast is inevitable. In general, development activity along the coastline destroys large tracts of mangroves, wetlands, and swamps.

Antigua and Barbuda has no indigenous sources of oil, natural gas, coal, or hydropower. As a result, the country remains highly dependent on imported fossil fuels (oil imports stand at 4,500 barrels per day), in particular petroleum-based products for electricity production and transportation (REEGLE, n.d.). Fuel imports comprise 35 percent of all import merchandise. In terms of the energy sector's vulnerability, dependence upon imported petroleum makes electrical generation costs susceptible to fluctuations in global oil prices. In addition, the islands are located in an area of the Caribbean subject to hurricanes, thus requiring a robust hurricane-resistant model of power generation and transmission.

Although there remains a lack of funding for renewable energy projects, the government of Antigua and Barbuda is committed to the adoption of renewable energies. In 2013, it partnered with several international groups and countries through the **Caribbean Renewable Energy Development Programme** project and launched the first renewable energy project on the island: a 6-kilowatt solar power system. The government reported that the project has spurred productivity and reduced environmental pollution as well as foreign dependency on oil. More recently, the Ministry of Education and Ministry of Tourism installed 25-kilowatt solar panels (Malone, 2013). Though the prime minister has been vocal about increasing clean energy use in the country, there have been very few feasibility studies on both islands for the development of such projects.

The GEF is financing **The Energy for Sustainable Development Programme** with capacity-building support from the Caribbean Community Climate Change Centre (CCCCC). This program will take an integrated, systematic approach to reducing energy consumption in the built environment based on near-term incremental energy-efficiency improvements, coupled with the introduction of renewable energy where appropriate. Baseline data collection for this project has begun.

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change** (RRACC) project, USAID is financing two activities in Antigua and Barbuda: (1) the establishment of an agricultural station to carry out research on climate-change-resilient crops in Antigua, and (2) the development of a water catchment and irrigation scheme for vegetable production in Barbuda.

The Global Environment Facility (GEF) of the **United Nations Environment Programme** (UNEP) is financing the **Sustainable Island Resource Management Mechanism** (SIRMM). This project was officially launched in June 2005 by the Environment Division of the Ministry of Agriculture, Lands, Housing, and Environment. There are four outcomes outlined in the SIRMM.

The first outcome is easy and reliable access to information for environmental management by all stakeholders through the development of the **Environmental Information Management System** (EIMAS) by the Environment Division. This process resulted in the creation of a geographic information system (GIS) mapping tool in order to assist government agencies to access up-to-date data on specific environmental indicators. This GIS system facilitates looking at areas with recurring problems and it is being used mainly by the **Development Control Authority** (DCA) for the mapping of protected areas and by the **National Office of Disaster Services** in conducting of vulnerability assessments.

The second outcome of the SIRMM is a **Sustainable Island Resource Management Zoning Plan** (SIRMZP) developed on the basis of the outputs of Outcome 1, which is a framework for the zoning of the islands' resources watershed by watershed. This process resulted in the preparation of a **National Physical Development Plan** (NPDP) in 2012. This is the country's third national physical development plan, with previous plans being prepared in 2000 and 1976. However, an informant indicated that the 2012 NPDP "does not incorporate climate change into long-term planning."

The third outcome is for policy and institutional reforms to provide a framework for SIRMM plan's implementation. This process has led to the development of a **Sustainable Island Resource Financial Plan**. The GEF is financing the establishment of this national trust fund. The fund is expected to be approved by the Cabinet by July 2013 as a component of the Draft Environmental Management Bill. This plan focuses on the use of natural resources services (water, electricity, and biofuel) as areas to save money that would ordinarily be used on fossil fuels, and directs the profit toward the implementation of climate-change adaptation measures. The aim is to have financing available for preventative and restorative work. Lastly, the fourth outcome is the requirements for implementation of the SIRMM. An informant indicated that currently, activities under the SIRMM project are being finalized and the project is scheduled to terminate at the end of 2013, with a terminal evaluation planned for January 2014.

An application has been made to the **Canada Caribbean Disaster Risk Management (CCDRM) Fund**, financed by the Canadian International Development Agency, by the Environmental Awareness Group for financing of a project proposal entitled "**Improving Watershed Stability of the Sawcolts Village-Body Ponds Watershed through Community Outreach, Land Improvement, and Fire Management Techniques.**" According to an informant, the aim is to help train firefighters to fight plant-based fires started by the oily, invasive lemongrass plant which the government is currently unable to manage. The project also will implement a watershed protection component by working with three communities (Sawcolts, Swetes, and John Hughs) to raise awareness of the anticipated impacts of climate change. This project is still being processed by the Project Steering Committee of the CCDRM.

The Ministry of Agriculture is now placing more emphasis on local food crops. Plans are now in place to work with the **Caribbean Agricultural Research and Development Institute** (CARDI) in Antigua to maintain local germ plasm and promote the development of more-resistant local crops in the light of climate variability. In the past, the ministry imported seeds and there was very little emphasis placed on local germ plasm.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of Antigua and Barbuda. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist Antigua and Barbuda to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies needed actions to resolve the issues that are both especially important for Antigua and Barbuda to address and appropriate for USAID support.

PRIORITY ISSUE I: LACK OF PROGRAM/PROJECT IMPLEMENTATION

Government officials repeatedly indicated that no more studies are required about climate change. This is based on the view that the government has numerous studies on shelves that cannot be implemented because there are no resources assigned to aid program implementation. Informants indicated that "any funds that are available for Antigua and Barbuda need to be directed to projects on the ground that will result in a positive outcome, rather than being spent on studies carried out by consultants." The government of Antigua and Barbuda, through its Environment Division, is proposing to use demonstration projects as a mechanism for

generating local baseline data for climate change management—specifically, local projects which seek to address vulnerabilities in the coastal areas and well-defined and intensely used watershed areas. However, local area plans are needed to guide development on the ground, including practical demonstration projects that facilitate the generation of local climate change data. There is a scarcity of these plans. A needed action, therefore, is to ***develop a procedure for the preparation of strategic local action area plans within the established framework of the SIRMM.***

No other program or organization could be identified that is working to ensure the ongoing implementation of on-the-ground projects in local areas with an emphasis on comprehensive watershed management and integrated coastal zone management systems. The establishment of a local area planning system could be an exemplary model for other islands. We recommend that USAID ***finance the government of Antigua and Barbuda to develop a procedure for the design and implementation of a series of local area plans incorporating demonstration projects for climate change adaptation within the established framework of the SIRMM.***

PRIORITY ISSUE 2: FINANCIAL CONSTRAINTS

One informant said, “Antigua has to find a financial solution to climate change management. A financial perspective has to be put on everything. Funds are required for staffing, training, program implementation, and so forth. At least US\$10 million per annum is needed for infrastructure alone to get us ready for climate change.” Climate change mitigation and management is a very expensive process and the country must secure a great deal of funds in order to implement appropriate initiatives.

Through its Environment Division, the government of Antigua has established a national trust fund known as the Sustainable Island Resource Financial Plan, which is expected to assist with the financing of climate-change management. Elements of the fund include: an investment arm, revolving fund, small loans, NGO facility, and insurance for the slow onset effects on climate change. Investment components of the fund are: renewable energy (solar and wind); processing of sewage, biofuel, and recycled fuel (natural gas); and watershed management. Possible sources of capital for the fund include: green climate fund, adaptation fund, GEF, bilateral sources, the Caribbean biodiversity fund, water levy (co-financing), proceeds from investment, soft loans, and donation of technology. A needed action is ***to establish a strong mechanism for attracting capital to the national trust fund on an ongoing basis.***

No project was identified as providing long-term support to the marketing of this sustainable financing plan. Therefore, we recommend that USAID ***finance the government of Antigua and Barbuda to establish a mechanism for attracting capital to the Sustainable Island Resource Financial Plan on an ongoing basis.***

PRIORITY ISSUE 3: FOOD SECURITY

Climate change creates favorable conditions for the spread of additional invasive species in Antigua and Barbuda. Due to the significance of the threat that invasive species pose to agricultural production in Antigua and Barbuda, this vulnerability is considered a priority. Furthermore, there are direct and indirect effects are anticipated from irregular rainfall patterns. According to CARIBSAVE (2012), climate-related events, expected low annual rainfall, and high evaporation and transpiration rates make irrigation necessary for sustained yields and moderate levels of production, especially in drought years. With climate variability it is now more difficult to predict rainfall patterns and there is additional uncertainty about when to undertake ground preparation. To promote food security in the face of climate variability, a needed action is ***to strengthen research models and pilot programs to support the development of local food crops that are less susceptible to climate variability.***

The Ministry of Agriculture has embarked on a program that seeks to protect local food crops, mainly sweet potatoes, cassava, local squash, herbs, and spices. It is important that these crops be accepted by the local

population. In support of the Ministry of Agriculture, it is recommended that USAID *develop a program to extend the research and marketing on the use of new varieties of traditional food crops.*

PRIORITY ISSUE 4: STORAGE AND TREATMENT OF WATER RESOURCES

The country has recently installed desalination plants to supplement its limited freshwater supplies, which has resulted in high energy costs that have put a financial constraint on the economy. Currently 60 percent of the water for domestic and industrial purposes comes from desalination plants due to the occurrence of droughts, the inconvenient location of reservoirs downstream from settlements, the contamination of water supplies by soil erosion and waste, and the high costs of water treatment. The alternative to desalinization is surface water sources; however, climate variability is expected to reduce the available supply of both surface and ground water. These challenges point to a need for education and awareness among citizens about climate change and water management. A needed action for improving water management in the context of climate variability is *the implementation of a broad-based public education and awareness program.*

No current program was identified that is supporting national water resources management through providing a broad-based public education program. It is therefore recommended that USAID *finance the design and implementation of a broad-based public education and awareness program on water resource management and climate change.*

PRIORITY ISSUE 5: COASTAL ZONE MANAGEMENT UNIT

Most of Antigua and Barbuda's population lives in small, coastal villages, and tourism, the country's primary industry, is coastal-based as are most major economic development initiatives. Development activity along the coastline destroys large tracts of mangroves, wetlands, and swamps, and causes sedimentation and pollution in near-shore environments. Poor agricultural and fishing practices combine to have deleterious effects on marine and coastal resources. Against this backdrop, the potential impacts of climate change-related threats such as sea surface temperature increases, ocean acidification, coral bleaching, and storm surges increase the vulnerability of coastal and marine ecosystems and infrastructure. A needed action for improving adaptive capacity for the coastal zone is to support the proposal of the Environment Division for the establishment of a national Coastal Zone Management Unit.

No current program was identified that is supporting the establishment of the national coastal zone management unit. It is recommended therefore that USAID *finance the development of an implementation framework for a national Coastal Zone Management Unit.*

Based on the assessment team's findings in interviews with key informants, focus group meetings, and literature review, the following shortcomings in the institutional and legal frameworks for environmental protection exacerbate Antigua and Barbuda's vulnerability to climate change: (1) lack of sufficient and sustainable funding mechanisms for climate change management; (2) lack of capacity in government organizations to carry out climate change management; (3) absence of an institutionalized, integrated coastal zone management framework; (4) no existing indicators to monitor impacts of climate change nor adaptive capacity at the national level; and (5) no evidence of existing systems for monitoring and evaluating climate change-related threats.

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APPENDIX A: QUOTATIONS FROM KEY INFORMANTS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: LACK OF PROGRAM/PROJECT IMPLEMENTATION

- What is needed is more demonstration projects that can allow for the capture of best practices.
- There is a need for action on the ground. No more reports.
- We need local area plans but we are not getting the assistance technically or financially in implementation.
- Reports from funding agencies need to include an implementation phase. What is needed is more implementation.
- Community-based assessment and vulnerability assessments should be feeding into a local area plan.

PRIORITY ISSUE 2: FINANCIAL CONSTRAINTS

- Antigua has to find a financial solution to climate change management. A financial perspective has to be put on everything. Funds are required for staffing, training, program implementation, and so forth. At least US\$10 million per annum is needed for infrastructure alone to get us ready for climate change.
- The country's energy bill for water is about US\$10 million per annum. This high energy bill is a major challenge.
- Main constraints relate to finance, personnel, watershed management, and lack of legislation.

PRIORITY ISSUE 3: FOOD SECURITY

- Climate change can potentially lead to the introduction of invasive species that threaten food crops and biodiversity. There is a lack of legislation which makes it difficult to know who is responsible for some management areas.
- There are no resources to make institutional changes required for climate change adaptation.
- We are concerned with climate change and how it affects food security. Climate change creates the possibility for more invasive species of plants to come in. Invasive species are transported by hurricanes and this is an area of vulnerability that has to be addressed.
- Agriculture is the most vulnerable to climate change.

PRIORITY ISSUE 4: STORAGE AND TREATMENT OF WATER RESOURCES

- Changing rainfall patterns, erosion, and solid waste are the biggest challenges affecting the supply, storage, and treatment of water resources.
- Rainfall is very variable. The heavy and torrential nature of rainfall has resulted in the need for changes in the design of infrastructure such as dams and roads. The safety factors are now much higher.
- Sea water intrusion is an issue for water resources. Therefore, the amount of water to be exploited for use is decreasing.
- Public education on climate change and watershed management—and why it is important—is needed.
- Rainwater harvesting can end up being a strain on the Authority [APUA]. Managing water after harvesting is always a problem.

PRIORITY ISSUE 5: COASTAL ZONE MANAGEMENT UNIT

- The focus is on vulnerable areas, e.g. vulnerability and capacity assessments on the southwest coastal area, with an emphasis on the water sector.
- The southwest coast is susceptible to damage because of loss of vegetation cover and resulting soil movement.

- With respect to coastal resources management: there is management of the marine resources but very little land management. There are issues in this area with who is responsible for the coastal lands.
- The Environment Division is carrying out beach restoration and is now allowing groynes and other coastal structures to be built for coastline protection.
- Coastal buildings are now required to be on pillars so that the waves can wash under the building.
- Special attention needs to be given to tourism, specifically, and coastal development in general.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 3: BARBADOS

LIST OF ACRONYMS

CC	Climate Change
CRMP	Coastal Risk Assessment and Management Program
CZMU	Coastal Zone Management Unit
EED	Environmental Engineering Division
EPD	Environmental Protection Department
EU	European Union
GoB	Government of Barbados
IDB	Inter-American Development Bank
IGEMP	Integrated Gully Ecosystem Management Plan
MED	Ministry of Environment, Water Resources, and Drainage
NOAA	United States National Oceanic and Atmospheric Administration
RE	Renewable Energy
SLR	Sea Level Rise
SWH	Solar Water Heaters
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase Barbados' mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation (CARIBSAVE, 2012). A sea level rise (SLR) of 1 meter together with a 1-in-100-year storm surge are predicted to affect 45 percent of its tourist resorts and 100 percent of its ports by 2080 (Simpson et. al., 2010). Airports, agriculture, crops, plantations, and roads would be much less affected. A rise in sea level of 1 meter is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$1.8 billion and a rise of 2 meters US\$9 billion by 2080, mostly for tourist resorts (CARIBSAVE, 2012) (see Tables 1–3). Marine ecosystems, coral reefs, and fisheries will continue to be adversely affected by increased sea surface temperatures, ocean acidification, coral bleaching, and storm surges, threatening additional economic and food security impacts. These increased costs and impacts on natural ecosystems may make Barbados less competitive in attracting international tourists and thereby cause its economy to create fewer well-paying jobs than otherwise would be possible. A weaker economy might especially affect the income of more-vulnerable segments of the population such as youth and women. A principal means to strengthen Barbados' resilience to climate change is to improve its capacity for protecting and managing its natural terrestrial and marine ecosystems. We recommend that USAID provide assistance to Barbados to: (1) design, establish, and finance mechanisms for providing reliable, timely, and sufficient financing for the implementation of the Integrated Gully Ecosystem Management Plan; (2) design and implement educational programs to increase public support for the measures required to conserve marine ecosystems; (3) improve the capabilities of the Barbados Coastal Zone Management Unit (CZMU) to plan and manage marine zones; and (4) improve its capacity to measure changes in sea level.

BACKGROUND AND PURPOSE

Barbados is 34 kilometers long, 23 kilometers wide, and has 431 km². Its population is about 284,000, of which 80,000 live near Bridgetown, the largest city and capital (CIA, 2013). It has a Westminster parliamentary system of government, with a governor general, a Senate, and a House of Assembly. The prime minister's personality, style, and popularity greatly influence government policies and actions (CIA, 2013). Barbados has a generally capable government, as indicated by its rank in 2011 of second in the Americas and 16th globally on Transparency International's Corruption Perception Index (Wikipedia, 2013). Until the 1960s its economy depended on mostly the production of sugar, rum, and molasses, but since then tourism has become the most important component of the economy (UWI, 2009).

This report reviews the vulnerabilities of Barbados to climate change, identifies the priority actions which are required to increase its resilience to the effects of climate change, and makes recommendations for how USAID could best assist Barbados to implement these priority actions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for Barbados by 2080. Average annual temperature may increase from between 2.4 degrees Celsius and 3.2 degrees Celsius. Predictions for changes in precipitation range from -36 millimeters/month to +12 millimeters/month. Sea surface temperature may rise by +0.8 degree Celsius to + 3.0 degrees Celsius. Tropical storms and hurricanes may become more intense.

Table 1 Predicted climatic effects of climate change by 2080

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Mean Annual Atmospheric Temperature	Increase between 2.4°C and 3.1°C
Precipitation	Decrease of 36 mm/month to an increase of 12 mm/month
Sea Surface Temperature	Increase between 0.8°C and 3.0°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

An increase in average annual temperature would be likely to raise operational costs of tourist operations, through increased energy costs for cooling buildings and vehicles. Decreases in precipitation might reduce the quantity and reliability of fresh water in part due to intrusions of sea water into fresh water aquifers. Increases in precipitation, by contrast, might augment the rate of soil erosion, thereby increasing sedimentation onto Barbados' coral reefs and sea beds, which would reduce their vigor and increase their susceptibility to invasive species, rises in sea level, and increases in the acidity of sea water and temperatures. Changes in air temperature and precipitation could make agricultural production more risky and vary the types, prevalence, and patterns of human diseases. More intense tropical storms and hurricanes would be likely to cause severe damage to tourism infrastructure and put human lives at risk.

Table 2 indicates the predicted effects on land uses and infrastructure of a SLR of 1 meter and 2 meters and of 1 meter combined with a 1-in-100-year storm surge.

Table 2 Predicted effects of SLR on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M SLR	2 M SLR	1 M SLR+ 1-IN-100-YEAR STORM SURGE
Area	1%	1%	2%

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M SLR	2 M SLR	1 M SLR+ 1-IN-100-YEAR STORM SURGE
Population	1	1	2
Urban Area	< 1	< 1	1
Wetland Area	*	*	*
Agricultural Land	<1	<1	1
Crop and Plantation	<1	<1	0.3
Major Tourism Resorts	8	32	45
Airports	0	0	0
Road Network	0	0	0.1
Protected Areas	*	*	-
Sea Turtle Nests	3	8	-
Power Plants	0	0	-
Ports	100	100	-

Source: Simpson et al., 2010

Table 2 indicates that a rise in sea level 1 meter would severely damage Barbados' ports. A rise in sea level of 2 meters would severely damage its tourism resorts as well, and a combination of a 1-meter rise in sea level with a 1-in-100-year storm surge would further damage its tourist resorts. Barbados' power plants would not be affected by rises in sea level of 1 or 2 meters, but no data were available on the physical effect on power plants of a 1-meter rise in sea level combined with a 1-in-100-year sea surge.

Table 3 indicates the predictions of economic losses by 2080 in Barbados of 1- and 2-meter rises in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs due to SLR by 2080

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	850	854
Agriculture	2	2
Industry	*	*
TOTAL	852	857
<i>Capital Costs</i>		
Airports	*	*
Ports	40	76
Roads	*	*
Power Plants	*	*
Property	81	276
Tourist Resorts	946	7,615
Dryland Loss	750	1,074
Wetland Loss	*	*
TOTAL	US\$1.8 billion	US\$9.0 billion

Source: Simpson et al., 2010

Table 3 indicates that a rise in sea level of 1 or 2 meters would result in severe economic costs in Barbados. Tourism and tourist facilities would suffer the highest annual and capital costs, respectively. Capital costs to tourist resorts from a 1-meter rise in sea level are predicted to be US\$946 million and from a 2-meter rise in sea level, US\$7.62 billion. On the other hand, power plants are not predicted to suffer economic losses due to a 1- or 2-meter rise in sea level.

The physical and economic effects of the predicted changes in Barbados' climate indicated in Tables 2 and 3 would be likely to decrease the international competitiveness of its principal industry—tourism—by raising its costs and thereby reducing its attractiveness to many tourists. Barbados' agriculture and industry also would suffer high economic costs. Such costs would likely reduce Barbados' international competitiveness for these products and services. Reduced competitiveness would be likely to reduce the number of well-paying jobs available for Barbados' residents. To the extent that they have fewer employment opportunities, reduced job opportunities would be likely to negatively and disproportionately affect the income and welfare of its more economically vulnerable groups, who are often youth and women.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Ministry of Environment, Water Resources, and Drainage** (MED) is the overall lead agency in Barbados for responding to climate change. Within MED, the **Environmental Protection Department** (EPD) is responsible for monitoring and controlling the conditions that are likely to affect the quality of Barbados' land, air, and water and the general health and environmental wellbeing of its inhabitants. The EPD has departments for regulating, controlling, and monitoring building developments, marine pollution, solid waste disposal, and water quality (EPD, 2013). The EPD's **Environmental Engineering Division** (EED) has principal responsibility for enforcing the **Marine Pollution Control Act** of 1998, which is intended to “prevent, reduce, and control pollution of the marine environment...” and which establishes, by reference, the maximum permitted levels for contaminant discharges and some regulations and fines (<http://faolex.fao.org/docs>). Also within the MED, the **Coastal Zone Management Unit** (CZMU), established by the **Coastal Resources Management Act** of 1998, has three sections, **Coastal Resource Management, Engineering, and Marine Research**, and advances “the knowledge, use, development, conservation, and management of the coastal zone and its resources” (<http://www.coastal.gov>). It serves as chair for the **Technical Standing Committee on Coastal Standards**. The **National Conservation Committee** deals with re-vegetating beaches, conserving marine turtles, policing beaches, and reforesting the Scotland District in the northeastern part of the island. It also manages the Marine Museum Underwater Park, the Caves of Barbados, and other public areas (Marshall, n.d.). The **Soil Conservation Act** gives the Chief Agricultural Officer power to forbid any kind of action that may contribute to soil erosion within the Scotland District, such as cutting trees, grazing cattle, and construction.

The **Office of Town and County Development Planning**, established by the **Town and County Planning Act** of 1968, has “the responsibility for the orderly and progressive development of Barbados...” using the Physical Development Plan “to chart settlement, growth patterns, and the allocation of land to various uses” (<http://www.townplanning.gov.bb>). The **Fisheries Division** of the **Ministry of Agriculture and Rural Development** (MAR), which operates under the **Fisheries Act** (1998) and its **Fisheries Management Regulations**, protects vulnerable species such as marine turtles, lobsters, sea urchins, ornamental fish, and yellow fin tuna (MEWRD, 2010); develops and manages fisheries in collaboration with the representative of fishermen in a **Fisheries Advisory Committee** (FAC); and works with the **Coast Guard** and **Police** to enforce fisheries management measures (FAO, 2013). The **Barbados Meteorological Services** collects, analyzes, and makes available meteorological data. The **Water Authority Act** of 1980 established the **Barbados Water Authority** (BWA), which “assesses, develops, manages, and licenses water resources” (<http://www.oas.org/usde/environmentlaw/waterlaw>). The **Department of Emergency Management** (DEM) operates under the **Emergency Management Act** of 2006 and is responsible for

coordinating emergency management activities in Barbados, especially to “encourage, equip, and accustom the people ... to work together for their own preservation ... activating the community to be prepared to deal with any type of disaster” (<http://www.dem.gov.bb>).

Barbados Red Cross International helps people prepare for and respond to natural disasters (Barbados Red Cross, 2013). The **Barbados National Union of Fisherfolk** improves the socioeconomic conditions of fisherfolk through the sustainable development of fisheries (BARNUFO, 2012). The **Centre for Resource Management and Environmental Studies** (CERMES) of the University of the West Indies does research and trains graduate students on watershed management and marine conservation issues. Since 1954, the **Bellairs Research Institute of McGill University** has operated a research station on the edge of Folkstone Marine Reserve in Holetown (McGill University, 2013). The **Barbados Hotel and Tourism Association** is a trade association whose members represent all aspects of the tourism industry (Barbados Ministry of Tourism, 2011).

Since 1981, the **Inter-American Development Bank** (IDB) has financed large coastal engineering projects in Barbados in order to protect coastal infrastructure from beach erosion and storm surges. As climate change has become an issue, these engineering projects, without much change in their characteristics, have morphed into climate change adaptation projects. The foreign aid organizations of **Germany, Great Britain, and Italy** either have financed or are financing climate change activities in Barbados, but no information was available on their funding, objectives, content, or effectiveness.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

Urbanization is the principal development activity that is affecting Barbados’ capacity to reduce its vulnerability and strengthen its resilience to climate change. Time limitations prevented a thorough analysis of the location, extent, and pace of such urbanization, although the Barbados Planning Authority likely does have the data that would make such an analysis possible. Since 2008, when the European Union (EU) eliminated preferential access to its markets for Barbados sugar, urbanization, rather than other types of agriculture, has been replacing sugarcane cultivation as the principle driver of changes in land use. As a result, the area of concrete surfaces in areas above the beaches, particularly along the eastern shore, has increased considerably in the last 10 to 15 years. Rather than percolate into the soil, rainfall runs off paved surfaces into adjacent marine areas, carrying with it additional pollutants and reducing the rate of recharge of aquifers. According to an informant in the Coastal Zone Management Unit (CZMU), the construction of the Mid-Western Coast Sewage Treatment Plant would ameliorate the increase of sewage runoff into near-shore marine environments resulting from urbanization, but it has not been possible to build this treatment plant because the construction would disrupt the main western coastal road, and there is no alternative way to access the hotels and houses along the western coast.

Although Barbados is an oil producer and partially satisfies its own oil and gas demand, it imports 10 times what it produces. Electricity generation is roughly 100 percent fuel- and oil-based, and energy demand has been growing by close to 4 percent annually in the last several years (REEEP, 2012). The GoB has taken several successful policy steps to promote the development of renewable energy (RE) sources to offset growing energy use. Sustained support for the application of RE is seen in the prevalence and use of household solar technology. Solar water heaters (SWH), for example, have received strong governmental support through tax and other incentives (and disincentives of electric heaters). This support has helped to make Barbados a global leader in SWH technology with 50,000 systems installed and the highest surface area of SWHs in the world (GoB, 2001; REEEP, 2012). Due to the use of SWHs and sugarcane bagasse, renewable energy supplies about 15 percent of Barbados’ energy. Other renewable energy sources that have been assessed and promoted to varying degrees are solar crop dryers, stills, photovoltaic panels, introduction

of electric and hybrid vehicles, improvement of cement production, recapture of landfill gases for local energy use, ocean thermal energy conversion (OTEC), and wind farms (REEEP, 2012).

Several barriers limit the large-scale adoption of clean energy in Barbados. They include unfavorable policies, laws, and regulations; inadequate institutional arrangements; weak professional and technical capabilities; lack of information; low public awareness and understanding of the benefits of clean energy; and lack of sufficient economic and financial incentives (REEEP, 2012; GoB, 2001). While progress in formulating and implementing policies favorable to investments in renewable energy production has been made, especially with the assistance of the Inter-American Development Bank (IDB), the lack of a national energy policy is a significant barrier to investments in the production of clean energy.

CLIMATE CHANGE PROJECTS

The **Coastal Risk Assessment and Management Program** (CRMP) has been the principal international, donor-funded project related to climate change in Barbados. It is financed by a loan for US\$42 million from the IDB and implemented by the Coastal Zone Management Unit (CZMU). The project started in 2009 and will end in 2015. It is “building resilience to coastal hazards through improved conservation and management of the coastal zone” through three components: coastal risk assessment, monitoring, and management; coastal infrastructure; and institutional strengthening” (<http://www.coastal.gov.bb>). Field observations confirmed the opinion of an informant that “the civil work components of the project are on schedule.” Data were not available for a thorough analysis of how the implementation is actually addressing vulnerabilities, or of how the project activities and results could be potentially expanded upon to further address vulnerabilities. However, the project did appear to be giving much more emphasis to the re-construction of relatively short sections of beaches that are important for tourism than to resolving the institutional and legal impediments to protecting and managing terrestrial and marine ecosystems so that they can protect Barbados from the effects of climate change.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicated that Barbados is not fully prepared institutionally and legally to reduce its vulnerability and augment its ability to adapt to climate change by increasing the resilience of its natural ecosystems through their improved management and protection. USAID, however, lacks sufficient resources to assist Barbados to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies the priority issues that are both important to address and appropriate for USAID to support, and needed actions to increase Barbados’ institutional and legal capacity to increase the resilience of its natural ecosystems.

PRIORITY ISSUE 1: FINANCING MECHANISMS FOR WATERSHED MANAGEMENT

Healthy, vigorous, near-shore marine ecosystems, including reefs, sea grass beds, and beaches, provide protection against the effects of climate change; keep Barbados more competitive in international tourism markets; and support the growth of marine seafood consumed by both tourists and permanent residents. Sediments that originate in Barbados’ uplands threaten the reefs’ health and ability to survive changes in sea water levels, temperatures, and acidity. Thus effective watershed management would contribute importantly to Barbados’ ability to increase its resilience to the effects of climate change. The Integrated Gully Ecosystem Management Plan (IGEMP) has already been prepared for the north–central part of Barbados, and it sets forth the policies that are required to reduce erosion while permitting orderly development. The IGEMP, however, is not currently being implemented due to inadequate and irregular financing. A needed action to increase Barbados’ adaptive capacity to climate change is to ***establish a permanent source of financing for the IGEMP.***

USAID has financed a number of successful projects in Latin America that have helped water companies incorporate watershed management into their cost structures so that funds are available to finance watershed management. We recommend that USAID use this experience to assist Barbados to ***design, establish, and finance mechanisms for providing reliable, timely, and sufficient financing for the implementation of the Integrated Gully Ecosystem Management Plan.***

PRIORITY ISSUE 2: PUBLIC AWARENESS OF CLIMATE CHANGE

To increase its ecological and economic resilience to climate change, Barbados must manage its reefs, sea grass beds, beaches, and uplands to protect them from degradation. Yet most of the residents of Barbados still understand little about the links between the conservation of these ecosystems, resilience to climate change, and their own economic welfare. Consequently, in general, the public only tepidly supports the actions required to implement necessary conservation actions for terrestrial and marine ecosystems. A needed action, therefore, is ***to increase the understanding of Barbados citizens about the links between conservation, resilience to climate change, and their own economic welfare.***

USAID has financed many projects around the world that have created widespread public support for government actions to protect and manage natural ecosystems. Barbados' marine ecosystems are both very important for its resilience to the effects of climate change and are largely underappreciated by different segments of the Barbados population. We therefore recommend that USAID assist the Barbados Ministry of Environment, Water Resources, and Drainage to ***design and implement an educational program to increase public support for the measures required to conserve marine ecosystems.***

PRIORITY ISSUE 3: MARINE PLANNING AND REGULATION

Barbados' marine ecosystems are both vulnerable to the effects of climate change and contribute to its resilience to climate change as well as to food security and economic growth (Burke et. al., 2004). Barbados has land-use plans and regulations but lacks equivalent plans and regulations for its marine areas. Without planning and regulation, its marine areas cannot be effectively managed and protected. A needed action, therefore, to increase Barbados' resilience to climate change is to ***prepare plans and regulations for its marine areas, legally approve these plans, and implement them effectively.***

USAID's program in the Coral Triangle has worked successfully with six countries to support the development, implementation, and enforcement of laws, policies, and regulations for marine protected areas to address climate change vulnerabilities

(www.uscti.org/pages/WhatWeDo_ClimateChangeAdaptation.html). The United States National Oceanic and Atmospheric Administration and the United States Park Service have technical expertise in planning and zoning marine areas. USAID could share the expertise these projects and institutions have accumulated to assist Barbados to improve its plans and regulations for its marine areas. Given its proven capabilities and its legal responsibilities, the Barbados CZMU would be the appropriate institution through which to channel such support. We therefore recommend that USAID provide technical assistance to Barbados to ***improve the capabilities of the Barbados Coastal Zone Management Unit (CZMU) in planning and managing marine zones.***

PRIORITY ISSUE 4: COLLECTION OF CLIMATE CHANGE DATA

To increase its adaptive capacity to climate change, Barbados must collect reliable and sufficient scientific data to use in making decisions about the use and management of natural resources. Although Barbados has excellent institutions and capable scientists working on climate change problems, it is not collecting sufficient scientific data on the trends and conditions of its marine ecosystems, the socioeconomic aspects of management of its natural resources, rainfall patterns, the rate of SLR, and other data that are needed to manage its terrestrial and marine ecosystems effectively. Therefore, a needed action for increasing Barbados' resilience to climate change is to ***expand its capabilities for collecting, analyzing, and utilizing scientific data related to its terrestrial and marine ecosystems.***

Reliable data on the rate of the SLR on Barbados' coasts are critical for establishing reasonable regulations for setbacks from the high water level for development projects, such as hotels and restaurants, which are so important to increasing Barbados' economic prosperity. Barbados, however, lacks the technical capacity to determine the rate of SLR on its coasts. We recommend, therefore, that USAID finance an activity to assist Barbados to *improve its capacity to measure changes in the sea level along its coasts*.

PRIORITY ISSUE 5: INTER-INSTITUTIONAL COORDINATION

Barbados has well-organized public conservation institutions staffed by competent professionals, but they do not always work together in the most effective and efficient way possible to strengthen the resilience of Barbados' ecosystems to climate change. Increasing the resilience of Barbados' ecosystems to climate change, therefore, requires its institutions to coordinate more effectively, even when that requires subordinating specific institutional objectives to the goal of improving the management and protection of Barbados' natural ecosystems. A needed action, therefore, is to *make inter-institutional coordination more effective, consistent, and focused on increasing ecosystem resilience*.

Although increasing inter-institutional coordination is necessary to increase Barbados' capacity to adapt to climate change, we do not recommend that USAID become involved in assisting Barbados to resolve this issue, since doing so requires more administrative determination rather than technical expertise.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS TO PROTECT NATURAL RESOURCES IMPORTANT TO CLIMATE CHANGE RESILIENCE

In Barbados, some legislation for the management of ecosystems already exists, such as the Coastal Management Act and Marine Pollution Control Act, but do not yet have regulations, and other legislation, such as the Environmental Management Act, has yet to be legally approved. To increase its resilience to climate change, Barbados will need to *approve and implement additional laws and regulations*.

Barbados has the technical ability to write the additional legislation and regulations that are required to increase the resilience of its natural ecosystems to the effects of climate change. However, the approval of such legislation and regulation requires political leadership. For that reason, we recommend that USAID not assist Barbados to resolve this issue.

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: FINANCING MECHANISMS FOR WATERSHED MANAGEMENT

- What we may have are stations that are recording information incorrectly. Lack of funding has caused this problem. Lack of funding and the fact that because water resources is embedded within a service provider, the resources are more targeted toward service provision and less so toward resource management.
- This should be rebalanced. Previously we have worked on the issue of separating the two, which has run into difficulties. But there is no reason why we couldn't establish a user-free system to provide the additional resources needed to carry out the resource management job.
- We have to find a way of raising the natural resource management issue and asking them to include it in the water tariff rate.
- I do not think it's feasible; I think it would take a lot of convincing. USAID has financed this in several countries.

PRIORITY ISSUE 2: PUBLIC AWARENESS OF CLIMATE CHANGE

- I have interacted with a lot of young people about climate change and they are not clued into [climate change] ... they talk about ice caps and polar bears; they have not linked it to agriculture and fisheries.
- Older fisherfolk are not linking the changes we are seeing to climate change.
- We need to implement things in the household itself, especially about the use of concrete. People do not understand that they are causing the problem themselves.
- We need to educate people that climate change doesn't only affect tourism but lots of other things... most things we do affect fisheries and other parts of the economy. We have to educate people more on the impact and adaptation for CC.
- Supporting community groups that are innovative [is necessary]. Physical action in each community, creating green spaces is one thing; their management is another important factor in which we have failed. Those spaces could be managed better if there is more community responsibility.
- I have now seen what happens when we put tourism ahead of our home. We make the beaches look pretty for the tourists. There are institutions in place. Yes, they need strengthening, but it comes down to winning the hearts and minds of community members.

PRIORITY ISSUE 3: MARINE PLANNING AND REGULATION

- One of the tools that we are just beginning to work with and we would welcome technical assistance in this case more than money is marine spatial planning. We need to get to a point where we replicate the land-use planning system for the marine environment. It is relatively new, but it has a lot of potential. Zoning of the marine environment would be a useful thing to do to protect critical areas of the marine environment.
- Now we have setback limits and excluded areas. You are allowed to put the building back in the same footprint as before. However, you are not allowed to go any further seaward. We are too small to prohibit building on the beach. A lot of this stuff preceded from the '60s before town planning existed. There were already houses on the other side of the road.
- The reef is affected by the sediment in the water. It is a stress. If the event comes sequentially then it can affect the reef. We need to stop the sediment load to save the reefs. The sediment has been reduced a lot. Sediment load has not gone down because there are only one or two quarries built to catch storm water runoff.
- This beach was identified as a critical area that needed attention, because it actually is a big catchment area for water. That is why you see all these trees. It was a lot of mangroves then. Fishing is occurring right along the beach. There was no planning. The hotels changed the whole place. There is a heavy sediment load here. Three big gullies. The reef is not as healthy as it should be. There is no sewage

project here because of tearing up the road. Have to make satellite plants because to run pipes down the entire west coast would damage things too much. The big business here does not accept that disturbance.

- The whole island is zoned for water. Zone 1 is where the water is extracted and you cannot build there. Marine biologists may have said that there has been an improvement since the south coast project came on line.

PRIORITY ISSUE 4: COLLECTION OF CLIMATE CHANGE DATA

- Scientific monitoring is the most critical one because it has to do with the high water mark. If we can determine the true high water mark and also the predicted SLR then we can plan in terms of setbacks and design solutions. For Barbados as a country, our primary tourism structure is within the coastal zone and our primary highways traverse the coastal zone. It is absolutely critical to us to get that as close to right as possible.
- There are limitations especially on the coasts as it relates to the scientific information on the true high water mark because the high water mark we use today is the one we used 42 years ago. We need to have more up-to-date scientific information. It is difficult to determine because it requires sophisticated instruments. In Texas there was work done and they came up with how to predict the true high water mark. If we say that SLR is eminent then we need to use another setback as a planning standard. Galveston Island might have done that work. Given the emphasis on adaptation to CC that would be something that we need to look at as planners. That would be the most critical missing link at this time.
- We do have student research papers that have dealt with aspects of CC. They are three- to four-month studies. Not generally usable. It is a gray area. Other faculties within the university not only in Barbados but also Jamaica and Trinidad have other projects of a similar nature.
- Julia Harooks is the regional expert on marine turtles. They have published some papers on the impact of coastal setbacks on nesting of turtles in the Barbados coast.
- We are in the middle of a Coastal Risk Assessment and Management Project of US\$30 million with the IDB for six years, started in 2011. It is not on schedule except for the civil works. The studies are for storm surges and different CC scenarios. How vulnerable different places are. Vulnerability maps. It is for planning the future.
- There needs to be ... less emphasis on the physical and more in the social data, especially regarding links to economic development. The CZMU executed a project on the behalf of the government of Barbados to build the south coast boardwalk. If anyone asks us the impact on tourism, we cannot tell them.
- There is modeling work in Grenada. There is work done in Jamaica and Belize ... I am not sure of anywhere else. We have speculated about the impact of CC on water resources in Barbados and some rudimentary work is being done on that.
- Florida has almost an identical limestone aquifer in some areas; what are they implementing there for adaptation? What can we learn from them?
- We have observed some trends in the rainfall patterns, but in terms of quantifying it and determining what the potential impact is, that is difficult. Right now we don't have consistent long-term meteorological data, so it is difficult to measure differences then and now.

PRIORITY ISSUE 5: INTER-INSTITUTIONAL COORDINATION

- Inter-institutional rivalries [about data] are blocking progress. How we share information is a problem.
- Each person who is head of a government office tends to think the office is theirs. Inter-institutional rivalries are blocking progress. How we share information is a problem. I have maps; if you want to borrow them you have to pay for the maps, even if it is another government department. How we interact affects our work a lot. It causes a lot of inefficiencies. IDB project wants to develop a policy for information sharing that is clear but it will depend on the confidentiality of the information. Latter half of the project is the institutional strengthening and adaptation part of the project.
- The final component of the IDB project is introducing disaster risk reduction formally.

- The Water Division needs the correct staffing to do that kind of work. Not part of the IDB project. They do not even know what staff they need to hire. They only recently hired an engineer. It was stuck inside the Ministry of Transport and Works and its job was to construct wells.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS TO PROTECT NATURAL RESOURCES IMPORTANT TO CLIMATE CHANGE RESILIENCE

- Barbados has a huge amount of legislation that has remained only in draft: Coastal Management Act and Marine Pollution Control Act. Regulations have not been written. Official line is that the capacity for drafting the regulations does not exist. Government itself has to meet those standards as well. That has also been raised but it is an unofficial response that you will get. There is general knowledge of what we need to do.
- There is a penalty for damaging coral of two or three hundred dollars per meter. Environmental claims are still not seen as significant crimes in the court. People just pay the money to not go to court.
- Coastal management is understood theoretically but not applied because politicians prefer to ask IDB for money to construct things. Do not worry about uplands or reefs. Sewage plant is in the mangroves as well.
- The problem is the storm waters that destroy the reef that then causes the destruction of the beach. The IDB financed the beach part because the CZMU could handle the loan while the Water Division lacks the capacity to implement the upland project and it is private land there so it is more difficult to do a project because private landowners tend to not cooperate. The problem originates in the storm runoff water from the land uses up there in the uplands. This is the third time that this beach has been rebuilt. Most Caribbean islands probably have it worse than us because they are volcanic and the water runs off faster. They are not yet as developed on the coast yet though.
- We sing Calypso here. A famous Calypso singer's house went into the sea during a large storm. That happened in 1991. We decided that we cannot continue like that. Barbadians take their garbage and throw it in the gullies, creating blockages that led to the destruction of the singer's house. The study was intended to educate the people to not throw the garbage in the gullies. The people learned from the experience. The drainage division wants to look at how to prevent so much water from coming down from the hills. The recovery of the reef is a slow process but is what you ultimately want.
- If we could manage the storm water we would have protection against the destruction of the beach. Our biggest problem is the management of storm water runoff. How many dams can we build? How many quarries can we build?
- The EPD has a Marine Pollution Control Act that was written at the same time as the Coastal Resources Management Act. Neither one has regulations although they were passed in 1996. Just the CRZU Act will get the regulations but perhaps the MPCA will also get the regulations out of the project.
- Although the Environmental Management Act has never been approved, we have a system that works fairly well because civil servants ... know each other personally.
- The government abides by it 90 percent of the time ... but if anybody challenges us in court we would be in trouble. It would give the enforcement capacity. We need the law. There are certain areas we are regulating but we have no legal basis to do so, such as private water wells.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 4: DOMINICA

LIST OF ACRONYMS

CARICOM	Caribbean Community
CCRDR	Caribbean Community Resilience to Disaster Risk
CIF	Climate Investment Fund
GEF SGP	Global Environmental Facility, Small Grants Programme
JICA	Japan International Cooperation Agency
NEPO	National Emergency Planning Organisation
NGO	Nongovernmental Organization
ODM	Office of Disaster Management
PPCR	Pilot Program for Climate Resilience
SIDS CBA	Small Island Developing State Community-Based Adaptation Project
SLM	Sustainable Land Management
SLR	Sea Level Rise
SPACC	Special Programme for Adaptation to Climate Change
UNDP	United Nations Development Program
USAID	United States Agency of International Development

SUMMARY

In recent times Dominica has struggled with the devastation resulting from significant climatic events, mostly in the form of hurricanes. The country's rain and temperature patterns are evolving, resulting in unforeseen impacts such as the erosion of coastal areas, the undermining of the agriculture sector, the loss of valued biodiversity that is at the center of the tourist industry, and an increase in mudslides and landslides. The estimated economic impact of a 1-meter sea level rise (SLR) alone amounts to US\$71 million in annual costs (e.g., operations and maintenance) and US\$186 million in capital costs (e.g., rebuilding/relocation costs and lost land-value). Dominica's roads and ports are most vulnerable to this level of SLR, with 14 percent and 67 percent predicted to be affected respectively. The tourism industry, however, is expected to suffer the greatest annual costs of any sector at US\$55 million (CARIBSAVE, 2012) (see Tables 1–3). The population of Dominica is known for its close relationship to the environment and as such demonstrates a very strong understanding of how the island is being affected by climate change. At the same time, there is limited experience regarding the potential of climate change adaptation measures. Adaptation measures to reduce vulnerability can be envisaged in a variety of areas, including the introduction of climate-resilient crops, targeted research, and better models of community planning. A key concern is the limited number of institutions and organizations capable of working effectively on matters related to climate vulnerability. Project activity in the climate field is typically channelled through the Environmental Coordinating Unit. Departments such as forestry, agriculture, and tourism have large stakes in seeing the concept of climate resiliency flourish on the island. Through the GEF-SGP, the NGO sector in Dominica has been able to become more involved in environmental issues, but more support and guidance is required to produce more direct involvement in climate-resilient activity. The World Bank and UNDP have been supporting exercises in participatory land-use planning, and this process is under consideration to become a nationwide process. This process could either be supported directly or could create options for providing support for the implementation of certain components of the current national plan.

BACKGROUND AND PURPOSE

Dominica is located in the Lesser Antilles, south–southeast of Guadeloupe and northwest of Martinique. Dominica is 750 km² and is relatively mountainous, with the highest elevation being Morne Diablotins at 1,447 meters. As of 2011, Dominica’s population was 71,293. An increasing number of immigrants from the Dominican Republic and Haiti have arrived to Dominica over the past several years. Dominica is also attempting to attract a business immigrant class from countries such as China and the United Arab Emirates. This report reviews the vulnerabilities of Dominica to climate change, identifies the priority actions which are required to increase its resilience, and recommends which of these measures USAID might finance in its Eastern Caribbean Regional Program.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predictions for Dominica by 2080. Average annual temperature may increase by 2.4 degrees Celsius to 3.1 degrees Celsius. The predictions for changes of precipitation range from -34 millimeters/month to +6 millimeters/month. Sea surface temperature may rise by +0.9 degrees Celsius to +3.0 degrees Celsius, and tropical storms and hurricanes may become more intense.

Table 1 Predicted climatic effects of climate change in Dominica

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase between 2.4°C to 3.1°C
Precipitation	Decrease of 34 mm/month to an increase of 6 mm/month
Sea Surface Temperature	Increase between 0.9°C to + 3.0°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

The predicted changes in Dominica climate could affect its rate of economic growth. An increase in average annual temperature could, for example, raise operational costs of tourist operations. Decreases in precipitation might reduce the quantity and reliability of fresh water. Increases in amounts and intensity of precipitation might augment soil erosion, leading to increased pollution of Dominica’s coral reefs and sea grass beds, which could reduce their area and health and thereby their resilience to the effects of climate change. Changes in temperature and precipitation also could threaten agricultural production by creating favorable conditions for the spread of invasive species and increase the frequency, types, and virulence of human diseases (e.g., dengue, typhoid, gastroenteritis, leptospirosis, malaria and schistosomiasis) (CARIBSAVE, 2012). More intense tropical storms and hurricanes could cause severe damage to the physical tourism infrastructure and put human lives at risk. Landslides and flooding have already severely affected Dominica’s roads, which frequently become impassable during the rainy season.

Table 2 indicates the predicted effects on land uses and infrastructure in Dominica of a SLR of 1 meter, 2 meters, and 1-meter SLR combined with a 1-in-100-year storm surge.

Table 4 Effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENTAGE AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2M	1 M + 1-IN-100 YEAR STORM SURGE
Area	<1%	1%	1%
Population	1	1	2
Urban Area	<1	1	1
Wetland Area	*	*	*

PARAMETER (PERCENTAGE AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2M	1 M + 1-IN-100 YEAR STORM SURGE
Agricultural Land	5	5	8
Crop and Plantation	<1	<1	0.4
Major Tourism Resorts	0	6	18
Airports	0	50	100
Road Network	14	15	17
Protected Areas	0	0	-
Sea Turtle Nests	7	10	-
Power Plants	0	0	-
Ports	67	67	-

Source: Simpson et al., 2010

Table 2 indicates that a predicted SLR of 1 meter by 2080 will mostly affect ports and, to a lesser extent, roads. A 2-meter rise would affect half of Dominica's airports and part of its major tourism resorts. A 1-meter rise combined with a 1-in-100-year storm surge is predicted to negatively affect all of the airports and about one-fifth of the tourism resorts and roads.

Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value. In the case of a 1-meter sea level rise, tourism and dryland loss would have the highest annual and capital costs, respectively. For a 2-meter rise, tourism would suffer the greatest annual and capital costs, while the capital costs to airports (upon which tourism depends), ports, and dryland loss also would be substantial.

Table 3 Predicted costs by 2080 due to sea level rise

VARIABLE	COSTS US\$ MILLION	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	55	103
Agriculture	7	10
Industry	9	14
TOTAL	71	128
<i>Capital Costs</i>		
Airports	*	199
Ports	66	146
Roads	10	22
Power Plants	*	*
Property	17	59
Tourist Resorts	*	317
Dryland Loss	93	241
Wetland Loss	*	*
TOTAL	186	984

Source: Simpson et al., 2010

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Environmental Coordinating Unit** from the **Ministry of Environment, Natural Resources, Physical Planning, and Fisheries** is the government department responsible for climate change⁸, which includes representing Dominica in international forums. Dominica's **National Emergency Planning Organisation** (NEPO) is the state agency established to plan and coordinate the management of disasters. The **Office of Disaster Management** (ODM) is the implementation arm of NEPO and reports to NEPO. Dominica has adapted **CARICOM's Comprehensive Disaster Risk Reduction Management Strategy**. As noted before, Dominica has issued the Initial and Second National Communication on Climate Change and a Low-Carbon Climate Resilient Development Strategy was developed for 2012–20. The government has stated a desire to fully embrace the concept of a green economy for Dominica, however, no official strategy has been put in place. This might be because the low-carbon strategy is expected to provide guidance in this regard. The **Forest Act and the Fisheries Act** (currently under review) are somewhat out of date. There is also the National Park and Protected Area Act of 1975 and the Forestry and Wildlife Act of 1976. Overall, there is a need for changes in all legislation to be able to better prepare and respond to climate change.

Site-specific climate risks were identified during the **Special Programme for Adaptation to Climate Change** (SPACC) and the **Sustainable Land Management (SLM) Project**. Resource-specific risks from climate change have been identified in **Dominica's Biodiversity Strategy and Action Plan** as well as a process to develop the **Policy for Sustainable Water Resource Management Plan**. The national NGO sector is considered weak and there is minimum presence of international NGOs on the island. The presence of the **GEF Small Grants Programme** (GEF/SGP) has strengthened the overall and environment-specific capacity of a number of organizations on the island. There is the ongoing presence of international volunteers from countries such as Australia, who have been involved in climate issues, including land-use planning.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

All types of property across the island are for sale, from residential to farm land to areas for potential industrial use. At the same time, housing and settlement patterns are changing because of a small influx of foreign investment, due to Dominica being promoted as an immigration haven. Tourism infrastructure is being developed in part by investment coming from Dominica's Diaspora. Land-use planning should be a serious issue for the island but as it stands, a great deal of unregulated building is taking place. Poor housing standards for new and existing structures which typically do not incorporate hurricane standards have become an issue. In addition, even with weak water management practices and the potential of scarcity on certain parts of the island, there is a push for increasing water exports. The **Tourism Master Plan 2022** and a **Strategic Plan for the Discover Dominica Authority** have been developed. The master plan does not clearly address climate change, even though in 2000 public officials acknowledged the negative impacts that climate change could have on the tourism industry (Ministry of Tourism, 2013). At the same time, many families and individuals are seeking to move inland to higher altitudes to escape the increasing heat. The environmental implications of this trend are not fully understood.

Dominica's energy sector relies on a mixture of imported fossil fuels and locally produced hydroelectric power. Dominica has two operating diesel plants (Fond Cole and Portsmouth) that produce 16.03 megawatts and three hydropower facilities (Laudat, Trafalgar, and Padu) that produce 6.42 megawatts (Fadelle, 2009). The country boasts favorable geographic conditions and natural resources that can contribute to significant

⁸ The participation of the Environmental Coordinating Unit in this study was solicited on a number of occasions, including providing an overall list of climate change projects in Dominica. After an initial e-mail indicating that due to international travel the Environmental Coordinating Unit would not be available during the mission, the Environmental Coordinating Unit did not respond to any further inquiries.

hydro, wind, solar, bio mass, and geothermal energy production. In 2009, the government of Dominica approved the **Energy Development Programme** with the objectives to minimize energy costs, diversify energy sources, reduce dependence on fossil fuels, and conserve energy, all while reducing greenhouse gas emissions. The program is expected to enable an increase in development of renewable energy sources, particularly geothermal energy production (Fadelle, 2009). There is currently an US\$24 million geothermal project in development in the Roseau Valley that involves a small power plant for domestic consumption as well as a plant with 100-megawatt production capacity for generation for export to Guadeloupe and Martinique (Kentish, 2013). In addition, there are future plans to produce 15 megawatts through other unspecified renewable energy methods to sell to existing energy distributors. However, the National Energy Policy, which is needed to establish the legal framework and strategy for the transformation of Dominica's power generation to a more environmentally and economically sustainable model, has not yet been approved by Parliament.

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project**, USAID is financing two activities in Dominica: 1) construction of a retaining wall to reduce vulnerability of the Mero community to storm surge and flooding, and 2) installation of rainwater harvesting and storage systems and bio-digesters to enhance soil quality at farms in Londonderry.

Dominica has participated in the **SIDS Community-Based Adaptation Project** (SIDS CBA). Dominica also is participating in the Red Cross–managed **Caribbean Community Resilience to Disaster Risk** (CCRDR) that has involved vulnerability mapping. Dominica is participating in the World Bank's **Pilot Program for Climate Resilience** (PPCR) that provides funding for adaptation activities through the **Climate Investment Fund** (CIF). Until recently the GEF/SGP has not been focused on climate change, but according to the fund's administrator this is changing. JICA has programming in the area of human security and sustainable development.⁹ 10 communities participated in a land-use planning exercise supported by the World Bank and the UNDP. There are discussions to expand this participatory planning exercise to cover the entire island. There are also discussions surrounding the introduction of a climate-resilient cassava growing project but no details were available. Although not conceptualized as a climate change project, a project has been introduced by the Dominica Academy of Arts & Sciences to promote fish farming as an income-generating activity and to reduce pressure on fish stocks in coastal areas.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of Dominica. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist Dominica to correct more than a few of these legal and institutional weaknesses. This section identifies the needed actions to resolve those issues that are particularly important for Dominica to address and are most feasible for USAID to support.

PRIORITY ISSUE 1: LIMITED INSTITUTIONAL AND COMMUNITY-LEVEL CAPACITY

In Dominica, new climate-related circumstances are being created that require changes in practices or the introduction of new laws, policies, and reinforcement of capacities from everything from the management of biodiversity to land-use planning. There is also a need for community-level capacity building where the impacts of climate change will be increasingly felt. A key objective is to create opportunities for learning and capacity building that can be incorporated into the Dominican people's desire to embrace environmental stewardship. However, pilot activities are required across a wide number of sectors to demonstrate how

⁹ During the mission to Dominica to prepare this report, the Environment Coordinating Unit was not available to meet. Since that time, repeated requests were made for information regarding climate change projects in Dominica without any response.

Dominica can adapt to climate change. Closely related to pilot activities is the need to **build NGO and government department capacity in the support of designing and carrying out climate change vulnerability reduction activities**. The focus should be on broadening the number of capable actors and reinforcing existing groups. It is believed by some observers, both in Dominica and within the region, that a major challenge is the narrow number of implementing agencies that are essential to move the climate change agenda forward. A broader base of human resource expertise and organizational capability needs to be nurtured. More research is required to understand how existing structures, such as the island's hamlet development committees, can act as conduits for developing awareness, knowledge, and capacity to reduce climate-related vulnerability. The CARIBSAVE Risk Profile captured some "local experiences and observations" on climate change as a means to better understand and determine the climatic vulnerability of coastal properties, infrastructure, and livelihoods. An expansion of this type of research would be beneficial, as this report's fieldwork revealed that the island's people have strong perceptions regarding climate change and its impact on the island.¹⁰ This could propel better laws and policies. It is therefore recommended that USAID support pilot projects in climate change adaptation and vulnerability reduction that have *the potential for island-wide replication and help establish national adaptation approaches and procedures*.

PRIORITY ISSUE 2: TARGETED RESEARCH

Before Dominica can get to the stage where it can develop effective practices, economic direction, and policies, precise issue-specific research has to be undertaken. At every turn, the negative impacts due to the lack of research and research gaps are very apparent. For example, there is no scientific information on issues such as the presence of invasive species whose numbers are considered to be increasing on the island. Better informed research would also help guide the development of improved institutional capacity. In addition, Dominica is losing valuable government staff, which is perpetuating the information and data gaps on matters like the country's forest inventory. It is recommended that USAID strongly considers how it can *support targeted research that relies both on scientific rigour and local knowledge that is focused on specific issues, such as better understanding the impact of invasive species*.

PRIORITY ISSUE 3: THE NEED TO PROMOTE CLIMATE-RESISTANT AGRICULTURAL PRACTICES

The agricultural sector would be a priority of targeted research, pilot activity, and capacity building. An integrated part of support in this area would be to promote the introduction and use of climate-resilient crops for consumption and sale. Another aspect of this would be the promotion of the examination, control, and monitoring of new agricultural practices and crops. On the island there has not been much experience in encouraging agricultural innovation—especially innovation dealing with climate change. Climate vulnerability becomes more challenging in the absence of a young and vibrant farming community. Therefore it is recommended that USAID considers *making agriculture a focus of its climate vulnerability reduction activity in Dominica*.

PRIORITY ISSUE 4: LAND-USE PLANNING

A clear consensus was expressed by interviewed stakeholders that land-use practices should be a starting point for building better climate-related capacity—this could also include areas such as building-code standards. It is necessary to establish opportunities for learning and the promotion and implementation of an island-wide land-use planning model that is accompanied by practical application of sound planning concepts. As Dominica has already made some progress in understanding and responding to the implications of climate change from a planning perspective, it is recommended that USAID provide *support to build a stronger land-use planning base for the country*.

¹⁰ The people of Dominica are cited by climate and environmental specialists for their strong connection to the environment.

PRIORITY ISSUE 5: CLIMATE AND ITS IMPACT ON HUMAN HEALTH

Reinforcement of Dominica's capacity to manage diseases associated with the conditions created by climate change is an issue that island officials have identified. The fear is that increasing migration to the island will further complicate circumstances related to human health. USAID should consider *programming in the area of health service provision, especially if other developmental, economic, or environmental objectives can be addressed.*

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CHAPTER 5: GRENADA

LIST OF ACRONYMS

ACCC	Adaptation to Climate Change in the Caribbean
CC	Climate Change
CIF	Climate Investment Fund
CPACC	Caribbean Planning for Adaptation to Climate Change
EIA	Environmental Impact Assessment
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GoG	Government of Grenada
IUCN	International Union for the Conservation of Nature and Natural Resources
JICA	Japan International Cooperation Agency
MACC	Mainstreaming Adaptation to Climate Change
NAWASA	National Water and Sewage Authority
PCU	Project Coordination Unit
PPCR	Pilot Program for Climate Resilience
SLR	Sea Level Rise
SPCR	Strategic Program for Climate Resilience
TNC	The Nature Conservancy
TWG	Technical Working Group
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
UWI	University of the West Indies

SUMMARY

Climate change is predicted to increase Grenada's mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation. These changes in climate are likely to add to the stress on its marine ecosystems already caused by pollution, aggressive invasive species, and physical destruction of reefs and sea grass beds by boats and fishing nets. A rise in sea level of 1 meter together with a 1-in-100-year storm surge is predicted to affect 38 percent of Grenada's tourist resorts and 100 percent of its airports. A rise in sea level of 1 meter is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$1.3 billion and a rise of 2 meters US\$3.7 billion in 2080, mostly on tourist resorts and dryland areas (CARIBSAVE, 2012) (see Tables 1–3). These financial costs and the degradation of marine ecosystems may make Grenada less competitive in attracting international tourists. Its economy consequently may create fewer well-paying jobs than otherwise would be possible. A principal means to strengthen Grenada's resilience to climate change and thereby avoid part of these economic losses would be to improve its capacity for conserving its natural terrestrial and marine ecosystems. We recommend that USAID assist Grenada to strengthen its capability to adapt to the effects of climate change by helping it to maintain and enhance the resilience of its marine ecosystems by financing: (1) Sustainable Grenadines to assist the administration of the Sandy Island/Oyster Bay Protected Area to formulate and implement mechanisms to ensure its adequate, permanent, and timely financing for its basic operational costs; (2) Sustainable Grenadines to assist the administration of the Sandy Island/Oyster Bay Marine Area to formulate and implement the actions required to create an effective, productive relationship with the fishermen who were displaced by the creation of the marine area; (3) training for the staff of the Physical Planning Department in the operation of its new equipment and to use the equipment to collect data on soil properties that is required to prepare land-use maps and regulations; (4) the Ministry of Health and the Environment to improve its ability to collect, analyze, and use data about natural terrestrial and marine ecosystems; and (5) Sustainable Grenadines to implement measures to resolve satisfactorily the current conflict between local fishermen and the Sandy Island/Oyster Bay Marine Protected Area.

BACKGROUND AND PURPOSE

Grenada has 344 km², an area twice the size of Washington, D.C., and 121 kilometers of coastline. It is a parliamentary democracy, with a prime minister, a governor general, a Senate, and a House of Representatives. In 2011, 9 percent of its land was arable, 20 percent was in permanent crops, and 71 percent was in other uses. Agriculture contributes about 5 percent, industry 13 percent, and services, mostly related to tourism, 82 percent of the GDP. Since the construction of an international airport in 1985, tourism has been Grenada's main source of foreign exchange. Hurricanes Ivan (2004) and Emily (2005) severely damaged Grenada's agricultural production, particularly its nutmeg and cocoa plantations (CIA, 2013).

This report reviews the vulnerabilities of Grenada to climate change, identifies the priority actions which are required to increase its resilience to the effects of climate change, and makes recommendations for how USAID could best assist it to implement these priority actions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for Grenada by 2080.

Table 1 Predicted climatic effects of climate change in Grenada

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Mean Annual Temperature	+2.4°C to 3.2°C
Precipitation	-40mm/m. to +7mm/m
Sea Surface Temperature	+0.9°C to +3.1°C
Tropical Storms/Hurricanes	Increased intensity

SOURCE: CARIBSAVE, 2012

Table 1 indicates that average annual temperatures may increase by between 2.4 degrees Celsius to 3.2 degrees Celsius. Predictions for change of precipitation range from -40 millimeters/month to +7 millimeters/month. Sea surface temperature may rise by +0.9 degree Celsius to +3.1 degrees Celsius. Tropical storms and hurricanes may become more intense.

An increase in average annual temperature could raise the operational costs of tourist operations. Decreases in precipitation might reduce the quantity and reliability of the fresh water required for human consumption and other uses. Increases in precipitation, by contrast, might augment soil erosion and thereby cause more sedimentation onto Grenada's coral reefs and sea grass beds. If such sedimentation were to reduce these ecosystems' health and vigor, they would be likely to become more susceptible to invasive species, rises in sea level, and increased temperature and acidity of sea water. Increases in temperature and precipitation could increase the uncertainty of agricultural production and might make some human diseases more common and virulent. More intense tropical storms and hurricanes could cause severe damage to tourism's physical infrastructure and put human lives at risk. Changes in marine ecosystems, especially a decrease in the extent or health of reefs, would be likely to make Grenada a less competitive destination for international tourists.

Table 2 indicates the predicted effects by 2080 on land uses and infrastructure of a sea level rise (SLR) of 1 meter and 2 meters and of a rise of 1 meter combined with a 1-in-100-year storm surge.

Table 2 Effects of sea level rise on land uses and infrastructure

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2 M	1 M + 1-IN-100 YEAR STORM SURGE
Area	1%	2%	4%

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2 M	1 M + 1-IN-100 YEAR STORM SURGE
Population	1	2	2
Urban Area	< 1	1	2
Wetland Area	*	*	*
Agricultural Land	3	5	10
Crop and Plantation	1	2	3
Major Tourism Resorts	11	18	38
Airports	100	100	100
Road Network	1	1	1
Protected Areas	*	*	-
Sea Turtle Nests	8	16	-
Power Plants	0	0	-
Ports	100	100	-

Source: Simpson et al., 2010

Table 2 indicates that a rise in sea level rise (SLR) of 1 meter by 2080 would most severely affect Grenada's airports and ports. A SLR of 2 meters and a SLR of 1 meter combined with a 1-in-100-year storm surge by 2080 would affect even more of its tourist resorts.

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1-meter and 2-meter rise in sea level. The annual costs capture the ongoing costs to the economy from the impact of SLR damages, while the capital costs identify the rebuild/relocation costs due to the direct damage as well as the lost land-value.

Table 3 Predicted costs due to sea level rise by 2080

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	66	127
Agriculture	17	36
Industry	0	0
TOTAL	84	164
<i>Capital Costs</i>		
Airports	90	170
Ports	30	62
Roads	0	1
Power Plants	*	*
Property	47	150
Tourist Resorts	788	2,538
Dryland Loss	339	772
Wetland Loss	*	*
TOTAL	US\$1.3 billion	US\$3.7 billion

Source: Simpson et al., 2010

Table 3 indicates that tourism would suffer the greatest annual and capital costs by 2080 of a 1-meter or 2-meter rise in sea level, but that the annual costs of agriculture and the capital costs of airports, ports, and dryland also would be substantial.

The predicted physical and economic effects of the potential changes in Grenada's climate indicated in Tables 2 and 3 would be likely to decrease the international competitiveness of various segments of its economy, and in particular its tourism industry, by raising operating and capital costs and reducing the quality of physical infrastructure. Consequently, employment and income would be likely to decline. Vulnerable segments of the population, often women and youth, may be disproportionately affected by such a decline.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Ministry of Health and the Environment** and the **Ministry of Finance, Economic Development, Energy, and Foreign Trade** are the government institutions most directly responsible for implementing measures for Grenada to increase its capability to adapt to climate change. They are responsible for implementing the most important legislation related to climate change, the **Public Health Regulations**, the **Water Quality Act**, and the **National Environmental Management Strategy and Action Plan** of 2006 (MHE, 2000). Other government institutions with responsibilities for dealing with climate change include the **Ministries of Finance, Economic Development, Energy and Foreign Trade, Environment, Foreign Trade and Export Development, Agriculture, Forestry and Fisheries; Tourism, Works, Physical Development and Public Utilities, Housing, Lands and Community Development, and Health**. The **National Climate Change Committee** has a **Technical Working Group** (TWG) with representatives from various ministries, the **National Water & Sewage Authority** (NAWASA), nongovernmental organizations (NGO), and the private sector (PCU, 2011). The **National Development Strategy for Grenada** provides for the reduction of risks from climate change and for adaptation to climate change. The **National Water Policy** includes planning for the prevention and mitigation of disasters related to floods and droughts and emergency responses. The **National Climate Change Strategy and Action Plan** indicates the government's plans for responding to climate change (CARIBSAVE, 2012).

People in Action is one of the most active conservation NGOs in Grenada and does community outreach and capacity-building related to climate change. The **Nature Conservancy** has been educating seaside communities near Grenville on their vulnerabilities to climate change. On Carriacou Island, the **Sandy Island Marine Protected Area Association** is a private conservation NGO that has been assisting the Sandy Island Marine Protected Area.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

The principal projects in the public and private sectors that weaken Grenada's resilience to climate involve construction on steep slopes and close to beaches. Construction on beaches mostly involves tourist infrastructure. When international tourism increases, pressure increases from politically influential business men and women for permission to build more hotels or expand existing hotels located on beaches. Such coastal construction projects, directly and indirectly, often cause the natural ecosystems, such as mangroves, beaches, sea grass beds, and coral reefs, which are so important for maintaining and increasing the country's resilience to climate change, to be degraded or eliminated. On Carriacou Island, for example, a large new marina for large, luxury yachts has eliminated about 5 acres of mangrove forest within the Sandy Island/Oyster Bay Marine Park. Construction on steep slopes is occurring in Grenada because most of its residents live on their own properties and most of the land is steep. Construction of houses on steep slopes tends to increase the rate of runoff and sedimentation, especially because many people completely clear their land of vegetation. No data were available on the effect of such an increased rate of runoff and sedimentation on near-shore ecosystems, such as reefs and sea grass beds, but given that construction is pervasive it is likely that at least in some areas it could be substantial and affect marine ecosystems.

While Grenada is nearly 100 percent reliant on imported fossil fuel for transport, electricity generation, and cooking, the National Energy Policy (NEP) of 2011 outlines a detailed strategy and action plan for reaching the goals of reducing dependence on foreign hydrocarbons and meeting 20 percent of its energy needs with renewable energy (RE) by 2020. To accomplish this, with a long-term transition to domestic energy production vision in mind, Grenada is seeking to exploit offshore hydrocarbon resources to finance energy-efficiency and renewable energy development (GoG, 2011). As of 2011 Grenada has the highest adoption of grid-connected solar photovoltaic technology in the Eastern Caribbean due largely to work of the private solar company GRENSOL (REEEP, 2011). Assessments of hydro, wind, biomass, geothermal, and waste-to-energy power potential have been carried out. Hydropower potential is insignificant and has not been implemented. Wind and biomass are being developed but have limited power generation offset potential. The greatest interest of private investors has been in the development of geothermal and waste-to-energy plants (REEEP, 2011).

Barriers to reaching the goals of the National Energy Plan include the lack of “adequate human capacity and [an] institutional regime to guarantee the appropriate allocation and management of resources” and the lack of an “appropriate and enabling legal architecture on which the policy can rest and be implemented” (GoG, 2011). Main barriers to the deployment of renewable energy projects include the current dependence of electricity companies on well-known diesel technology, a lack of successful demonstration renewable energy projects, and a scarcity of financing for energy projects (REEEP, 2011).

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project**, USAID is financing two activities in Grenada: (1) the establishment of a model farm to promote climate-resilient agriculture in Sauteurs, and (2) the development of a coastal restoration and rehabilitation plan to limit coastal erosion and increase coastal resilience to SLR in Carriacou and Petit Martinique. USAID also recently financed the **Reducing Risk to Human Health from the Effects of Climate Change Project**, which assisted the community of Ceriz to increase its adaptive capacity to a rise in sea level.

As of early 2011, Grenada has been participating in the **Climate Investment Fund’s (CIF) Pilot Program for Climate Resilience (PPCR)**. PPCR has assisted Grenada to establish its institutional structure, such as the Technical Working Committee mentioned above, to increase its resilience and adaptation to climate change (PCU, 2011). Grenada has cooperative arrangements related to climate change with the **International Union for the Conservation of Nature (IUCN)** and the **University of the West Indies (UWI)**. **People in Action** does community outreach and capacity-building related to climate change, including agricultural demonstration projects and mangrove restoration. The **Nature Conservancy** has been educating seaside communities near Grenville on their vulnerabilities to climate change.

The **Japan International Cooperation Agency (JICA)** has financed the **Community Development Project**, which has prepared maps of flood hazards and has strengthened systems for providing early warning for floods. The **GEF/UNDP Sustainable Land Management Project**, the **CARICOM Land-Use Project**, and the **Caribbean Satellite Disaster Project** are other climate change projects in Grenada (PCU, 2011). An **UN/FAO** project has determined the rate of landslides, erosion, and sedimentation in forested areas. The **GIZ** recently financed a meeting to discuss conflicts within the ministries about climate change and found there were a lot of contradictions.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of Grenada to reduce its vulnerability and increase its capacity to adapt to the effects of climate change. USAID, however, lacks sufficient resources to assist Grenada to

respond effectively to more than a few of these legal and institutional weaknesses. This section, therefore, notes the priority issues related to increasing Grenada's resilience to climate change by improving its management and protection of natural ecosystems that emerged from the data. It then identifies those needed actions that would be particularly appropriate and feasible for USAID to finance.

PRIORITY ISSUE 1: FINANCING

Grenada's forests create and protect the soils which regulate the flow of water into its drinking water reservoirs. Its marine ecosystems dissipate the energy of waves, thereby reducing the rate of beach erosion, and are an attraction for tourists as well as a habitat for various species of commercial fish. It was not possible to obtain quantitative data about the budgets of the government institutions that have legal responsibility for conserving these forest and marine ecosystems. However, informants said that the forest department and the marine parks lack sufficient budgets. For example, during the last five years, the forest department's funds were insufficient to further invest in forest management. A needed action for strengthening Grenada's adaptive capacity to climate change, therefore, is ***to provide sufficient and reliable financing for its public conservation institutions.***

Grenada's marine areas are particularly important for both increasing its resilience to the effects of climate change and attracting international tourists. USAID has experience in designing financing mechanisms for marine protected areas and in integrated coastal zone management. The Sandy Island/Oyster Bay Marine Protected Area in Carriacou lacks sufficient revenue to hire a park administrator or sufficient rangers to protect the park 24 hours a day. If it were to be financed and managed effectively, it would serve as a model not only for Grenada's other marine protected areas but for the management of marine areas which are not part of a protected area. Sustainable Grenadines, an NGO, already has experience in supporting the Sandy Island/Oyster Bay Marine Protected Area. We recommend, therefore, that USAID finance Sustainable Grenadines ***to assist the administration of the Sandy Island/Oyster Bay Marine Protected Area to formulate and implement mechanisms to ensure its adequate, permanent, and timely financing for its basic operational costs.***

PRIORITY ISSUE 2: PARTICIPATION

Terrestrial and marine protected areas are a source of resilience to climate change in Grenada. Yet many people, such as farmers and fishermen, live around and within Grenada's protected areas while others act or make decisions that affect them. To avoid the degradation of protected areas, people must understand the monetary and nonmonetary benefits of conservation (i.e., ecosystem services). Farmers, for example, must appreciate the benefits of forests for regenerating soil and ameliorating local climates. Fishermen must understand that reefs and mangroves provide habitat and food for commercial fish. Political and business leaders should comprehend that healthy ecosystems reduce the risk of catastrophic economic losses from tropical storms and hurricanes. In sum, management of protected areas largely concerns the management of relationships between people and protected areas. In Grenada, the relationship between people and protected areas are not always beneficial for the conservation of the protected area. For example, the fishermen who live on the coast of the Sandy Island/Oyster Bay Marine Protected Area in Carriacou stole the park's boat almost immediately after the park was established and they remain mostly opposed to its creation. Therefore, a needed action to conserve Grenada's ecosystems in a condition that is resilient to the effects of climate change is to ***establish clear policies and methodologies for creating productive relationships between protected areas and people who affect them.***

USAID can draw upon a great deal of expertise to assist Grenada to formulate and implement policies and methodologies regarding the relationships between protected areas and the people who are affecting them. The Sandy Island/Oyster Bay Marine Protected Area is a particularly important area for conserving marine ecosystems which contribute to Grenada's resilience to the effects of climate change. The creation of the marine area displaced numerous local fishermen from their traditional source of livelihood, fishing within the boundaries of what is now the marine area. The NGO Sustainable Grenadines has proven to be an effective, capable conservation organization and already has experience in assisting the Sandy Island/Oyster Bay

Marine Protected Area. We recommend, therefore, that USAID finance Sustainable Grenadines to assist the administration of the Sandy Island/Oyster Bay Marine Protected Area ***to formulate and implement the actions required to create an effective, productive relationship with the fishermen who were displaced by the creation of the marine area.***

PRIORITY ISSUE 3: PLANNING AND REGULATION

Land- and marine-use planning and regulation are required to reduce Grenada's vulnerability and increase its capacity to adapt to the effects of climate change. Although Grenada's National Physical Development Plan broadly outlines how land should be utilized and has been approved by the Cabinet, Grenada does not have a national land-use policy or plan regulating construction. Many people, including policy makers, fail to understand the risks from the effects of climate change caused by a lack of land-use planning or regulation. The Physical Planning Department lacks sufficient equipment, software, and technical capacity to prepare an adequate land-use plan. Its national survey network needs improvement, and it lacks adequate data on soil properties. A needed action to increase Grenada's capacity to adapt to the effects of climate change, therefore, is to ***formulate a land- and marine-use policy and its accompanying regulations and building codes.***

The World Bank is financing some equipment for the Physical Planning Department and is financing measures to improve the calibration of elevations. No institution, however, is providing the training that government staff requires in order to operate this equipment properly. We recommend, therefore, that USAID ***finance training for Physical Planning Department staff in the operation of its new equipment and to use the equipment to collect the data on soil properties, which is required to prepare land-use maps and regulations.***

PRIORITY ISSUE 4: DATA COLLECTION, ANALYSIS, AND USE

Strengthening Grenada's adaptive capacity to climate change requires that decisions about the management of its terrestrial and marine ecosystems be made based on reliable data collected over long periods of time by trained people who are knowledgeable about particular sites. Currently much of the data collected in Grenada about terrestrial and marine ecosystem does not meet these criteria. Therefore, a needed action to increase Grenada's adaptive capacity to climate change is ***to improve its collection, analysis, distribution, and use of data.***

Projects usually collect data during the period of implementation. However, no project could be identified whose objective is to assist Grenada to improve its system for obtaining and using data to increase its adaptive capacity to climate change. The Ministry of Health and the Environment should have responsibility for collecting, analyzing, and using data on natural ecosystems. We recommend, therefore, that USAID finance actions that would ***assist the Ministry of Health and the Environment to improve its ability to collect, analyze, and use data about terrestrial and marine ecosystems.***

PRIORITY ISSUE 5: INSTITUTIONAL CAPACITY

To strengthen its adaptive capacity to climate change, Grenada must develop its institutional capacity for planning, implementing, monitoring, and evaluating management of both its terrestrial and marine ecosystems. Its marine ecosystems are currently more threatened by degradation than its terrestrial ecosystems, and they provide more direct protection to the coastal areas where tourism, Grenada's principal economic activity, is concentrated. Aspects of institutional capacity for marine areas include the ability to coordinate effectively with other government and private institutions, utilize research, increase income from tourism, and regulate use of marine resources. Grenada lacks a replicable model for how to establish the institutional capacity to conserve effectively a marine area from the effects of climate change, fishing, and tourism. A needed action, therefore, is to ***establish a replicable model for strengthening institutional capacity for conserving a marine area.***

No current project or program in Grenada currently supports the development of a replicable model for strengthening institutional capabilities in a specific marine area. The Sandy Island/Oyster Bay Marine Protected Area off Carriacou Island offers a good opportunity to establish such a model. It was recently established, receives almost no assistance, has tremendous potential to bring economic benefits to the islands, and suffers from conflicts with the local fishermen who were displaced by its creation, when fishing within its boundaries was prohibited. The NGO Sustainable Grenadines is a capable institution with experience in the Sandy Island/Oyster Bay Marine Protected Area. We recommend, therefore, that USAID ***finance Sustainable Grenadines to implement measures to resolve the conflict between local fishermen and the Sandy Island/Oyster Bay Marine Protected Area.***

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS

Well-conceived, effective policies, laws, and regulations must underlie efforts to conserve Grenada's ecosystems in order to strengthen its adaptive capacity to climate change. Yet Grenada's current policies often do not adequately support the conservation of Grenada's natural ecosystems. Therefore, a needed action to increase Grenada's adaptive capacity to climate change is to ***establish policies and implementing laws and regulations that reconcile growth in tourism and housing with increased adaptive capacity to climate change through conservation of terrestrial and marine ecosystems.***

We recommend that USAID finance an activity that would assist Grenada to ***formulate policies that reconcile growth in tourism with conservation of marine ecosystems.***

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: FINANCING

- The budget for the forestry department is a problem. There has been no capital budget for the last five years. We would make the allocations in the budget but they have not been funded. Of course things are deteriorating because you need equipment to maintain the trails, etc. We try to use local material but you need higher quality in the things you have to buy.
- We have problems to the extent that the park cannot support itself. If the government does not pay the wardens, we could not do it. The fees are not enough. Orlando is paid by a temporary grant of two years. The grant is from CARIBSAVE but the funds come from UK aid.
- Initially, the thought was that we could attract enough grant money to sustain the park for three or four years and then be on its own. We were too optimistic.
- Here we have to depend on the government for everything. We have no way near enough revenue. We spend \$7,000 a month in fuel but we are only collecting \$4,000 and the government is making up the difference. The government meets the cost of salaries. There are only two MPAs in Grenada. The Grenada Trust Fund was recently established for the PAs in Grenada.
- We lack money in this island but we do not lack brains, so it is all about whether funds are available to make the changes.
- Once those funds come in and we prove that we can handle the funds and they make a difference, then more funds will become available. A lot of agencies are reluctant to give funds to the government because they are not always used well.

PRIORITY ISSUE 2: PARTICIPATION

- Community is the people in a geographic area who use the assets. It might be more than one village. What we found is that we do not operate in our own communities. We realize that when you go with one agency is that people get marginalized. It has to be independent mobilizers and you have to approach the most difficult characters. We tend to go to the grassroots levels and exclude the other peoples.
- It is about involving people in the very understanding of how to collect the data. We do not understand the cultural background as is required to actually have participatory research. There are methodologies. You end up with a lot more data. We have to look at the research in a more holistic manner, including the community's history and social characteristics. You have to start with participation in the beginning. You start to have the community question for themselves.
- We have a lot of technocrats but the man on the street does not know anything about it. The technocrats cannot impart the knowledge that we have gathered. I have brought this up at the Sustainable Development Committee over and over. It was formed by the UN years ago, but when they talk it goes right over the heads of the people who need to understand.
- People use the words participation and consultation very widely and vaguely.
- We have to be careful as to a Marine Protected Area; according to the international guidelines, a certain level of protection is expected to be carried out. A lot of these MPAs are bordering communities and a lot of those resources within those areas have been the economic life of communities. And so we have to be careful as to the type of naming convention we put on our protected areas. Because we still have to consider the economic life of communities. We could be killing the livelihood of certain families near the MPA.
- There was not a smooth transition from the pre-park to the park management stages. One of the largest shocks was the prohibition on fishing. The park prohibited fishing in certain areas.
- When you have people who live in the park and earn their livelihoods within the park, it is difficult to tell them that they can no longer earn their livelihoods anymore. Since 2011, the prohibition on fishing has

been enforced, but we have not prosecuted anybody yet. The legislation is in place to take them to court. The time is coming really soon for prosecuting illegal fishing.

- We want to establish an education program to explain to people why it is important to keep mangroves alive.
- There are a lot of politics. They wanted 4 more acres of property but the government said this is too close to elections so we have to give it to you after the elections and the incoming government stalled it. So the new government approved it right away. Politically, it is the right move to make.
- Although the MPA was established, many people did not know anything about it, even the people within the MPA itself. It was a process of re-education because there had been workshops in 2006. Either people did not learn from them or they had forgotten.
- If we could show the householders that they are contributing positively to the beach and the marine ecosystem, they would buy into its protection mechanisms.
- The scientific information is done sometimes with their help but the community remains clueless about what is going on. We need more participatory research so that our people learn more.
- At first, the local residents were very much for the marina because they thought it would generate lots of jobs, but we did a PR campaign and turned opinion around. The reopening of the marina was three weeks ago so it looks like there is another shift. It is coming so there has to be a balance between environment and people. If it comes down to a competition between people and the environment, then the people will win.
- The minister here is the key to it. He is a minister for Carriacou and Petiti. Anything on the island he has to approve.
- I think we need to do a lot of this public education because it is absolutely vital. People removed all the vegetation without understanding that they are making the area more vulnerable to the action of the sea. Public education: I am not saying it for the masses but also for politicians and ministers. They also need to learn about CC and conservation. Education is not only needed at the grassroot level but higher up as well.

PRIORITY ISSUE 3: PLANNING AND REGULATION

- We do not have a land-use policy. Every time it comes up, every year. Land policy development every year. We have been working to get a land-use plan for a long time. We have done it for the two small islands where even the school uses it now.
- There is not a land-use policy and having one would assist for disaster management. Again, it would help to reduce a lot of the risk. We see people building without plans. People build just anywhere and you end up with persons living in seriously vulnerable areas. Houses are built in the river. If you did not have these houses in the river, the disaster management agency would not have to provide relief material for them and there would be less cost for government. When we continue without land-use policy and allow building anywhere, we are creating vulnerability and risk and it will cost us more in the long term. We have not gotten to that point of understanding that we need to invest in mitigation today. We have to find some way to get to the policy makers. We need to make them understand that mitigation is important.
- There is a soils data set available but it is geared toward agricultural production so it has significant limitations for development planning, especially for engineering designs such as bearing capacity, so we need to extend this. We were hoping to do so under the World Bank Disaster Vulnerability Risk Reduction Project to further enhance our National Physical Development Plan, which broadly outlines how land should be utilized. It has been approved by the Cabinet. It gives some broad policy objectives, including one that speaks to risk from climate change. It is embedded within a broad environmental management policy framework which seeks to address some key environmental problems.
- The principal threat is inland flooding through our drainage channels. In some areas there are buildings in flood plains. A fundamental issue that you have to understand about Grenada is that 85 percent of the land is owned privately so the land tenure issue is very significant for us as planners.

- We are in a country where the impacts of a hurricane affect the majority of the population because almost everybody has a piece of land. The piece of land is where they want to live no matter where it is located. So policies for land-use controls have to be developed with the people so they understand the risk to the resources. The building codes are where we have to work. There is a Local Area Planning Initiative.
- We have limited information about hazard risk, which is a huge component of the next step of this, which is going back to the people and identifying the risks to which they are exposed and developing policies for land-use development for specific areas.
- We need to establish better opportunities for various types of uses for St. George, such as housing; the Cabinet is interested in this. We have to provide the direction. We have to utilize risk management planning. We do have some tools that we use, such as GIS, but we are very limited in equipment, software, and technical capacity. Under the World Bank project we have received some GPS equipment, but what is critical for this is our national survey network where we can calibrate properly to obtain heights for different areas properly so that the analysis would provide good results. At the moment, our national survey network is not the best so we need to bring it up to speed. The World Bank project is providing equipment and a TOTAL station. We need training. The WB project is not going to provide all of the training that is required to use the equipment that it is financing.

PRIORITY ISSUE 4: DATA COLLECTION, ANALYSIS, DISTRIBUTION, AND USE

- Getting the data is one thing but we need to get it to the community. I always have to change those data to suit the audience to make it understandable. Making the data mean something to the person is another thing.
- We have a number of issues with the data. The type of data that is collected is largely snapshot data. For informed decisions they are only for baselines. There is a lack of personnel to collect the data.
- There are loads and loads of data related to CC and conservation in different ministries, etc. We need a central place. It is expensive to collect these data. We should try to identify the major problems and issues in Grenada and try to access those data where we can make strategy. We cannot collect all the data. We have to focus on what we are going to do.
- Does the stakeholder understand the use of the data and how to apply the data in the management of water and land? No. The data remains with the institution or donor. There is not a sustainability plan for the data to indicate how to continue the data collection. We have to look at those kinds of things. We have to be more strategic about data collection and avoid doing the same process over and over.
- We have been doing a lot of studies for a long time in terrestrial and marine areas. If you look carefully they are there. Some of the data are inaccessible. What we need here is to try and show that we have a central area to store the data and help people to use it.
- The thing is that they are going to say the economy, but when we asked about the livelihood they came from the mangroves and other things that subsidized their living. They are not going to say economy but if you ask them in relation to the assets then the natural resources do show up. Some of the catch did not make money but a lot of it went into their pots.
- We have had projects that have done research and a lot of it paid for by USAID, but it is not available for people like us. The document is handed over without further use. The cost has been in tens of millions of dollars.
- We have been over-studied. We have so many research projects done and a vast number of consultants. The data is usually owned by the agency that pays for it. Data are collected sometimes with the assistance of the local communities. Efforts are often made to pass this information on to the ministries but it does not go beyond that and there is no single depositary for all this.
- The scientific information is done sometimes with their help but the community remains clueless with what is going on. We need more participatory research so we learn more.
- We have partnered with colleagues from Wisconsin Lutheran College who come down every year to take bathetic and fish diversity data. I am trying to get biomass data. We are able to monitor change over time

to see whether the system is improving or not. Right now it is degraded but stable. With the introduction of marine protected area we are seeing some change. The fish biomass—we are seeing more of the functional fish groups but they are overwhelmed by the macro algae.

- We have some scientific and some anecdotal data. We have sea floor data for two sites in the protected area and two outside of protect area. We started that data set in 2007 and since then we have had a survey annually in May.
- We should collect more data around the projects that are being built. We should get data right now to be able to see the effects. We should partner with the university and the government.
- In the coastal zone we have very little data. Since I came on board I started the coastal inventory. What type of beach? What type of biodiversity do you find there? I do it for each beach of the island. That is most of the data that we have for the coastal zone. There are spots where you have some more data such as the MPA but in the general sense, the data we have is from the Coastal Inventory.
- The most difficult part of my job is trying to get data from my members [in the Association of Hotels]. They feel they are in competition with each other. I have tried so many times; I find it impossible to get data from them.
- I think it is all about data. The legislation is being reviewed now and we are where we want to be with regard to legislation. We need to know what we have so we can document changes for management actions.
- Our local people use wood from the mangrove to make charcoal and for fish pots. We do not have data on the growth of the mangrove.
- The reason the MPA was established was to counter declining fish stocks but we could not establish the connection between them. I didn't see any studies. I just heard people come up with figures out of their heads.
- One of my problems with this is that even though they say the stocks are declining it may not be due to overfishing but to something else. There may be other reasons so to target the fishermen only, it is a difficult thing to swallow. If you tell them that they are the problem they may agree but do we have any data to show that it is their fault?
- We have no data of the impact of tourism on the resources. We do surveys on the reef annually. We want to do it twice a year since some of the impacts are seasonal. We have a distinct tourist season here and there are high and low points in tourism. We need to know what fluctuations there are and how these changes are correlated to the presence of the visitors. Also, we are only looking at the coral reefs, not the sea grass or mangrove. There have been no surveys that I know about these ecosystems.
- We need a habitat inventory of flora and fauna, which has never been done. We need the baseline for this marine park.
- There has been, for example, rainfall and temperature data that has been captured just through the rain gauges and temperature gauges over the years. Now we have automatic stations and many models prefer data from the automatic gauges. The use of the old data is a problem. How can we utilize the 40 or 50 years of data together with the five or 10 years of automatic stations and build a model showing impacts? The WB is not financing that type of work. It is a lot of infrastructure. One component is building stronger structures. There are slopes over the years that would have impacted on communities. For example, there are unstable slopes that we know will have a landslide so we take slope stabilization measures.
- There has been a ban on harvesting sea urchins for the last 10 years without a basis in the data. We do not know how these regenerate or their rates of regeneration.
- We are lacking data and research. We do not know the balance of water in the watershed. Three million gallons of water but we do not know how much water enters the watershed. Research is critical to address climate change.
- We do not have the capacity to collect the data we need for management to guide adaptation to climate change, watershed management. We do not have the equipment or capacity to collect such data as erosion, water retention, [and] soil compaction, which are crucial for management decisions.

- We use the float method. Five principal watersheds were measured and every month the water flow is continuing. Equipment is another limitation. If we were able to have equipment that would take systematic readings, we would be able to collect better data.

PRIORITY ISSUE 5: INSTITUTIONAL CAPACITY

- Training of the staff that we have is another area in which we are weak. We physically have people but the protection of the resources requires specialized training. The people we have can be trained.
- We need more specialized training in enforcement, including conflict negotiation and training in interpretation. We need basic Spanish and French or French and Italian.
- Anchoring on top of reefs is a big problem in Grenada. Sandy Island is 700 ha and has main reefs. One of the management actions is to install moorings so nobody is permitted to drop anchors there. The marine protected areas deal with some of these areas. In Mullen Marine Protected area on west coast of Grenada, we are able to address some of those problems by installing moorings.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS

- Create mangrove nurseries for material. Be able to plant large tracks of mangroves. We have a history of doing this so those kinds of projects are proven to be cost-effective, can be replicated, and get community involved. Big construction projects will cost a lot more and produce fewer benefits.
- We have laws that are toothless. Law enforcement is part of the public education. While public education is critical for making the public aware, we also need enforcement. Construction solid waste is a big problem.
- Grand Andes Reefs System remains unprotected and it encompasses the area. There are spear fishers so people have to use their judgment. Some people drop the anchors anywhere. We come across numerous cinder blocks, anchors, ropes around corals. Kites go on to the reefs and wrap around the reefs and pull them up. An increasing problem is that the material has changed over time. Now they are using more plastic that stay on the reefs for much longer. Paper would have dissolved. Yes, we do have a lot of problems with physical damage to the reefs and only have control in the marine reefs and otherwise rely on [the] conscious of the users to do the right thing. Hundreds of years of growth take a few minutes to destroy. The reefs that are not protected are off the Grand Anse beach; that is Grenada's calling card! It is world famous and is where most of the big hotels are.
- The hazards of climate change are enormous and are directly connected to land use. Recently we have seen—because of heavy rains in a short period of time, we see a lot of landslide. A lot of soil erosion. It reaches down to the sea.
- In 2009, there were wildfires and we saw farmers going up to the higher lands to do intensive farming using irrigation and agrochemicals. This is not very good because when you contaminate the higher lands with agrochemicals, what you are doing is washing everything down to the shoreline.
- Agriculture is one of the problems. Two of our biggest cash producers are our problems: development and agriculture. It is all in how they do it. It is about making dollars and cents for politicians. The wealthier places of our country are the higher-risk areas, such as marinas. If you asked our populace about mangroves, they would say mosquitos.
- Mangroves absorb the shocks. By protecting the mangroves you are protecting the coasts. The hurricane indicated that. Mangrove systems are very vulnerable to climate change. A politician looks at the number of jobs. They will dismiss the jobs created by the mangrove system itself. They dismiss the values.
- It comes down to telling people what the data mean for us. I realize that what contributes to this same perception is that we do not draw the link between the environment and the economy. All our economic activities depend on the environment. Our tourism products are based on the environment. Fisheries sector is also based on the environment. They realize it when it is too late. We have tried to address that with economic valuations to some extent. OAS made such a report. Politicians like dollars and cents. They might listen. Scuba diving and fisheries are examples.

- Recently there were data given away by TNC about CC adaptability on the shoreline, i.e. the risk possibilities. We have been asking for that data a long time ago and we had to get it from TNC before our local agents. But we had no access to the data.
- People feel that unemployment is the biggest thing, but when you relate that to natural resources you see that employment depends on the natural resources. We need to make that last link to find out from the people what the natural resources mean to the people.
- The main source of sand to Grand Andes reef comes from the reef. If we do not protect the reef system, we cut off the supply of sand. Sand always moves around the place so you need a source of sand.
- There is an absence of land-use policy. There is no land-use policy for Grenada. There is a forest policy that was approved in 2000. The policy takes into consideration social, economic, and environmental aspects. We need to complete the strategy plans to take into climate change considerations.
- We have the forest policy and we have prepared new forestry legislation in a draft form. We need to review it to ensure that we capture all the essential elements of protection. For example, to take into consideration urban forestry. To speak to development even in the town.
- One of the issues is policy framework in the marine areas. The Ministry of Tourism wants to protect these areas.
- It is a constant battle to maintain the coastal ecosystems because there are always proposals for development and we always have to justify why development should not take place in those areas. That is the area that is suited for development and it also is essential for ecosystems. Legislation would have to be put in place to ensure when the technical people make recommendations, the politicians adhere to them.
- Mangroves are creating livelihoods that are even more sustainable than the development that is proposed. The juvenile fishes in the mangrove enrich the catch for fishermen. The tourists see those areas. All this is contributing to income.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 6: GUYANA

LIST OF ACRONYMS

GDP	Gross Domestic Product
IDB	International Development Bank
KfW	German Development Bank
GRIF	Guyana REDD+ Investment Fund
GoG	Government of Guyana
LCDS	Low-Carbon Development Strategy
MoU	Memorandum of Understanding
NAREI	National Agricultural Research and Extension Institute
ODA	Official Development Assistance
REDD+	Reduced Emissions from Deforestation and Degradation
SLR	Sea Level Rise
UNDP	United Nations Development Programme
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase Guyana's mean annual atmospheric temperature and intensity of tropical storms, and to either decrease or increase its monthly precipitation. A sea level rise (SLR) of 1 meter by 2080 is predicted to affect 100 percent of its power plants and result in rebuilding/relocation costs and lost land-value capital costs of US\$816 million, while a rise of 2 meters by 2080 would cost US\$2.5 billion and lead to loss of roads, power plants, property, and dryland (CARIBSAVE, 2012) (see Tables 1–3). These costs may cause its economy to create fewer well-paying jobs than otherwise would be possible. The cost of rebuilding the existing sea wall along Guyana's coast to compensate for higher sea levels would be prohibitive, but Guyana is learning to reforest with mangroves as a means to protect the sea wall. A principal means to reduce Guyana's vulnerability to climate change would be to support Guyana in the creation of the necessary capacities and policy frameworks to increase the area of mangroves along the coast. We recommend that USAID finance: (1) a cost-benefit analysis of the use of mangroves to protect Guyana's coastlands; (2) an activity to strengthen the Center of Excellence on Biodiversity, support the newly created master's program in environmental management, and create Ph.D. programs in climate change at the University of Guyana; (3) an activity to provide the University of Guyana with the technical assistance it requires to contribute fully to collecting, analyzing, and using data related to increasing the resilience of natural ecosystems as a means to increase Guyana's capacity to adapt to the effects of climate change; and (4) an activity to provide technical expertise to Guyana for incorporating climate change into its National Land Use Plan.

BACKGROUND AND PURPOSE

Guyana is 214,969 km², slightly smaller than Idaho, and has 459 kilometers of coastline. A sea wall protects the densely populated area around Georgetown, the capital. Only 2 percent of Guyana's land is arable, less than 1 percent is in permanent crops, and 98 percent is in other uses. Its population has been estimated to be 739,903 as of July 2013 (CIA, 2013). Ninety percent of its population and most of its economic activity occurs within a few kilometers from the coast, in areas that are below sea level (ECA, 2009). The president is elected by popular vote as leader of a party list in parliamentary elections, which must be held at least every five years. The unicameral National Assembly, with 65 elected members, appoints the prime minister. The Guyanese economy is dependent upon the export of six commodities: sugar, gold, bauxite, shrimp, timber, and rice, which represent nearly 60 percent of the country's GDP. Weather conditions and fluctuations in commodity prices affect the profitability of these export products. More than 55 percent of its citizens reside abroad and they provide remittances to their relatives, and more than 80 percent of Guyanese nationals with tertiary level educations have emigrated.

This report reviews the vulnerabilities of Guyana to the effects of climate change, reviews its institutional and legal structure for increasing its capacity to adapt to the effects of climate change, identifies the priority actions which are required to increase the resilience of its natural ecosystems to the effects of climate change, and makes recommendations for how USAID could best assist Guyana to implement these priority actions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for Guyana by 2080. Average annual temperature may increase by between 1.4 degrees Celsius and 5.0 degrees Celsius. Predictions for change of precipitation range from -34 millimeters/month to +20 millimeters/month. There are no predictions for changes in sea surface temperature. Tropical storms may become more intense.

Table 1 Predicted climatic effects of climate change in Guyana

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase between 1.4°C to 5.0°C
Precipitation	Decrease of 34 mm/month to an increase of 20 mm/month
Sea Surface Temperature	No data
Tropical Storms	Increased intensity

Source: McSweeney, New & Lizcano, 2010

The predicted changes in Guyana's temperature and precipitation could make its agricultural production more difficult and less certain, and could also increase the number and rate of spread of various types and patterns of human diseases. More intense tropical storms could cause severe damage to physical infrastructure and put human lives at risk, especially along the coast, which is largely below sea level. Amerindians say that in southern Guyana, temperatures and rainfall patterns have changed, leading to crop loss in Amerindian communities.¹¹

Table 2 indicates the predicted effects on land uses and infrastructure of a SLR of 1 meter and 2 meters.

¹¹As representatives of the Amerindian communities informed us, a facility canning pineapple slices operated by an Amerindian community had to close due to declining pineapple yields caused by changing rain patterns, while in other communities, cassava roots are rotting prior to harvest as a result of excessive rainfall, leading to loss of livelihood opportunities and food insecurity in the hinterland.

Table 2 Effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080	
	1 M SLR	2 M SLR
Area	<1%	<2%
Population	1	3
Urban Area	< 1	1
Wetland Area	1	1
Agricultural Land	<1	1
Crop and Plantation	*	*
Major Tourism Resorts	0	0
Airports	0	0
Road Network	12	13
Protected Areas	*	0
Sea Turtle Nests	50	75
Power Plants	100	100
Ports	0	0

Source: Simpson et al., 2010

Table 2 indicates that a 1-meter rise in sea level by 2080 is predicted to most severely affect Guyana's power plants and, to a lesser extent, nesting areas for sea turtles and roads. A 2-meter rise in sea level by 2080 would affect sea turtle nesting areas considerably more and roads slightly more. It is not clear why the data in Table 1 indicate that neither a 1-meter or 2-meter rise in sea level by 2080 would affect more than a small percentage of the population, urban area, wetland area, agricultural land, or tourism resorts, even though most of the land that supports these uses lies near the coast below sea level. No data were available for the effects of a 1-meter rise in sea level combined with a 1-in-100-year storm surge. It seems plausible, however, that such an event would cause severe impacts on Guyana's infrastructure, since most of its infrastructure is located below sea level along the coastline and protected by a manmade sea wall which already is being occasionally overtopped by the sea.

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1-meter or 2-meter rise in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs by 2080 due to sea level rise

VARIABLE	COSTS US\$ MILLION	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	*	*
Agriculture	0	0
Industry	43	36
Total	43	36
<i>Capital Costs</i>		
Airports	*	*
Ports	*	*
Roads	76	209
Power Plants	208	309
Property	205	1,161
Tourist Resorts	*	*
Dryland Loss	261	513
Wetland Loss	65	275
TOTAL	816	US\$2.5 Billion

Source: Simpson et al., 2010

Table 3 indicates that industry would suffer severe annual costs from a 1-meter rise in sea level by 2080, while tourism and agriculture would be unaffected. Drylands, power plants, properties, wetlands, and roads would all suffer capital costs. Costs resulting from damage to property would increase significantly if the SLR were to be 2 meters rather than 1 meter. Even now, the sea is overtopping the sea wall that protects Georgetown and flooding on Guyana's coastal plain is causing losses of about 10 percent of Guyana's GDP annually (GoG, 2013).

If no adaptation measures were to be taken, the effects of climate change shown in Tables 1, 2, and 3 would severely affect Guyana's economy, thereby increasing unemployment and reducing income. It is likely that the often more-vulnerable segments of Guyana's population, such as indigenous peoples, women, and youth, would be disproportionately affected by these economic effects of changes in climate.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The principal legal instruments governing the various efforts related to adaptive capacity to climate change in Guyana are the **Environmental Protection Act** (1998), the **Sea Defense Act** (1998), which regulates measures to maintain the sea wall, and the **Drainage and Irrigation Act** (2002), which regulates drainage, irrigation, and flood control infrastructure.

The **National Development Strategy 2001–2010** set environmental, fiscal, and institutional sustainability as Guyana's goals. The **Climate Change Action Plan** of 2001 analyzed Guyana's vulnerability to the impacts of climate change; recommended assigning resources for emergency response caused by floods, droughts, and storms; and noted Guyana's excessive reliance on fossil fuels.

Guyana's **Low-Carbon Development Strategy** (LCDS) relies on the sale of carbon credits to finance development, and Guyana has signed an agreement with Norway for the creation of a **REDD+ Investment Fund** (GRIF). By the end of 2013, the fund will have provided Guyana with US\$415 million, of which US\$80 million will be used to build the Amalia Falls hydroelectric project and US\$20 million will be used to finance eco-tourism, aquaculture transportation, and micro-enterprise projects. US\$25 million has been used for creating employment opportunities, US\$10 million has been used for training and education, and US\$17 million has been used to improve coastal infrastructure, rehabilitate canals, and to finance a

comprehensive adaptation and climate-resiliency program. Currently, the GRIF is financing most of Guyana's measures to mitigate and adapt to the effects of climate change. The government, however, considers it as an interim financing mechanism and hopes to arrange by 2016 a more multi-lateral arrangement for REDD+ financing.

The **Office of Climate Change** in the **Office of the President** prepared the LCDS. However, the **Ministry of Finance**, which is responsible for planning national development, oversees its implementation. In the current administration, the creation of the **Ministry of Natural Resources and the Environment** has improved coordination of Guyana's environmental institutions by incorporating the **Guyana Geology and Mines Commission** and the **Guyana Forestry Commission** within the same ministry. Sea and river defense, however, remains the responsibility of the **Ministry of Public Works and Hydraulics**, which also has retained responsibility for the restoration of mangroves, being a component of seashore protection. The **National Agricultural Research and Extension Institute (NAREI)**, in the **Ministry of Agriculture**, however, actually implements mangrove reforestation. The **National Drainage and Irrigation Authority** maintains the drainage infrastructure for Georgetown.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

The two development projects that most influence Guyana's capacity to adapt to the effects of climate change are the **Amaila Falls Hydroelectric Project** and a boom in residential construction. The **Inter-American Development Bank**, the **China Development Bank**, the government, and the company **Sithe Global** are investing in the hydroelectric project. The plant will cost US\$840 million and will generate 165 MW, 90 percent of Guyana's current energy demand. The main rationale for this project is the fact that the country is currently almost 100 percent dependent on fossil fuels for energy. The hydroelectric plant will reduce energy price levels, CO₂ emissions, and vulnerability to energy price shocks. It also will increase the country's resilience to climate change, as all of Guyana's fossil fuel power plants are located in coastal areas vulnerable to flooding and SLR.

Guyana's recent rapid economic growth has stimulated a boom in the construction of housing on former agricultural land located close to the sea wall. An informant noted that although these houses are vulnerable to flooding during tropical storms and storm surges, the Ministry of Housing is not enforcing regulations that prohibit construction within 200 feet of the sea wall.

CLIMATE CHANGE PROJECTS

Although not exactly a project, Guyana's principal activity related to increasing its capabilities to adapt to the effects of climate change is its **Low-Carbon Development Strategy (LCDS)**. The **Adaptation and Climate Resilience** component of the LCDS includes five sub-components: i) upgrading infrastructure and assets to protect against flooding through urgent near-term measures, which includes investing in drainage and irrigation systems, construction of additional polders, dredging and de-silting of rivers and creeks to avoid further coastal erosion, and reinforcement of the sea wall; ii) hinterland adaptation measures, including the development, reproduction, and distribution of climate-resilient crop varieties and management techniques, and all-weather transport infrastructure; iii) addressing systematic and behavioral concerns, including the revamping of Guyana's early-warning system, improving the timely and accurate collection and dissemination of data and information on weather-related events, improving systems for providing safe drinking water, and improving electricity and communications networks; iv) financial risk management and insurance measures to develop instruments suitable to transfer risks to third parties who will have an incentive to avoid and reduce possible sources of risk; and v) switching to flood-resistant crops, through research to identify flood-resistant crops, the creation of flood-proof germ plasm banks, and the introduction of new technologies for crop cultivation during prolonged floods.

One informant commented that too many of the **REDD+ Investment Fund (GRIF)** funds are being directed to the country's hinterland, whereas the adaptation needs are most urgent in coastal areas, where the majority of the population resides. He argued that the Amerindian communities in the hinterland have limited capacity to absorb the investments made in their communities. On the other hand, the representatives of the Amerindian communities who were consulted complained that not enough of the funding under GRIF was going to the hinterland where they live. They argued that the funds are a compensation for their efforts to preserve the forest.

The **National Agricultural Research Institute (NAREI)** is implementing the **Mangrove Action Plan** with financial support from the government and from the European Commission. Mangroves were abundant at the coastline of Guyana when the sea wall was built 60 years ago, but have since then disappeared as a result of changes in climate and oceanic conditions, reduced salinity, and the collection of firewood and clay for construction. NAREI has acquired substantial technical expertise in the mangrove reforestation. To involve local people, the project includes activities to create jobs from beekeeping, tree nurseries, and other cottage industries. A campaign has raised awareness among fishermen about the importance of protecting mangroves to secure habitat for fish reproduction. Goats and aquaculture, however, continue to degrade mangrove forests (Guyana Mangrove Restoration Project, 2013).

Other donor-funded projects in Guyana include the **Guyana Water Resources Assessment**, financed by the US Embassy in 2005. A USAID project that promoted wood-based businesses by finding them export markets ended in 2012. UNDP, KFW, and the German NGO Chelionian have implemented projects related to the protection of sea turtles.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicated a range of weaknesses in the institutional and legal capacity of Guyana. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist Guyana to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies those issues particularly important for Guyana to address and appropriate for USAID support and needed actions to resolve those issues.

PRIORITY ISSUE 1: MANGROVES AND THE PROTECTION OF THE COASTAL PLAIN

Protection of its coastal plain from sea water flooding is Guyana's first priority for increasing its capability to adapt to climate change. Failure to protect the coastal plain would cause Guyana crippling economic losses. However, the cost of building the necessary amount of physical infrastructure to protect the coastal plain is prohibitive for Guyana. Reforestation of the mud flats outside of the existing sea wall could reduce the cost of its maintenance and the need to rebuild it. Reliable financial and technical data on the potential for mangroves to provide protection to the sea wall, however, is lacking. A priority issue, therefore, is *the efficacy of mangrove reforestation as a means to protect Guyana's coastal plain*.

No financing appears to be available to thoroughly study the financial aspects of mangrove reforestation along Guyana's coast as a means to protect its sea wall and reduce or prevent coastal flooding. We recommend, therefore, that USAID *finance a cost-benefit analysis of the use of mangroves to protect Guyana's coastlands*.

PRIORITY ISSUE 2: INSTITUTIONAL CAPACITY

Various Guyanese institutions require improved institutional capacity to implement their responsibilities for increasing Guyana's capacity to adapt to the effects of climate change. For example, Guyana lacks a plan for

responding to emergencies, although the number of extreme weather events is increasing. Likewise, it needs more technical capacity in mangrove reforestation, given the potential of such reforestation to reduce the cost of protecting the coast. There are numerous other technical needs for strengthening Guyana's capacity to adapt to the effects of climate change. A priority issue, therefore, is to ***strengthen the technical capacity in Guyana government and nongovernmental institutions to implement activities to adapt to the effects of climate change.***

The restoration of mangrove forests offers a particularly promising way to increase the resilience of Guyana's marine and coastal ecosystems to the effects of climate change while also increasing protection of Guyana's coastline from flooding. Some of the leading experts in mangrove restoration live in Florida. Guyana's efforts to reforest its sea flats outside of the sea wall could benefit highly from additional technical expertise. We recommend, therefore, that USAID ***finance the University of Guyana so as to strengthen the Center of Excellence on Biodiversity, support the newly created master's program in environmental management, and create Ph.D. programs in climate change.***

PRIORITY ISSUE 3: LACK OF DATA

To increase its capacity to adapt to climate change, Guyana must collect reliable and sufficient scientific data to use in making decisions about the use and management of its natural resources. Although Guyana has a high-caliber university and capable scientists working on climate change issues, it is not collecting sufficient scientific data on the trends and condition of its marine ecosystems, the socioeconomic aspects of management of its natural resources, rainfall patterns, the rate of SLR, and other data that are needed to manage terrestrial and marine ecosystems effectively. Therefore, a priority action for increasing Guyana's resilience to climate change is to ***expand its capabilities for collecting, analyzing, and utilizing scientific data related to its terrestrial and marine ecosystems.***

A number of informants noted that Guyana lacks equipment and technical expertise to centralize the collection, analysis, sharing, and use of data related to the effects of climate change. The University of Guyana is creating a Center of Excellence for the study of biodiversity and is using a loan of US\$25 million from the World Bank to implement the Science and Technology Project, which is improving the university's infrastructure for science and technology, including the use of GIS to collect and analyze large quantities of data on natural ecosystems. A priority action, therefore, is for the University of Guyana to ***make full use of these improved facilities to increase Guyana's capacity to adapt to the effects of climate change.***

Although the World Bank is providing funds for the installation of improved infrastructure and equipment at the University of Guyana, it is not providing technical assistance for the use of the university's improved facilities for the purpose of increasing Guyana's capacity to adapt to climate change. USAID, other parts of the U.S. government, U.S. universities, and U.S. consulting firms could provide the University of Guyana with valuable technical assistance to enable it to make full use of its improved facilities. We recommend, therefore, that USAID finance an activity to ***provide the University of Guyana with the technical assistance it requires to contribute fully to collecting, analyzing, and using data related to increasing the resilience of natural ecosystems as a means to increase Guyana's capacity to adapt to the effects of climate change.***

PRIORITY ISSUE 4: LAND-USE PLANNING

Large areas in Guyana on the coast are vulnerable to flooding induced by climate change. While relocation of the country's capital and agricultural lands to higher ground is not feasible, informants suggested that new population centers and employment opportunities should be located on less-vulnerable sites south of the coastal plain. In addition, Guyanese housing codes need to be formulated and enforced in order to reduce the vulnerability of new housing stock to flooding. These codes should be part of the National Land Use Plan that is currently being prepared. A priority issue is, therefore, to ***integrate the vulnerabilities caused by climate change into the National Land Use Plan.***

United States government agencies, universities, and consulting firms have professional expertise that would be highly useful to Guyana in preparing the climate change aspects of its National Land Use Plan. We recommend, therefore, that USAID *finance an activity to provide technical expertise to Guyana for incorporating climate change into its National Land Use Plan.*

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: FINANCING ECOSYSTEM MANAGEMENT

- The Office of the President is intended to raise additional investments into GRIF. They look at cooperative investments into GRIF. There is a sustainability issue to address.
- We have to approach both infrastructure and mangroves. One meter of sea defense costs US\$4,500. We have 300 km of coastline. Simply to maintain the sea defense system is very expensive. When we were developing the LDC we calculated roughly that it would cost US\$1 billion.

PRIORITY ISSUE 2: ROLE OF COMMUNITIES AND PUBLIC PARTICIPATION IN ECOSYSTEM MANAGEMENT

- Local communities are willing to be participants in the fight against global climate change. What is important is that they will need alternative livelihoods.
- I think one of the problems is collection of information. For example, you talk to fishermen along the coast and realize that although they see beach erosion they do not link it to climate change. They may think it is a one-off event, so they do not want to do long-term planning.

PRIORITY ISSUE 3: PLANNING AND REGULATION FOR ECOSYSTEM MANAGEMENT

- We tend to do reactive management rather than planning for the long term. For example, when the waves come over the sea wall, we throw sand bags down rather than having prepared ahead of time.
- I think it is important for USAID to help with long-term planning. In Guyana, long-term planning tends to be sporadic in its reaction to climate change. Money should go to activities that produce longer-term benefits.

PRIORITY ISSUE 4: COLLECTION, ANALYSIS, AND USE OF DATA

- There are several things we have noticed in the last 10 years. Beaches are getting washed away faster than usual. There is a cycle of changes on the coast of 35 years of accretion and removal. Normally, it takes about a month for a beach to shift, but now it can be gone within a week and we think it is because 5 to 6 foot waves are now hitting the beach. This change affects the communities.
- We are providing information to the communities of Guyana about fighting global climate change. It is not an easy task. There may be issues that are generic to indigenous peoples.

PRIORITY ISSUE 5: INSTITUTIONAL CAPACITY FOR ECOSYSTEM MANAGEMENT

- I think research and human capacity-building would be the most important areas for USAID financing. We do have training but we lose a lot of professionals due to migration.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS FOR ECOSYSTEM MANAGEMENT

- Each ministry plays its own roles and responsibility. Environment is not compartmentalized. That is the challenge of greening the economy. We are trying to develop a green economy by doing it in an integrated way.
- Despite the increasing threats from climate change, we are still not seeing a successful example of moving cities and people inland. It is very challenging and complex.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 7: ST. KITTS AND NEVIS

LIST OF ACRONYMS

CIA	Central Intelligence Agency
CSEP	Caribbean Sustainable Energy Program
DOE	Department of Environment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOSKN	Government of St. Kitts and Nevis
GSEII	Global Sustainable Energy Islands Initiative
MPA	Marine Protected Area
MTSEP	Medium Term Economic Strategy Paper
NGO	Nongovernmental Organization
NHCS	National Historical and Conservation Society
OAS	Organization of American States
SCNT	St. Christopher National Trust
SKN	St. Kitts and Nevis
SLR	Sea Level Rise
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase St. Kitts and Nevis' mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation. A 1-meter rise in sea level together with a 1-in-100-year storm surge is predicted to affect 64 percent of its tourist resorts, 50 percent of its airports, and at least 50 percent of its ports. A rise in sea level of 1 meter is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$2.6 billion and a rise of 2 meters is predicted to be US\$6.2 billion by 2080, mostly in tourism (CARIBSAVE, 2012) (see Tables 1–3). These costs may make St. Kitts and Nevis less competitive to other Caribbean nations in attracting international tourists and thereby cause its economy to create fewer well-paying jobs than otherwise would be possible. Means to strengthen the St. Kitts and Nevis adaptive capacity would be to improve its capabilities to protect and manage its marine and terrestrial ecosystems. We recommend that USAID assist St. Kitts and Nevis to finance: (1) the development of a program to strengthen institutional capacity within the framework of a federal coastal zone management unit for both states, and (2) the design and implementation of a public education and awareness program to support ongoing ecosystem conservation and climate change management initiatives.

BACKGROUND AND PURPOSE

St. Kitts (with 168 km²) and Nevis (with 93 km²) have a combined area of 261 km², one and a half the size of Washington, D.C., and 135 kilometers of coastline. As of July 2013, its estimated population was 51,134, of which 13,000 lived in its capital, Basseterre. St. Kitts and Nevis (SKN) is a federal state with a unicameral National Assembly of 14 members, of whom three are appointed and 11 are elected. The governor general appoints the prime minister and the Cabinet. In 2011, arable land occupied 19 percent, permanent crops 0.4 percent, and other uses 80 percent of its terrestrial surface. Agriculture contributed 1.5 percent of the GDP, industry 16 percent, and services 82 percent of the Gross Domestic Product (GDP). Since the 1970s, tourism has become the most important part of the economy. Roughly 200,000 tourists visited the islands in 2009, but reduced tourism arrivals and foreign investment led to an economic contraction in 2009–12, and the economy has not yet returned to growth (CIA, 2013).

This report reviews the physical and socioeconomic vulnerabilities of SKN to climate change, summarizes the institutional and legal structure for reducing those vulnerabilities, identifies the priority actions which are required to increase its resilience, and recommends to the USAID Eastern Caribbean Regional Program which of these measures to finance during its next strategic planning period.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the changes in climate variables that various models predict for SKN by 2080 as a result of climate change. Average annual temperature may increase by between 2.4 degrees Celsius to 3.2 degrees Celsius. Predictions for change of precipitation range from -40 millimeters/month to +7 millimeters/month. Sea surface temperature may rise by +0.9 degree Celsius to +3.1 degrees Celsius. Tropical storms and hurricanes may become more intense.

Table I Predicted climatic effects of climate change

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Mean Annual Atmospheric Temperature	2.4°C to 3.2°C
Precipitation	-40 mm/month to +7 mm/month
Sea Surface Temperature	+0.9°C and +3.1°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

Such changes in SKN climate could affect its rate of economic growth. An increase in average annual temperature could, for example, raise operational costs of tourist operations. Decreases in precipitation might reduce the quantity and reliability of fresh water. Increases in precipitation, by contrast, might augment soil erosion and thereby cause more sedimentation onto SKN's coral reefs and sea grass beds. If that were to reduce their vigor, they would become more susceptible to invasive species, rises in sea level, ocean acidification, and higher temperature of sea water. Changes in temperature and precipitation could make agriculture less certain and vary types and patterns of human diseases. More intense tropical storms and hurricanes could cause severe damage to tourism's physical infrastructure and put human lives at risk.

Table 2 indicates the predicted effects on land uses and infrastructure of a sea level rise (SLR) of 1 meter, 2 meters, and 1 meter combined with a 1-in-100-year storm surge. SLR will severely damage SKN's tourism resorts, airports, sea turtle nests, and ports. A combination of a 1-meter rise in sea level with a 1-in-100-year storm surge would devastate its tourism resorts.

Table 2 Effects of sea level rise on land uses and infrastructure

PARAMETER (PERCENT AFFECTED)	1 M SLR	2 M SLR	1 METER SLR+ 1-IN-100-YEAR STORM SURGE
Land Area	1 %	2%	6%
Population	2	3	6
Urban Area	1	2	4
Wetland Area	*	*	*
Agricultural Land	5	8	17
Crop and Plantation	1	1	*
Major Tourism Resorts	64	77	86
Airports	50	50	50
Road Network	0	0	3
Protected Areas	*	*	-
Sea Turtle Nests	35	43	-
Power Plants	0	0	-
Ports	50	50	-

Source: Simpson et al., 2010

Table 3 indicates the predictions of economic losses by 2080 in SKN due to 1- and 2-meter rises in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value. Tourism would suffer by far the greatest annual and capital costs. Capital costs to airports (upon which tourism depends), ports, and dryland also would be substantial.

The predicted physical and economic effects of the potential changes in SKN's climate indicated in Tables 1, 2, and 3 would be likely to decrease the international competitiveness of its tourism industry by raising its costs and reducing its attractiveness when compared with alternative regional and international tourist destinations. To the extent that there are fewer income opportunities in SKN, the potential consequences of changes in its climate could disproportionately affect vulnerable groups of the population, such as youth and women.

Table 3 Predicted economic losses by 2080 due to sea level rise

VARIABLE	COSTS US \$ MILLION	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	101	144
Agriculture	1	2
Industry	0	0
TOTAL	102	146
<i>Capital Costs</i>		
Airports	132	216
Ports	44	79
Roads	0	0
Power Plants	*	*
Property	30	102
Tourist Resorts	2,207	5,394
Dryland Loss	196	398
Wetland Loss	*	*
TOTAL	US\$2.6 billion	US\$6.2 billion

Source: Simpson et al., 2010

The potential effects of the predicted changes in SKN's climate would be likely to decrease the international competitiveness of its tourism industry by raising its costs and reducing its attractiveness in comparison with alternative international tourist destinations. These effects might also raise the risks, reduce the profitability, and lower the competitiveness of SKN's agriculture and industry. A reduction in the competitiveness of these economic activities would be likely to reduce economic opportunities for its residents. To the extent that they have fewer opportunities to earn their livelihoods over the coming decades, these potential consequences of changes in SKN's climate would be likely to affect negatively and disproportionately the income and welfare of its youth and women.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **National Conservation and Environmental Protection Act** of 1987 makes the most explicit provisions for the articulation of the **Department of the Environment** (DOE) into the multilateral environmental agreement implementation process. The DOE is expressly empowered to negotiate environmental treaties initiated by regional and international inter-governmental organizations and nongovernmental organizations. The department also has the function of implementing environmental policies, programs, and projects in order to achieve sustainable development. Both St. Kitts and Nevis have Environment Units with responsibility for addressing the issues raised by climate change. They have distinct, although linked responsibilities with the states' **Departments of Physical Planning**, and they share climate change information with the departments of **Agriculture**, **Public Works**, and **Public Health**. Currently the St. Kitts unit is preparing the **Second National Communication on Climate Change of St. Kitts and Nevis**. The St. Kitts **Department of Marine Resources** implements the **St. Kitts and Nevis Fisheries Act** (1984) as updated in 2002; there is no Coastal Zone Management Unit. The **Planning Unit** of the **Ministry of Finance, Development, and Planning** wrote the **National Physical Development Plan** of 2008, which sets guidelines and regulations for sustainable development of land and promotes conservation of natural resources, such as zoning and prohibition of construction above 1,000-feet elevation, but which the Cabinet has never approved. In 2012, the **Fisheries Department** was renamed the **Department of Marine Resources**.

Under the provisions of the **Nevis Physical and Development Control Ordinance** of 2005, as amended in 2011, the **Department of Physical Planning** in Nevis makes routine decisions about applications for building permits and administers them. Ministers make the decision on less-routine building permit applications with the advice of the **Development Advisory Committee**. Under the provisions of the **St. Christopher and Nevis Development Control and Planning Act** of 2000, the Department of Physical Planning of St. Kitts administers environmental impact assessments and processes routine building permits. Ministers, with the advice of the Building Board, make the decisions on less-routine building applications.

The **St. Christopher National Trust** (SCNT) is a national, nongovernmental, voluntary organization established in 2009 by an action of parliament. The **National Historical and Conservation Society** (NHCS) works to conserve biodiversity and natural resources, and collaborates with universities to increase data related to the environment of Nevis. The nongovernmental organization (NGO) **H.O.P.E Nevis Incorporated**, which stands for “Helping Our People Excel,” seeks to bring about positive and progressive transformation in the communities and is a partner in the implementation of the Sustainable Communities: Building Resilience to Reduce Disaster Risk project, which has some climate change components. The **Nature Conservancy** is assisting SKN to implement the **Draft Marine Zoning Plan**.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

Currently, the principal development projects in SKN involve the construction of buildings and associated infrastructure at elevations higher than 1,000 feet above sea level. These projects violate national policies for land use and are likely to cause changes in drainage and soil erosion that could result in increased sedimentation into marine ecosystems, thereby affecting SKN’s resilience to the effects of climate change. This is particularly an issue on the eastern peninsula of St. Kitts, where significant private-sector construction threatens the health of coastal ecosystems. Insufficient data were available to quantify the extent, location, severity, and reversibility of these possible impacts on the vulnerability of SKN to the effects of climate change.

SKN has no local sources of oil, coal, natural gas, or hydropower. The island is entirely reliant on imported fossil fuels for electricity generation and transportation. Between 2005 and 2008, increased fuel costs caused electricity prices to double. For this reason, the government is very interested in developing renewable energy (RE) sources on the island. In fact, in its **Medium Term Economic Strategy Paper: 2003–2005** (MTSEP), the government of St. Kitts and Nevis (GoSKN) has stated its commitment to identifying alternative ways of supplying power and the introduction of economic incentives for the renewable energy sector, particularly solar energy, with emphasis on energy conservation in residential and commercial sectors. The GoSKN also is seeking to encourage the use of alternative sources of energy by introducing economic incentives for the purchase and use of energy-saving devices.

SKN accessed a US\$175,000 add-on to develop its Clearing House Mechanism and to conduct a capacity needs assessment (Carter, 2010). RE projects currently in varying stages of development or in the pipeline include bioenergy generation, wind, solar, and geothermal. Currently the furthest advances have been made in wind energy, with several wind mills contributing 10 megawatts to the local consumption pool. Both bioenergy and geothermal are poised to contribute even more significantly, but as of yet neither development has come on line. Based on current estimates, the potential of bulk solar generation is considered uneconomic, but household use for water heating and energy are being promoted (REEGLE, n.d.).

The Ministry of Public Works, Housing, Energy, and Utilities and the Ministry of Finance, Sustainable Development, and Human Resource Development are responsible for renewable energy sources and have

developed energy targets that have reductions in demand and increased renewable energy systems. The achievement of these goals, which were projected to be met in 2015, suffer from institutional capacity barriers—both in terms of information and mechanisms—for promulgating policy about renewable resources development.

SKN is also part of the **Caribbean Renewable Energy Development Programme**, a Global Environment Facility (GEF)–funded project which aims to remove barriers to renewable energy use in the Caribbean.

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project**, USAID is financing two activities in SKN: (1) performance of water audits in the tourism and agricultural sectors to monitor water use and inform new ways of improving water-use efficiency and water harvesting in St. Kitts, and (2) the development of an early-warning system for Nevis. USAID also formerly financed the **Nevis Peak National Park and Camp Rivers Watershed Project**, which worked to conserve the area surrounding Nevis Peak.

In 2010, as part of the **Caribbean Challenge Initiative**, USAID financed the **Draft Marine Zoning Plan** for SKN and the preparation of a proposal for a **Marine Protected Area** (MPA) in the channel between SKN (TNC, 2013). Stakeholder consultations took place between May and August 2013, and most fishermen support the proposal for a marine protected area. By September 2013 the Cabinet paper that is required to implement the marine protected area should be completed and approved. The European Union, through the Organization of American States (OAS), financed the preparation of the **Draft National Energy Policy and Action Plan** (2011) under the Caribbean Sustainable Energy Program (CSEP). The Caribbean Development Bank is financing the **Physical Infrastructure Bedrock Drilling for Water Project**, which involves providing access to clean water for residents of SKN and, under the Regional Water Review, an assessment of SKN's water resources, including institutional issues (GWP, 2013). The National Historical and Conservation Society (NHCS) implements the **Reforestation of the Coastline** project, which an informant stated plans to re-vegetate eroding beaches on a small scale. In Nevis, the OAS is financing the **Sustainable Communities: Building Resilience to Reduce Disaster Risk**, also known as the All Five Parishes Project. The project, which started in March 2013, is being implemented by the Nevis Disaster Management and the Physical Planning, Natural Resources, and Environment departments in collaboration with H.O.P.E. NEVIS Inc. (HOPE, 2013).

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicated a range of weaknesses in the institutional and legal capacity of St. Kitts and Nevis. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist St. Kitts and Nevis to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies needed actions to resolve those issues that are both particularly important for St. Kitts and Nevis to address and appropriate for USAID support.

PRIORITY ISSUE 1: LIMITED INSTITUTIONAL CAPACITY

St. Kitts and Nevis' public institutions are unable to adequately implement their responsibility to conserve terrestrial and marine ecosystems. Regulatory institutions operate *inter alia* without a national climate change policy, an updated national land-use plan, a management mechanism for wetland areas, and, in some instances, overlapping regulatory responsibilities. There are limited human and financial resources to regulate, enforce, and monitor the development actions that threaten vulnerable ecosystems, particularly along the coast. To strengthen SKN institutions, it is necessary to promulgate and implement their policies, laws, and regulations; train their personnel; and provide them with adequate financing. To strengthen the climate

change adaptive capacity of St. Kitts and Nevis, it is a priority ***to establish an integrated institutional framework for managing their vulnerable terrestrial and marine ecosystems.***

One approach to balancing social and economic demands on the coast with the protection of coastal ecosystems is by managing vulnerable areas using an integrated coastal zone management approach. Though a need for integrated coastal management was identified by the Physical Planning Department and Environment Units within the two states, no current program or project is assisting with the development of such an initiative. We recommend, therefore, that the USAID ***finance the development of a program to strengthen institutional capacity within the framework of a federal Coastal Zone Management Unit for both states.***

PRIORITY ISSUE 2: PUBLIC SUPPORT

Most citizens of St. Kitts and Nevis use and benefit from the resources and services of natural ecosystems but do not appreciate their importance, particularly for strengthening resilience to climate change. Without citizen support it will be difficult to implement actions to conserve ecosystems. Targeted educational programs are needed to increase public understanding and support for the actions required to conserve natural ecosystems.

Given the fundamental importance of stakeholder “buy-in” at all levels to the effective implementation and maintenance of conservation initiatives for natural ecosystems, a needed action is to ***design and implement a public information and education strategy.*** No current project or program was identified as providing a mechanism for ongoing education and awareness on the relationship between natural ecosystems and climate change. Therefore, we recommend that USAID ***finance the design and implementation of a public education and awareness program to support ongoing ecosystem conservation and climate change management initiatives.***

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: LIMITED INSTITUTIONAL CAPACITY

- There is no National Climate Change Committee currently in place and no national climate change policy to strategically guide mitigation and adaptation initiatives—for example, for flood and drought.
- The federation needs a climate change policy and climate change is not the main focus at this time.
- The Environment Unit is responsible for monitoring the environmental components of major projects but it is not possible to monitor everything with only one person.
- With limited human resources, officers are often called to wear six or seven hats.
- Agencies collaborating on climate change work well together but the issue is overlapping responsibilities. It needs to be made clear who has responsibility for different parts of the legislation.
- Departments in different ministries are trying to manage the same land.
- All legislation dealing with environmental management should be revisited to bring it in line with international standards.
- Need better enforcement. Even on this small island, enforcement is a problem. This is because everyone is related, and [they] don't want to hurt the economic situation of their family. This is evident with coastal construction in general, where the coastline development is not supervised in terms of monitoring the work of contractors and builders.
- There is no one on the government's side that understands the effects of these developments on the marine area.
- There are no marine engineers on island. The result is that sea grass beds are destroyed; fish nurseries and coastal areas are depleted. Sand mining is also a threat to the coast.
- Need training in the area of climate change for fisheries officers in St. Kitts and Nevis. Most fisheries officers don't think of climate change. They see that as an area for physical planning.

PRIORITY ISSUE 2: PUBLIC SUPPORT

- There is not enough awareness among members of the Building Board about the impacts of climate change and so the Building Board members do not necessarily think about climate change when making a decision for development.
- NGOs do important work in the communities as the government is unable to do everything on their own.
- The government needs to set the example for developers by complying with its own regulations. This process is getting better and would set the tone for the general public.
- An education program—education and awareness is key to managing several of the problems, e.g. wetlands management, construction, land owners. We could make use of the community's centers to get a program implemented.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 8: ST. LUCIA

LIST OF ACRONYMS

BPoA	Barbados Program of Action
CIF	Climate Investment Fund
CPACC	Caribbean Planning for Adaptation to Climate Change
CZMU	Coastal Zone Management Unit
DCA	Development Control Authority
GIS	Geographic Information System
GoG	Government of Grenada
IUCN	International Union for Conservation of Nature
MAFPRD	Ministry of Agriculture, Food Production, Fisheries, and Rural Development
MACC	Mainstreaming Adaptation to Climate Change
MMA	Marine Management Area
MOU	Memorandum of Understanding
MSDEST	Ministry of Sustainable Development, Energy, Science, and Technology
MSI	Mauritius Strategy for Implementation
NCCC	National Climate Change Committee
NEMO	National Emergency Management Office
NEP	National Energy Policy
NGO	Nongovernmental Organization
RET	Renewable Energy Technology
SDED	Sustainable Development and Environment Division
SEP	Sustainable Energy Plan
SMMA	Soufriere Marine Management Area
SPACC	Special Program on Adaptation to Climate Change
SL	St. Lucia
SLNT	St. Lucia National Trust
SLR	Sea Level Rise
SS	Storm Surge
TOR	Terms of Reference
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VCA	Vulnerability and Capacity Assessment
WRI	World Resources Institute
WWF	World Wildlife Fund

SUMMARY

Climate change is predicted to increase St. Lucia's mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation. A sea level rise (SLR) of 1 meter together with a 1-in-100-year storm surge is predicted to affect 37 percent of its tourist resorts, 100 percent of its airports, and at least 67 percent of its ports. A rise in sea level of 1 meter is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$996 million and a rise of 2 meters US\$2.2 billion in 2080, mostly due to damages to tourist resorts, dryland, ports, and airports (CARIBSAVE, 2012) (see Tables 1–3). These impacts may make St. Lucia less competitive in attracting international tourists and thereby cause its economy to create fewer well-paying jobs than otherwise would be possible, which would likely affect vulnerable groups such as women and youth disproportionately. A principal means to strengthen St. Lucia's resilience to climate change, and thereby avoid part of these losses, would be to improve its capabilities for conserving its terrestrial and marine ecosystems. We recommend that USAID assist St. Lucia to: (1) assess the economic value of conservation and report the findings to St. Lucia's political and business leaders; (2) create and test a system for individuals, families, and communities to design and implement conservation measures; (3) assess the economic value of land-use planning and building codes and develop a program to persuade political and business leaders to incorporate its findings into land-use plans; (4) establish a system for collecting, analyzing, and distributing data required for strengthening resilience of natural ecosystem to the effects of climate change; (5) design, implement, and divulge economic and policy studies and educational programs necessary to strengthen its policy, legal, and regulatory basis for managing its natural ecosystems; and (6) finance a private, nonprofit conservation organization to prepare and divulge the assessments of the economic value of conservation measures, land-use planning, and building codes.

BACKGROUND AND PURPOSE

St. Lucia has a land area of 617 km² and is 42 kilometers long and 22 kilometers wide. In 2010, its population was 174,000, 32 percent of which lived in Castries, its capital. St. Lucia has a parliamentary democracy with a governor general, prime minister, and Senate and House of Assembly. Tourism provides St. Lucia's principal source of employment and income, although its manufacturing activity is the most diverse in the Eastern and Southern Caribbean region. In 2010, Hurricane Tomas devastated its banana industry and destroyed much economic infrastructure (CIA, 2013).

This report reviews the vulnerabilities of St. Lucia to climate change, identifies the priority actions which are required to increase its resilience to the effects of climate change, and makes recommendations for how USAID could best assist St. Lucia to implement these priority actions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for St. Lucia by 2080. Average annual temperature may increase by 0.9 degree Celsius to 3.1 degrees Celsius. Predictions for change of precipitation range from -40 millimeters/month to +7 millimeters/month. Sea surface temperature may rise by +0.9 degree Celsius to +3.1 degrees Celsius. Tropical storms and hurricanes may become more intense.

Table 1 Predicted climatic effects of climate change in St. Lucia

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase between 0.9°C to 3.1°C
Precipitation	Decrease of 40mm/month to an increase of 7 mm/month
Sea Surface Temperature	+0.9°C and +3.1°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

An increase in average annual temperature would be likely to raise operational costs of tourist operations. Decreases in precipitation might reduce the quantity and reliability of fresh water, affecting its supply for human consumption, industry, and agriculture. Increases in precipitation, by contrast, might augment soil erosion and thereby cause more sedimentation onto St. Lucia's coral reefs and sea beds. If increased sedimentation were to reduce their vigor, the reefs and sea grass beds would be likely to become more susceptible to invasive species, rises in sea level, sea water temperature, and acidity. Less extensive or vigorous reefs would provide less protection for beaches and coastal infrastructure, fewer and less competitive tourism opportunities, and less abundant and varied marine sources of food. Changes in temperature and precipitation could make agriculture more risky and vary the types, prevalence, and patterns of human diseases. More intense tropical storms and hurricanes could cause severe damage to tourism physical infrastructure and put human lives at risk.

Table 2 indicates the predicted effects on land uses and infrastructure of a SLR of 1 meter, 2 meters, and 1-meter rise in sea level combined with a 1-in-100-year storm surge.

Table 2 Predicted effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1M SLR	2M SLR	1M SLR + 1-IN-100-YEAR Storm Surge
Area	1 %	1 %	2 %
Population	1	1	3
Urban Area	< 1	1	2
Wetland Area	*	*	*

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1M SLR	2M SLR	1M SLR + 1-IN-100-YEAR Storm Surge
Agricultural Land	1	1	3
Crop and Plantation	1	1	3
Major Tourism Resorts	7	10	37
Airports	50	50	100
Road Network	0	0	2
Protected Areas	0	0	-
Sea Turtle Nests	6%	10	-
Power Plants	0	0	-
Ports	100	100	-

Source: Simpson et al., 2010

Table 2 indicates that a SLR of 1 meter would most severely affect St. Lucia's ports and airports. A SLR of 2 meters would devastate its airports and severely affect its tourism resorts, sea turtle nests, and ports. A SLR of 1 meter combined with a 1-in-100-year storm surge would affect one-third of its tourist resorts and all of its airports.

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1- and 2-meter rise in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs by 2080 due to sea level rise

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	144	231
Agriculture	3	2
Industry	0	0
TOTAL	147	233
<i>Capital Costs</i>		
Airports	98	200
Ports	132	294
Roads	0	0
Power Plants	*	*
Property	37	123
Tourist Resorts	315	952
Dryland Loss	414	626
Wetland Loss	*	*
TOTAL	996	US\$2.2 billion

Source: Simpson et al., 2010

Table 3 indicates that with a 1-meter rise, tourism would suffer the greatest annual and capital costs and a large area of dryland would be lost. With a 2-meter rise, the annual cost to tourism, airports, ports, dryland property, and tourist resorts would greatly increase.

The data in Tables 1, 2, and 3 indicate that the predicted physical effects on St. Lucia of climate change are likely to affect its economy severely. A reduced or negative rate of economic growth would reduce the

number and remuneration of jobs and income for St. Lucia's residents. To the extent that they have fewer opportunities to earn their livelihoods in St. Lucia over the coming decades, these potential economic consequences of climate change would be likely to disproportionately decrease the income and welfare of the more-vulnerable segments of its population, who, in many cases, are youth and women.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Second National Communication on Climate Change** indicates that St. Lucia is committed to the implementation of the **Barbados Program of Action (BPoA)** and the **Mauritius Strategy for Implementation (MSI)** of **Agenda 21** (GoSL, 2011). The government has approved a **National Vision Plan** and a **Sector Development Plan**, which sets the development priorities for each of St. Lucia's regions and incorporates considerations of vulnerability to climate change (SDED, 2011).

The **Ministry of Sustainable Development, Energy, Science, and Technology (MSDEST)** is the lead public institution with responsibility for taking actions to increase St. Lucia's capacity to adapt to the effects of climate change. Within the MSDEST, the **Sustainable Development and Environment Division (SDED)** coordinates national climate change activities and prepares the climate change communications to the UNFCCC. The **National Climate Change Committee (NCCC)** is a multi-sectorial group of public and private institutions, including the **Ministry of Tourism**, and supports and monitors SDES' activities. The **Forestry Department** implements the provisions of the **Wildlife Protection Act No. 9** of 1980, and the **Forest, Soil, and Water Conservation Ordinance** (1946/1983). In 2008, it prepared a forest policy, but the government has never approved it (SDED, 2011). The **Environmental Management Act** was completed in 2008 but has not yet been approved officially (SDED, 2011). The **Water Resource Management Agency** administers the **National Water Authority Act**, which was revised in 1994, and the **Water and Sewage Act** of 1999. The **Coastal Zone Management Unit (CZMU)** implements the **Coastal Zone Management Strategy and Action Plan** of 2008 (MAFPFRD, 2009).

The **Fisheries Department** of the **Ministry of Agriculture, Food Production, Fisheries, and Rural Development (MAFPFRD)** is responsible for implementing the **Fisheries Act of 1984** and the **Fisheries Regulation of 1994**, which provide for the creation of marine reserves and fisheries research, the protection of marine biodiversity, and the regulation of other marine-based activities so as to mitigate negative impacts on the fishery sector and ensure the overall educational advancement of fishers (MAFPFRD, 2009). The **Agriculture Department** is concerned with food production and the conservation of natural resources (MAFPFRD, 2009).

The **Physical Planning Section**, in the **Ministry of Physical Development, Environment, and Planning**, is headed by the chief physical planning officer, who also serves as executive secretary to the **Development Control Authority (DCA)** and administers the **Physical Planning and Development Act of 2001**.

Other public institutions have more specific interests and roles related to climate change effects and adaptation measures. The **Tourism Division** of the **Ministry of Tourism, Heritage, and the Creative Industries** is concerned with protecting tourism investments (such as hotels) and tourist attractions (such as beaches). The **National Emergency Management Office (NEMO)**, in the **Office of the Prime Minister**, implements the **National Emergency Management Plan**. In 2001, the **Ministry of Infrastructure, Port Services, and Transport** adopted the **National Climate Change Policy and Plan**, and the **Sustainable Energy Office**, in the **Ministry of Planning, Development, Environment and Housing**, has prepared a **Sustainable Energy Plan** and a **National Energy Policy** (SDED, 2011), which is intended to reduce St. Lucia's vulnerability to the effects of climate change on energy supplies.

In the private sector, the **St. Lucia Hotel and Tourism Association** represents about 80 percent of the country's tourism enterprises. According to an informant, the members of the association are mostly

concerned about tourism markets and have little interest in technical issues related to climate change. The **Sufrein Regional Development Foundation** is a private, nongovernmental organization (NGO) that manages some of St. Lucia's tourist attractions, such as the sulfur springs located in the southwest of the island. The **St. Lucia National Trust (SLNT)** was established in 1979 under the **Saint Lucia National Trust Act** and manages the conservation areas of Pigeon Island National Landmark, Maria Island Nature Reserve, Pointe Sable Environmental Protection Area, Morne Pavillon, Morne Fortuné, and Anse La Liberté. Plans are currently being made to revive the **Saint Lucia Naturalist Society** as an organization that will work to stimulate interest in conservation among different segments of St. Lucia's society.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

Additional hotels and golf courses continue to be planned and constructed on St. Lucia, mostly close to beaches. They are likely to increase St. Lucia's vulnerability to a rise in sea level, flooding, and hurricanes. Construction of houses on the hills above the western beaches continues (Kernan, per. obs.) and is most likely causing an increase in the rate of sedimentation into fresh and marine water bodies. One informant summed up the relationship between development and increasing St. Lucia's resilience to climate change as follows:

“What interests decision-makers is the provision of jobs, because it translates into work—and it has to be big and has to generate revenue. Our approach to development has been demand-driven. Somebody decides that they want to do something and the policy has been to help it happen rather than analyze it technically and ask if it is the best thing to do.”

St. Lucia is almost entirely dependent on imported fossil fuels for energy generation, and is therefore vulnerable to increases in their price (Government of Saint Lucia, 2011; REEGLE, n.d.). However, preliminary technical studies have demonstrated potential to develop renewable energy sources, particularly from solar, wind, geothermal, and biomass (REEGLE, n.d.). St. Lucia approved a **Sustainable Energy Plan (SEP)** in 2006 that set an objective of delivering 30 percent of installed capacity from renewable sources by 2010 (CIPORE, n.d.), but that goal has not been achieved. The **National Energy Policy (NEP)**, approved in 2010, is an important step for planning greater use of renewable energy (Contreras & al., 2012). However, the Electricity Supply Act of 1994 gave the public electricity utility a monopoly on energy generation, transmission, and distribution. This monopoly has discouraged investment in energy generation by private companies (REEGLE, n.d.; Government of Saint Lucia, 2011).

St. Lucia's second national communication to the UNFCCC (December 2011) identified five strategies and actions required to stimulate the production of energy from renewable sources (Government of Saint Lucia, 2011):

- (1) Building institutional capacity for energy-sector planning and evaluation of renewable energy technologies (RETs);
- (2) Development of appropriate regulatory framework for the successful implementation of the SEP;
- (3) Development and implementation of education and awareness program to support the SEP;
- (4) Conduct of research into RET potential and energy-efficiency measures; and
- (5) Implementing energy conservation and renewable energy pilot projects.

There are currently several planned and ongoing renewable energy projects, including a geothermal project in the Pitons Management Area, a 200–300-kilowatt hydropower at the John Compton dam, and a wind farm project (REEGLE, n.d.). While there are efforts to develop renewable energy sources in St. Lucia, a major oil refinery has been proposed and, if implemented, would increase GHG emissions (Government of Saint Lucia, 2011).

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project**, USAID is financing capacity building in GIS for the Water and Sewerage Company of St. Lucia; the project will help the company map the infrastructure in the northern part of the island and improve its capabilities for performance and maintenance.

The **Climate Change Vulnerability and Capacity Assessment (VCA) Project** (2005–06) implemented by the UNDP—tested approaches to vulnerability reduction with community involvement. The **Mainstreaming Adaptation to Climate Change (MACC) Project** (2004–09) made a **Knowledge, Attitudes, and Practice Study (KAP)** in relation to people’s attitudes toward climate change and trained people to make systematic observations of coral reefs (GoSL, 2009). St. Lucia participates in the **Global Environmental Facility’s (GEF) Special Program on Adaptation to Climate Change (SPACC)**, which implements activities to strengthen coastal infrastructure in the area of Castries (GoSL, 2009). The **World Resources Institute (WRI)** has made maps of St. Lucia’s coral reefs. The **World Wildlife Fund (WWF)** is no longer implementing climate change projects in St. Lucia. The **World Bank** is in the process of contracting a study on the health of coral reefs and is financing the **Climate Resilience Project**, which is beginning to dredge the reservoir behind the Roseau dam. Through the **Climate Investment Fund (CIF)**, the World Bank is providing grant and loan funds to St. Lucia to strengthen its capacity to adapt to climate change in forestry, fisheries, and health institutions. The World Bank also is providing St. Lucia with a loan of US\$35 million for watershed protection. The funds will be used mostly for infrastructure and for the restoration of habitat in the watersheds behind the Roseau reservoir. The **Government of Australia** is financing a US\$300,000 project to plant tree crops on 200 ha of landslide-prone hillsides.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of St. Lucia to reduce its vulnerability to climate change by increasing the resilience of its natural terrestrial and marine ecosystems. USAID, however, lacks sufficient resources to assist St. Lucia to correct more than a few of these legal and institutional weaknesses. The following priority issues and needed actions are both particularly important for St. Lucia to address and appropriate for USAID support.

PRIORITY ISSUE 1: FINANCING

Huge costs have been predicted to St. Lucia’s economy from the effects of climate change. Measures to increase the resilience of St. Lucia’s natural terrestrial and marine ecosystems to the effects of climate change could substantially reduce these costs. Yet those government institutions with responsibilities for conservation have been severely underfunded year after year. Moreover, due to a lack of financing, there is only one small and almost inactive civil society conservation organization in St. Lucia. Apparently, St. Lucia’s political and business leaders do not perceive investments in the conservation of natural ecosystems to be a worthwhile use of public or private funds. A priority action needed to increase St. Lucia’s resilience to climate change is to ***increase the support of its political and business leaders for financing of conservation of natural terrestrial and marine ecosystems.***

No project or program appears to be attempting to change the perceptions of St. Lucia business and political leaders so that they would support public and private financing for conservation measures. USAID has experience in designing, financing, and implementing programs to influence public- and private-sector leaders to adopt improved public environmental policies. We recommend, therefore, that USAID finance ***an activity to assess the economic value of conservation measures and a program to divulge its findings to St. Lucia’s political and business leaders.***

PRIORITY ISSUE 2: PARTICIPATION

The effects of climate change affect individuals, families, and communities. In 2010, for example, Hurricane Tomas devastated the lives of thousands of people in St. Lucia. People in St. Lucia, therefore, should understand and support measures to reduce their own vulnerability to the effects of climate change. In fact, without their understanding and support for these measures, it will be almost impossible to implement them since in St. Lucia individuals, families, and communities make many of the decisions about how to use land and marine resources. Thus a needed action to increase the resilience of St. Lucia to climate change is to ***implement actions to ensure full participation of individuals, families, and communities in designing and implementing conservation measures.***

Currently, St. Lucia does not have a system for involving its citizens in designing and implementing conservation measures, and no project or institution was identified that is providing it with assistance to establish such a system. We therefore recommend that USAID finance an activity to assist St. Lucia to ***create and test a system for individuals, families, and communities to design and implement conservation measures.***

PRIORITY ISSUE 3: PLANNING AND REGULATION

St. Lucia is a small, hilly island with few suitable building sites, and almost all its land is privately owned. St. Lucia lacks a national land-use plan and building codes, and there appears to be little public or political support for their preparation or approval. Without land-use planning and regulation, uses of land become incompatible with reducing vulnerability to climate change and often increase that vulnerability. A needed action to increase St. Lucia's resilience to climate change, therefore, is to ***create support among business and political leaders for the preparation and implementation of a national land-use plan and building codes.***

In order to create such support, the business and political leaders would need to believe that a national land-use plan and building codes would serve their own financial and political interests. We recommend, therefore, that USAID finance an activity to ***assess the economic value of land-use planning and building codes and a program to persuade political and business leaders to incorporate its findings into land-use plans.***

PRIORITY ISSUE 4: DATA COLLECTION, ANALYSIS, AND USE

Decisions on what actions would be most effective in strengthening St. Lucia's resilience to climate change will be sound only if they are based on expert technical analysis of sufficient and reliable data. Yet currently, data for such parameters as weather, sedimentation rates, coastline erosion, and the condition of reefs and wetlands are inadequate to provide a basis for sound decision-making. For example, there are no plans to collect data about the country's northeast, although it may soon be developed for tourism, and there are no data on how trolling for fish is affecting fish populations in St. Lucia's offshore waters. A needed action to increase St. Lucia's resilience to climate change, therefore, is to ***establish a system for collecting, analyzing, and distributing the data required for strengthening the resilience of natural ecosystems to the effects of climate change.***

No current activity is assisting St. Lucia to establish a system for collecting, analyzing, and distributing data about natural ecosystems using standard and recognized methodologies. USAID could draw upon a number of U.S. government agencies, including the Forest Service, the National Oceanic and Atmospheric Administration, and the Department of Interior, to assist St. Lucia in improving its capability for the collection, analysis, and use of such data. We recommend, therefore, that USAID finance an activity to ***provide technical assistance and training to St. Lucia to establish standard protocols for collecting, analyzing, and distributing the data required for strengthening resilience to climate change.***

PRIORITY ISSUE 5: POLICIES, LAWS, AND REGULATIONS

St. Lucia's current policy for increasing its capacity to adapt to climate change is to build infrastructure rather than improve the protection and management of natural ecosystems. Most infrastructure projects, however, are likely to deteriorate quickly or be expensive to maintain if the natural ecosystems around them are not well-managed and effectively protected. Reefs, for example, often provide effective protection of beach infrastructure from storm surges. Similarly, forests on steep hillsides protect water infrastructure from sedimentation. A needed action for St. Lucia to increase its capacity to adapt to the effects of climate change, therefore, is ***to formulate and implement policies, laws, and regulations that support sound management of natural ecosystems.***

So far as could be determined, no project or program in St. Lucia is working systematically to make persuasive arguments that more emphasis should be given to managing and protecting natural ecosystems as a cost-effective means to increase resilience to climate change. We recommend, therefore, that USAID assist St. Lucia to ***design, implement, and divulge economic and policy studies and educational programs necessary to strengthen its legal and regulatory basis for managing its natural ecosystems.***

PRIORITY ISSUE 6: CONSERVATION NGO CAPACITY

Capable public and private conservation institutions are necessary to achieve the effective protection and management of the natural ecosystems upon which strengthening St. Lucia's capacity to adapt to climate change largely depends. Public institutions generally are best suited to setting national policies, enforcing regulations, and representing the country at international meetings about environmental agreements. Private conservation institutions often are able to do a more efficient and effective job of implementing field projects and representing the interests of the private sector. St. Lucia has established numerous public conservation institutions but has no functioning private conservation institution. A needed action, therefore, is to ***establish a private, nonprofit conservation institution in St. Lucia.***

We recommend, therefore, that USAID help to establish a private conservation institution in St. Lucia by providing funds to ***finance a private, nonprofit conservation organization to prepare and divulge the assessments of the economic value of conservation measures, land-use planning, and building codes.***

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: FINANCING

- We rely on external resources. We are so limited in terms of financial resources and actually having bodies that we have to rely on regional entities, students, grantees. A lot of our work is project-driven. After it finishes, it is over.
- I remember once at a meeting with the prime minister. He said, “I like you guys because you raise your own funding.” I know for sure that health and education are the basic survival needs and then the rest usually goes for roads. Then you work your way down. Environmental issues are down on the totem pole. When we put in [a] request for new initiatives and actually get it, we are surprised. The tendency is to cut these things if there is a more-urgent need.
- Very often you either get it or you do not get anything. They do not usually get just part of it. Usually you get all or nothing. Most times you get nothing. Sometimes they say, “Look, we will give you X if you get Y from external sources.” It is easier to get counterpart funding than a completely new funding. Salaries are 50 percent of our budget. Our revenue base is decreasing because of what has happened to bananas and all of that. If you look at a capital project, you just see the external financing.
- There is also the Climate Investment Fund (CIF) where we have access to seventeen million in US\$ of grant funding. We are working with various entities to build climate resilience. Forestry, fisheries, health, sustainable health. That is grant funding. There is also loan funding from the WB for US\$10 million national and US\$5 million regional. They blended two projects.
- Resources for the implementation measures have come on stream only recently and in limited amounts in spite of the promises. There has been limited financing especially for CC adaptation. Where there might be some degree of accommodation is in road building, bridge building, and a water resource management system. That is where the government is more likely to finance. In addition to that, there have been limited resources for resilience because the government wants to finance education and basic needs. There is a lot more scope into putting resources into building resistance to natural systems.
- This habitat restoration rehabilitation is the primary focus of the Forest Department now and is supported by a recurring fund of US\$350,000.
- Not all people are paying sufficient fees. All users would be fined according to rules of the current system. We are changing the system based on the number of people coming in from the cruise ships, so now they are doing a flat rate charge per cruise ship, for the hotels.
- Critical to do business planning study to find sustainable financing sources
- Marine reserves are established but no funding is allocated (needs \$10,000/year).
- Soufriere has fees that are paid by users (like scuba divers).
- Government can provide incentives to private owners to maintain trees. They can be given incentives to maintain forest cover.
- Other studies are still being done. The Ministry of Physical Development also has housing. In certain areas, such as Cresslands in Soufriere where [a] severe landslide went down water courses, there was severe damage. It was in a drainage route that had severe landslides. The top of the mountain came down. A study is still being undertaken. There are studies about the geology of the country and where the slopes are more stable. People have their own theories about the situation. I don’t think the sewage tanks contributed. I think there should be more sewage treatment plants to get the water out of the soil in dense communities. The Ministry of Health has general guidelines for septic tanks. Because of our poor housing situation, there are houses one on top of the other. The septic tanks are too close together. It is something that is common on the hills. There is the issue of saturation of the ground. There is no plan to build another sewage plant. The current sewage plant is underutilized. The networks have not been constructed. The main networks themselves do not exist so buildings cannot connect to them.

PRIORITY ISSUE 2: PARTICIPATION

- We do not have the capacity to defend the environment by ourselves. We need the collaboration of civil society. We need to build capacity within the communities to make our job a lot easier.
- We must work in the communities and also provide them with their basic needs. We must do a good blend. Their livelihood issues must be taken care of, or we are wasting time.
- We have to look at the human health point-of-view: food supply and food production and an increase in disease vectors. We must never overlook the human aspect of climate change.
- The educational part of it would be very useful, including public relations about the need for planning. Education is very important. Without the education we cannot accomplish much.
- A lot of pressure on reef fish, no studies on how fishing and the new practice of trolling has impacted [the] size of these fish stocks. Fishermen are interested in the establishment of more marine reserves. When fisherman come to us and ask for more marine reserves you know there is a problem. Need to look at net size and impact of fishing practices on fisheries. Rehab of fisheries is needed.
- There is also some regression to older systems of sharing fishery access. Each fisherman has a day that they are assigned in a turn-taking system. People from outside communities come in and don't understand these traditional systems. The fishery department is in charge of these systems but fishermen are allowed to apply to enter the fishery. Applicants/new fishermen are then vetted through the regulatory agency (Department of Fisheries) depending on what is known about the carrying capacity of the fishery in questions.
- Marine reserves are overly top-down. There needs to be more of a participatory process with communities. MPAs need to have community ownership; when they don't they are not as successful.
- We have a public sensitizing campaign going into the communities about construction standards. We are educating them in the public health part too. People do not understand that the septic tanks have to be done well. We go to the secondary schools to educate the students. The idea is to change attitudes. We just started this program. We have just been appointed to these posts. We also intend to put articles in the newspaper to create awareness and use the mass media. We find after the sessions that many more people are coming to us to ask about the standards and procedures. They ask a lot of questions at the public meetings. There are more plans being submitted than before. We still have a long way to go.

PRIORITY ISSUE 3: PLANNING AND REGULATION

- I believe that one of the areas we should focus on is the issue of coastal water quality driven by sedimentation and pollution and waste water. The way we dispose of storm water and domestic waste water, green and brown water. We have limited capacity to dispose of waste water. It has a direct impact on marine biodiversity. We have to reduce the erosion problem from hills. It has to transplant into the urban environment. A lot of the land clearing is done to develop the urban environment. Where we are clearing land is in the commercial and housing sectors and it is affecting the erosion issue. What do we put into the urban planning? It has not been digitized. It is basic for land management. I think some work is planned in elevation models for coastal models but we need that for the entire country. Also we have to look at the issue of land-use planning. We do not have a land-use plan.
- One of the things we have realized in the Ministry of Tourism is that the land-use policy is so crucial. It is so easy to convert land from one use to another. It needs to be tightened up. Otherwise the forces we are fighting will be a waste of time. One hundred seventy thousand population expansion has [added] more pressure.
- We need to recognize that community and civil society can use the biological resources for socioeconomic development so as to encourage protection.
- The national land-use plan is very important. World Bank, etc. mention it all the time. The political drive is not there. We sit down at meetings all the time and hear about a national land-use plan, but it is never prepared. If we had the plan it would be an educational tool as well as an enforcement tool. Politicians may not want it because they prefer chaos.

- We have the Physical Development Planning Act but the legal process to remove illegal structures is too long, even when we just want to remove small structures along the roads of roadside vendors. It is difficult to get rid of them. People claim they are the lifeblood of somebody.
- Housing causes sediment. Biggest gap of all the islands is lack of land-use planning. They were all approved and passed. They have DC approvals. There were EIAs prepared. All the relevant agencies are involved. The issue of monitoring becomes an issue. Nobody monitored the actual construction.
- Mangroves are a difficult and challenging ecosystem to protect. They are in private hands, are in desirable lands for development but have been declared marine reserves and RAMSAR sites.
- We have no current zoning plans. We do not have a land-use plan either. We are hoping that in the next budget it will be considered. We try to use consultancies to fund this type of activities. We have no immediate plans to get it done. I don't think St. Lucia has ever had a land-use plan at the national level. I believe there are reasons why as a nation we cannot get it off the ground. There may not be the political will to get it off the ground. The politicians want to manipulate the decisions so it is advantageous to allow things to be ad hoc.
- We do not have a building code; that has been in draft for 20 years at least. The structural integrity of the buildings is at risk. We need codes as a tool in planning. It would be a tool for adapting to CC. People want to put structures next to the coast, etc.
- There is this thing called political interference and missing political will. St. Lucia is very small with a small population and a land area of 248 square miles. The majority of our land space is very hilly and difficult and costly to develop. So we have small pockets for building space that are in high demand. Even on the slopes they are being used for agriculture and housing and are being exposed by the removal of trees and exposed to the elements and weather which results in landslides. There is a serious need for having such a land-use plan. The persons who are most vulnerable are the less fortunate. They are the ones who will take the most risk.
- We have 12 coral reef marine reserves and 12 marine mangrove reserves. Have not been delineated. No assessment of what reefs are inside and outside of the marine reserves, these are key needs. A reef check is done annually. This gives you a percent of coral cover but not a sense of the changes in health.
- The marine reserves are not mapped as far as we can tell. There is no formal delimitation of these areas. They are just declared on paper and very little study and mapping has taken place. This is an issue especially as many of these areas have edges along the shoreline and the lack of clear lines where the marine reserve ends can create an opportunity for private land owners to dispute the protection of coastal areas that they would like to develop. The law is that private land ends at the high water mark according to the colonial rule of the 'Queen's Chain' (coastline) being the end of the crown lands. There have been examples of disputes over this rule. Sandals, for instance, constructed pilings below the high water mark in certain areas where zoning was not clear regarding where construction was permitted.
- The NE of SL is really the last frontier and an increase in access such as would occur as result of the Iyanola Road project would have a significant impact if proper zoning and management restrictions are not put in place. This is a must for this region but enforcement is not a strength for many of the government departments charged with oversight of the relevant regulatory controls over development process.
- The lack of a national land-use policy and development plan are huge issues that threaten the sustainable development and use of biodiversity in St. Lucia.
- Land-use planning is a huge issue and needs to be improved. Currently there is no land-use policy or national land-use plan. There have been some for specific regions but no coherent plan. A vision plan exists and this is a good start but is not adequate. We need to have this plan to understand what the implications of development are that need to be addressed and in order to maximize the positive impacts of development projects (i.e., maintenance of critical habitats for species preservation, allocation of green spaces, areas that can be used for development agriculture, etc.). What is it that we can do in our planning regulations, and amend them, to improve the land use within developments to ensure that you retain some biodiversity? They enrich a residential area. How do we build on our residential areas? The total

absence of a land-use plan allows politicians to say we have no plan, so we are free to decide how to best make use of different regions.

- We have mostly soils data. We do have an OAS map that was produced in 1992. There was one in 1961 of the UWI about soils. We also have other information with regard to winds, a little information on rainfall. We have data on flooding zones in low-lying flooding areas. It is broken up into 1 in 100 years and 1 in 50 years. For us to be able to get new data we need a consultancy and then we try to get data through the consultancy.
- They are private lands so you have to buy the land. The critical point is that there is limited jurisdiction about how people can use their land. When you leave it in private ownership it depends on benevolence. Once you encourage in protected areas, you also need the private forest landowners to invest in the forest. There is no incentive from timber value.

PRIORITY ISSUE 4: DATA COLLECTION, ANALYSIS, AND USE

- We do not have the appropriate personnel to collect data or the equipment to collect it. We rely on other agencies. The Physical Planning Section is the depository for the national GIS, which is why we can procure information from other government agencies. We are not monitoring the coastline.
- Marine environment will be destroyed if your forests are not intact. But we have very little information on adaptation to climate change for our forests. Not just looking at the public forest but agro forestry, urban forest. You have to look at the synergy with other sectors.
- A study of reducing the vulnerability of water needs to be done so that we could look at the catchment points and decide what needs to be bought. In 2009 we did it for biodiversity and we know the critical terrestrial biodiversity areas. There is no financing for the study that would be required. Maybe the water company has such a report but I have never heard it. It is done for one watershed.
- If you take a look at the island after a heavy rain, you see a ring of mud. It is clear that the reef health is impacted by the land-use activities.
- There is need for NRM and research method standardization for data collection, soil and targeting of soil conservation methodology, and monitoring of habitat restoration effects in the reduction of negative lower watershed impacts.
- A key need is the use of a recognized and standard methodology for data collection and improved monitoring and analysis capacity. The U.S. Forest Service could help in the establishment of these standard methods.
- There is a lack of widespread monitoring by the Meteorological Service. Their stations are mostly based in the population centers so it is difficult to directly link changes in forest and coastal ecosystems to climate change because we lack monitoring of climate data that is specific to these zones.
- They are trying to quantify the amount of sedimentation using crude calculations of area filled but there have been no detailed analyses of these trends in sedimentation.
- The Department of Fishery hires community members as 'data collectors,' sometimes fisherman, to do data collection. Used to look at landings for the year and used in parliamentary review for policy decisions. A lot of data are available for particular projects. This is a weakness because longevity of this data collection is an issue. Environmental aspects do not tend to be a high priority for the government agenda. So reliance is on projects. So lots of good baseline data but not much beyond that.
- We have very little data for the northeast of the country. There is not much happening there. This is one of the few untapped areas and it is the reason the iguana still exists on the island. Also because of the Central Forestry Reserve. There are no plans to obtain data. The government of St. Lucia recently signed a contract with SAF 2012 for it to do a study project about the northeast coast. The TORs are being written for the study and the study will involve different ministries and departments, including forestry, physical planning, fisheries, etc. The TORs are being undertaken to obtain the necessary data.
- RAMSAR status helps improve the monitoring; IUCN manages the convention and should send monitors to check on status of protection. They invited an IUCN monitor this year and hopefully he will come in the near future.

- There are rainfall data. In terms of the wetlands location, we have that in the forestry department. There is no general assessment of wetlands. The St. Lucia National Trust did a study in 1980 but we have not done a recent wetland study.
- Forestry has permanent sample plots all over the islands. They were established in 1914 and some of them remain. New ones as recently as 2010. They are measured every five years, with some gaps. Some plots were lost. Sometimes there are not enough people. The data are quite good.
- The institutional arrangement as far as data collection, distribution, and access could probably be improved. It is collected, stored but not analyzed in a timely manner to inform management decision-making.
- MOUs should be established between different agencies which allow access sharing upon request. One facility that we try to establish under a project Pilot Program for Climate Resilience. We have established a platform between the agencies. It is essentially for climate change but can be used for other [purposes]. We are trying to establish this now. It does not exist yet. The Ministry of Physical Development is leading this effort and it will reach out to nodes in other agencies.
- My concern is for a system. GPS in the field to forward to the central area where somebody vets it. So all the data available are put in to one location. The protocol, etc. should facilitate sharing of data. Namibia with cell phones is an example. Use modern technology and improve the data culture. That people understand that they can use data as part of their work and manage their data.
- The Fisheries Department has an extensive database that goes back to the 1980s. They collect mostly on commercial species but also other species. They generate reports for the agency with which they collaborate internationally.

PRIORITY ISSUE 5: POLICIES, LAWS, AND REGULATIONS

- The businesses too need to be convinced that there is money to be gained through sustainable management. Businesses now have to start thinking differently. Businesses respond to people's behavior. If we accept the goals they have then they will not change. I think somebody said that there is a profit motive. Businesses need a profit. If people can take measures that are financially profitable and environmental responsible, there will be results.
- It is well and good to say that but our approach to development has been demand-driven. Somebody decides that they want to do something and the policy has been to help it happen rather than analyze it technically and ask if it is the best thing to do. Land-use plans have not been used. To stick to a zoning policy ties the hands of the politicians—that is a fact.
- Even more than that the market is more influential as well. Look at what happened to banana and sugarcane and cotton. If we have another type of market, people could go in the forest and destroy the areas and do it fast. The market influences how people behave in response to markets.
- I want to link to that point because I think we are missing an opportunity to learn from other places. The Scheylles provides an example. They say that the environment is primary importance. Market the environment. We are not doing that cross-fertilization.
- Most times, you do not talk about soil. The life cycle of the soil affects our ability to be resilient. Even the rock crumbles. You also have to look at the soil. We have a fairly young geology so you find that there is mass waste of soil and land slippage all over the country. The forest did its job. In the context of Haiti, you would have had this soil flowing downstream the river channels and covering the village, and in our case, you saw trees trapping debris and the water was gradually released. Places that would have been covered over were actually protected. So in a CC context that is where we see opportunities from REDD+ but I am interested in reforestation or landscape restoration.
- Our legislation is now powerful enough because we do not have the level of empowerment that would enable them to stop the work. The legislation is so fragmented that it takes a lot of effort to work in a team. It happens but not efficiently. There is an aspect of political interference in these construction projects. Political will plays a critical role. We get the EIAs to give our comments on. You can give all your comments in the interest of the nation but political interference can override it all.

- The money should be there to reclaim those slopes under tree cover. Not just tree cover but also biodiversity is important for resilience. Diversity in the forest would be better than monoculture. You need to have more bugger zone. That would have to be acquisition of land. A lot of land that was under banana cultivation. A lot of abandoned fields do have new growth and they should be kept. Acquisition is very important. The discussion is that restoration and planting of forests would be with local tree species.
- In terms of climate change, the Sustainable Development and Environment in the ministry has principal responsibility. We have a collaborative effort with all the agencies. A National Climate Change Committee meets to discuss projects, movements. It is governmental and nongovernmental. We have a Climate Change Policy from 2002 and have prepared a revised Climate Change Policy that we hope will be adopted by the Cabinet of Ministers.
- The World Bank project focuses on infrastructure work. This is supported by political interests involved in the decision-making as these types of projects provide highly visible, short-term results that can be used to get them re-elected. So the focus on infrastructure works by politicians and WB projects is the norm as result. Research and NRM activities are not as well-funded because that are not as 'sexy' as infrastructure works. Health, communication/roads, and education projects receive the majority of these funds.
- So the country has to borrow heavily after the destruction caused by storms in order to provide for recovery and rehabilitation of these expensive infrastructure. Reforestation and related research into more long-term solutions to recurring threats to infrastructure are not prioritized as they should be in order to protect this infrastructure in the long run. Solid and liquid waste disposal, particularly sewage treatment and management. Must start to think about alternative storage, treatment, and disposal methods and technology as we currently rely on the dual chamber septic tank that is not always the most efficient or effective, depending on where the level of sewage treatment is needed based on the location.
- There is a lack of understanding and education on the part of politician's and decision-makers about these biodiversity and CC issues.
- One issue is that the developer pays for the EIA. Even if it is a very good EIA however, implementation is lacking, the constructions do not have the mitigation measures. When offices get involved to try and prevent that, developers use political clout to push against this. The Ministry of Planning is responsible for monitoring of EIA implementation.

PRIORITY ISSUE 6: CONSERVATION NGO CAPACITY

- A key constraint in St. Lucia is that civil society is nonexistent. The national civil society has pushed out the NGO civil society and this is a key constraint. SL needs a lot more civil society organizations. The capacity for administering and managing these types of organizations is not easily found.
- Train communities and at-risk youth or vulnerable HHs in alternative economic opportunities to avoid the clearing of forest and mangrove areas.
- The available resources are stretched very thin; the same staff is doing all the education and enforcement. There is an HR deficit.
- The Coastal Zone Management Unit is severely understaffed (only one person on the staff).
- Projects should have simple project administration and not overly burdensome reporting requirements, etc.; target key needs of community or particular issue; and be integrated and multi-sectorial so as to address issues in multiple sectors and that are closely related in terms of their causes.
- There are not enough people, nor is there enough financing. We have staff people and eight rangers to enforce the protection of the Soufriere Marine Management Area (SMMA). This is insufficient. There is no monitoring staff. Need at least six people per Marine Management Area (MMA). It is necessary to give people time off.
- Capacity building is needed. Infrastructure-focused projects are common but there is a lack of capacity to manage infrastructure.
- Are there lessons to be learned from the SMMA for other marine reserve?

- A number of hotels tend to put their structures close to the beaches and because of SLR that is a serious concern to us. We have to monitor this closely. The monitoring is not being done to the extent that we would like. It would require a team of various experts from different agencies to have a joint monitoring approach. It requires resources. An agency could come in and assist in the organization and training. I am always concerned about the maintenance of trees, etc. The large developments think they can come and bulldoze everything. The Forestry Department can only look at lands that belong to them.
- I think that there is quite a history of cooperation between government agencies and with CC and community groups. One of the key deficiencies is that of capacity among the government agencies.
- St Lucia probably has the lowest levels of NGOs in the region. In fact, we've had limited optic, for example, in the first stages of GEF proposals because we did not have development NGOs. The capacity to hire people for these projects was lacking. The local pastor was also the director of the local development organization. A lot of initiatives have been funded by projects and they die out when the project's funding ends.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 9: ST. VINCENT AND THE GRENADINES

LIST OF ACRONYMS

CARICOM	Caribbean Community
CCCCC	Caribbean Community Climate Change Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CIMH	Caribbean Institute for Meteorology and Hydrology
CSDU	Conservation and Sustainable Development Unit
EIA	Environmental Impact Assessment
GEF	Global Environmental Facility
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Society for International Cooperation)
MarSIS	Grenadines Marine Resource Space-use Information System
NGO	Nongovernmental Organization
NPA	National Parks, Rivers, and Beaches Authority
OECS	Organization of Eastern Caribbean States
SLR	Sea Level Rise
SS	Storm Surge
SVG	St. Vincent and the Grenadines
TNC	The Nature Conservancy
USAID	United States Agency for International Development

SUMMARY

Climate change is predicted to increase St. Vincent and the Grenadines' (SVG) mean annual atmospheric temperature, sea surface temperature, and intensity of tropical storms, and to either decrease or increase its monthly precipitation. A 1-meter rise in sea level by 2080 combined with a 1-in-100-year storm surge is predicted to affect 67 percent of its tourist resorts, 100 percent of its airports, and at least 67 percent of its ports. A rise in sea level of 1 meter by 2080 is predicted to result in rebuilding/relocation costs and lost land-value capital costs of US\$1.3 billion; costs for a rise of 2 meters is predicted to be US\$3.6 billion, mostly for tourist resorts and dryland loss (CARIBSAVE, 2012) (see Tables 1–3). These costs may make SVG less competitive with other Caribbean nations in attracting international tourists, and thereby cause its economy to create fewer well-paying jobs than otherwise would be possible. A principal way to strengthen SVG's capacity to adapt to climate change would be to improve its capacity to protect and manage its marine ecosystems. We recommend that USAID assist SVG to finance Sustainable Grenadines, an NGO that works in environmental conservation of the coastal and marine environment and sustainable livelihoods in the Grenadine Islands, to work with the staff of the Tobago Cays Marine Park to: (1) formulate and implement mechanisms to ensure adequate, permanent, and timely financing for its basic operational costs; (2) establish systematic procedures for incorporating fishermen into some aspects of its protection and management; (3) implement the spatial plan for the marine areas in and around the Tobago Cays Marine Park; (4) establish regular, adequate, locally based research and monitoring of the ecosystems within the park; (5) develop and implement a model program to strengthen the institutional capacity of the Tobago Cays Marine Park; and (6) complete the drafting and begin the implementation of regulations for the use of the resources of Tobago Cays Marine Park.

BACKGROUND AND PURPOSE

St. Vincent and the Grenadines (SVG) has a coastline of 84 kilometers and a total area 389 km², twice the size of Washington, D.C. St. Vincent Island has an area of 344 km² and the Grenadine Islands, which stretch 60.4 kilometers to the south, have a total area of 45 km². As of July 2013, the population was 103,220, a large percentage of which lives in the capital, Kingstown. SVG is governed by a governor general, a prime minister, and a unicameral House of Assembly. Arable agriculture occupies 13 percent, permanent crops 8 percent, and other uses, including forest, 79 percent of the land. Tourism contributes about 74 percent of SVG's economy. Migrants' remittances, industry, and agriculture contribute most of the rest. Tropical storms devastated SVG's crops and infrastructure in 1994, 1995, and 2002 (CIA, 2013), severely affecting its economy.

This report reviews the vulnerabilities of SVG to climate change, identifies the priority actions which are required to reduce its vulnerability to the effects of climate change by increasing the resilience of its natural ecosystems, and makes recommendations for how USAID could best assist SVG to implement these priority actions.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for SVG by 2080 according to the CARIBSAVE Risk Profile for SVG (2012). Average annual temperature may increase by 2.4 degrees Celsius to 3.1 degrees Celsius. Predictions for change of precipitation range from -34 millimeters/month to +6 millimeters/month. Sea surface temperature may rise by +0.9 degree Celsius to +3.0 degrees Celsius. Tropical storms and hurricanes may become more intense.

Table 1 Predicted climatic effects of climate change in SVG

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase between 2.4°C to 3.1°C
Precipitation	Decrease of 34 mm/month to an increase of 6 mm/month
Sea Surface Temperature	Increase between 0.9°C to +3.0°C
Tropical Storms/Hurricanes	Increased intensity

Source: CARIBSAVE, 2012

An increase in average annual temperature could raise operational costs of tourist operations, since more energy would be required to cool hotels and vehicles. Decreases in precipitation might reduce the quantity and reliability of fresh water and increase the potential for salt water intrusions into fresh water aquifers. Increases in precipitation, by contrast, might augment soil erosion and thereby cause more sedimentation runoff that may affect SVG's coral reefs and sea beds. If that were to reduce their health, they would become more susceptible to invasive species, rises in sea level, and rises in the temperature and acidity of sea water. Changes in temperature and precipitation could make agriculture more risky and vary the types, prevalence, and patterns of human diseases. More intense tropical storms and hurricanes could cause severe damage to tourism infrastructure and put human lives at risk.

Table 2 indicates the predicted effects on land uses and infrastructure in 2080 of a sea level rise (SLR) of 1 meter, 2 meters, and 1-meter SLR combined with a 1-in-100-year storm surge.

Table 2 Effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2M	1 M + 1-IN-100-YEAR STORM SURGE
Area	1%	2%	3%

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080		
	1 M	2M	1 M + 1-IN-100-YEAR STORM SURGE
Population	1	2	3
Urban Area	1	1	1
Wetland Area	*	*	*
Agricultural Land	2	3	7
Crop and Plantation	1	1	2
Major Tourism Resorts	10	24	67
Airports	50	75	100
Road Network	1	1	2
Protected Areas	*	*	-
Sea Turtle Nests	11	16	-
Power Plants	0	0	-
Ports	67	67	-

Source: Simpson et al., 2010

Table 2 indicates that a rise in sea level of 1 or 2 meters by 2080 would severely damage SVG's airports and ports. A rise in sea level of 2 meters would severely damage its tourism resorts as well. A combination of a 1-meter rise in sea level with a 1-in-100-year storm surge would increase damage over two-thirds of its tourist resorts and 100 percent of its airports. SVG's power plants would not be affected by a rises in sea level of 1 or 2 meters, but no data were available on the physical effect on power plants of a 1-meter rise in sea level combined with a 1-in-100-year storm surge. By contrast, SVG's urban areas, the percentage of agricultural land, and crop and plantations that would suffer from the combination of a 1-meter rise in sea level with a 1-in-100-year storm surge is relatively small, most likely because much of the land where these activities occur is well above sea level.

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1-meter and 2-meter rise in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs by 2080 due to sea level rise

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
<i>Annual Costs</i>		
Tourism	174	328
Agriculture	34	24
Industry	1	1
TOTAL	208	354
<i>Capital Costs</i>		
Airports	201	677
Ports	135	332
Roads	1	2
Power Plants	*	*
Property	47	146

VARIABLE	COSTS (US\$ MILLION)	
	1 M SLR	2 M SLR
Tourist Resorts	315	1,586
Dryland Loss	592	886
Wetland Loss	*	*
TOTAL	US\$1.3 billion	US\$3.6 billion

Source: Simpson et al., 2010

Table 3 indicates that of SVG's economic sectors, tourism would suffer the greatest annual and capital costs, followed distantly by agriculture. SVG has almost no industry to be affected by the effects of climate change. The capital costs anticipated for airports (upon which tourism depends), ports, and dryland also would be substantial.

The predicted physical and economic effects of the potential changes in SVG's climate indicated in Tables 1, 2, and 3 would be likely to decrease the international competitiveness of its tourism industry, by raising its costs and reducing its attractiveness when compared with alternative regional and international tourist destinations. To the extent that there are fewer income opportunities in SVG over the coming decades, the potential consequences of changes in SVG's climate could disproportionately decrease the income and welfare of its youth and women.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The **Ministry of Health, Wellness, and the Environment (MHWE)** is responsible for measures for SVG to adapt to climate change. Within the ministry, the **Conservation and Sustainable Development Unit (CSDU)** implements multi-lateral environmental agreements. An informant stated that the **National Environmental Advisory Board**, consisting of heads of 10 different public sector agencies and one nongovernmental organization (NGO), advises the CSDU. Another informant said that the **Environmental Management Act**, developed in 2009, has not yet been approved by the Cabinet. This act would regulate marine and terrestrial pollution and would complement other legislation related to forestry, agriculture, and protected areas.

In the **Ministry of Housing, Informal Human Settlements, Lands and Surveys, and Physical Planning**, the **Physical Planning Unit** implements the **Town and Country Planning Act** by preparing land-use plans, issuing construction permits, and formulating land-use policies based on the **National Land Information System** and, in late 2011, began the implementation of the **National Building Regulations**. The absence of mandated guidelines for EIA structure and content in the act—and a failure to prosecute many offenders who do not comply with land-use restrictions or comply with EIA requirements—undercuts its effectiveness.

Within the **Ministry of Agriculture, Industries, Forestry, Fisheries, and Rural Transformation**, the **Fisheries Division** manages and develops fisheries, and the **Forestry Division** manages the national forest reserves. **Act # 33/2002** established the **National Parks, Rivers, and Beaches Authority (NPA)** under the **Ministry of Tourism, Sports, and Culture**. According to an informant in the NPA, cuts in the NPA budget, as well as delayed funding disbursements, have restricted the authority's ability to perform effective protected area management.

The **Nature Conservancy** currently finances most operations of **Sustainable Grenadines (SusGren)**, a local NGO that works in environmental conservation of the coastal and marine environment and sustainable livelihoods. **AvianEyes** supports conservation by conducting research and educating the public about environmental issues, as part of the **Society for the Conservation and Study of Caribbean Birds Project**

(Birdlife International, 2013). The **Progressive Community Organization** (JEMS) trains communities to conserve their natural resources (JEMS, 2013). The **Union Island Environmental Attackers** improves garbage disposal and educates tourists and local people about conservation (Union Island Environmental Attackers, 2013). An informant stated that **Ocean Governance** is surveying people's attitudes toward conservation in the Grenadines.

The **Caribbean Institute for Meteorology and Hydrology** (CIMH), the **Caribbean Community Climate Change Center** (CCCCC), the **Caribbean Disaster Emergency Management Agency** (CDEMA), and the **Caribbean Community** (CARICOM) operate in SVG. The **World Bank** finances projects of the CCCCC.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

The construction and operation of the new **Argile International Airport** on St. Vincent's southeast coast is the development project that will be likely most to increase SVG's vulnerability to climate change. The new airport will permit large aircraft to land in SVG, thereby increasing the number of tourists. Consequently, it is likely that the financial incentive to construct tourist facilities on beaches will increase, thereby also augmenting the number of buildings that are vulnerable to a rise in sea level and storm surges. Increased construction on beaches also may increase pollution of reefs, thereby reducing their extent and health and their ability to mitigate the effects of climate change on beaches.

SVG has no indigenous sources of oil, coal, and natural gas. Its electric power derives from diesel power stations: 88.5 percent across all islands and from five hydropower stations (11.5 percent), all located on St. Vincent (REEGLE, n.d.). It is thus heavily dependent on imported petroleum products for electricity generation, transportation, cooking, and other energy requirements. Though the country has abundant geothermal, wind, and solar potential, these sources have been underutilized. The low-lying parts of the country have been identified as having good solar resources, while wind energy has been deemed viable in the eastern side of St. Vincent, Bequia, and on all of the smaller islands. Geothermal energy production could be possible but has not been studied seriously. The five hydropower stations are dependent on a reliable flow of water and may be affected by changes in rainfall patterns (REEGLE, n.d.).

The government has established policies to increase the production of energy from renewable sources. In 2008, the Office of the Prime Minister established an Energy Unit to assist in the formulation and implementation of renewable energy and energy efficiency. In addition, the guiding principles of a National Energy Policy approved by the Cabinet of Ministers in 2009 include provisions for reducing SVG's dependency on fossil fuels and imported energy by increasing the production of energy from renewable sources. The country also approved an Energy Action Plan in 2010 that set goals for increasing the use of energy from renewable sources by 2030 (EAP 2010). Despite these efforts, problems of weak technical expertise and institutional structures persist. Further feasibility studies and knowledge, technical know-how for the use of renewable resources, increased funding for green projects, and private-sector participation in renewable energy use are required.

CLIMATE CHANGE PROJECTS

Under the **Reducing Risk to Human and Natural Assets Resulting from Climate Change (RRACC) Project**, USAID is financing two activities in St. Vincent and the Grenadines: (1) construction of a rainwater harvesting and storage system for agricultural production on mainland St. Vincent, and (2) expansion of water storage facilities connected to the Bequia **Sea Water Reverse Osmosis Desalination Plant**.

The **Regional Disaster Vulnerability Reduction Project**, financed with a World Bank loan, operates in SVG; 80 percent of the funds are for infrastructure and 20 percent for flood protection. The Global Environmental Facility (GEF) finances the **Management of Clifton Harbor on Union Island** project; it is preparing a management plan for Clifton Harbor to reduce water pollution and enforce regulations (Sustainable Grenadines, 2013). The **Grenadines Marine Resource Space-use Information System** (MarSIS) project has compiled information on marine space-use on the Grenada Bank that can be used to identify areas for special management. The **Nature Conservancy** is implementing a project called **At the Water's Edge: Climate Resilience in St. Vincent and the Grenadines**, which is formulating strategies to conserve coastal ecosystems (TNC, 2013).

The **International Institute for Environment and Development** with financial support from the **United Kingdom Department for International Development** implemented the **Developing Markets for Watershed Protection Services and Improved Livelihoods** project. The **Caribbean Natural Resources Institute** (CANARI) has carried out studies on the economic aspects of natural resources in SVG. The Physical Planning Department, with funding from the Australian government, is preparing a land-use plan and land use for all of SVG, which it expects to finish by the end of 2014. The **GIZ** recently completed a project to assist SVG with protecting its marine biodiversity and coastal areas (GIZ, 2013).

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of St. Vincent and the Grenadines. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist SVG to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies the issues that are both particularly important for SVG to address and appropriate for USAID support and needed actions to resolve those issues.

PRIORITY ISSUE 1: FINANCING FOR MANAGEMENT OF MARINE AREAS

SVG's marine ecosystems and beaches help to maintain its socioeconomic and ecological resilience to climate change. They are also integral to SVG's attractiveness for international tourists, who are the clients for the most important segments of the country's economy, which is also its principal source of employment and income. Therefore, it is important to SVG's economy that its marine areas are managed and protected effectively. Managing and protecting marine ecosystems and beaches is relatively expensive, however, given the cost of marine transportation and the large size of the country's marine areas. And a rise in sea level, higher sea temperatures, and more intense tropical storms and hurricanes will be likely to make the management of marine ecosystems even more expensive and difficult because they will increase the problems that management of the marine areas will have to solve. Even now, however, SVG's official marine protected areas lack sufficient financing to cover basic operating costs and capital investments. The Tobago Keys Marine Park, for example, is so underfinanced that it is patrolled only eight hours a day. No successful model exists for how to achieve reliable, adequate, and timely financing for the protection and management of marine protected areas. A needed action, therefore, is to ***establish a model for adequate and reliable sources of financing for the operating and capital costs of marine protected areas.***

No other project or organization could be identified that is working to establish adequate financing for SVG's marine protected areas. USAID has experience in designing financing mechanisms for marine protected areas and in integrated coastal zone management. The Tobago Cays Marine Park is SVG's main marine tourist attraction. Its reefs are being degraded due to lack of facilities, insufficient patrols, and lack of data. If it were to be financed and managed effectively, it would serve as a model not only for other SVG marine protected areas but for the management of marine areas that are not part of a protected area. Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Cays Marine

Park in particular. We recommend, therefore, that USAID *finance Sustainable Grenadines to assist the administration of the Tobago Cays Marine Park to formulate and implement mechanisms to ensure adequate, permanent, and timely financing for its basic operational costs.*

PRIORITY ISSUE 2: PARTICIPATION OF COMMUNITIES IN MARINE AREA MANAGEMENT

For generations people in the SVG have drawn sustenance and income from marine ecosystems, mostly by fishing in its reefs. Marine reserves may be necessary in order to preserve reefs and their ability to draw tourists, reduce beach erosion, maintain populations of marine organisms, and sustain commercial fishing. However, exclusion of fishermen from marine reserves creates potential for conflict and economic injustice, especially when fishermen lack capital or skills to fish for non-reef fish or to earn a living in other occupations, such as tourism, agriculture, or commerce. Fishermen, moreover, often have detailed knowledge of the current and past condition of reefs, which is valuable for their management. Full, organized, consistent participation of fishermen in the management of marine reserves, therefore, is often a prerequisite for their successful management and thereby their contribution to SVG's economy and its resilience to climate change. Thus a needed action for strengthening the SVG's adaptive capacity to climate change is to *achieve full participation of fishermen in the management of marine reserves.*

No current project was identified that is providing adequate support to SVG to establish a clear, replicable model for fully incorporating fishermen into the management of its current and future marine protected areas. USAID has substantial experience in designing and implementing projects that are intended to increase fishermen participation in marine reserves management. Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Cays Marine Park in particular. Therefore, we recommend that USAID *finance Sustainable Grenadines to assist the Tobago Cays Marine Park with establishing systematic procedures for incorporating fishermen into some aspects of its protection and management.*

PRIORITY ISSUE 3: MARINE SPATIAL PLANNING AND REGULATION

The implementation of plans for the use of marine areas, as for terrestrial areas, is a prerequisite for effective management and protection, which is a prerequisite for maintaining and increasing the resilience of their ecosystems to the effects of climate change. Yet so far, no spatial plan for its marine areas has been implemented on a large scale. To increase SVG's adaptive capacity to climate change, it is necessary to *implement successful, replicable models for planning and regulating the use of marine areas.*

Sustainable Grenadines, with the participation of more than 500 stakeholders, has prepared a spatial plan for the Grenadines that defines the best uses for different marine areas and provides a scientific basis for reducing conflict and establishing decentralized, detailed planning and implementation of their management. If time goes by without implementing the plan, it may become outdated and the stakeholders who participated in its preparation will lose interest in its implementation. No support currently exists, however, for implementing all or part of the spatial plan for the Grenadines marine area. Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Cays Marine Park in particular. We recommend, therefore, that USAID *finance Sustainable Grenadines to implement the spatial plan for the marine areas in and around the Tobago Cays National Park.*

PRIORITY ISSUE 4: LACK OF DATA ON THE STATUS OF MARINE ECOSYSTEMS

Strengthening SVG's adaptive capacity to climate change requires conservation of its terrestrial and marine ecosystems as well as natural resource management decisions based in the analysis of reliable data collected over long periods of time by people who are knowledgeable about particular sites. Data for marine areas generally are less available, more expensive, and difficult to obtain than for terrestrial ecosystems, although they are frequently both more severely affected by the effects of climate change and are more vital to strengthening SVG's resilience to climate change. Yet data about SVG's marine areas are not being collected regularly and sufficiently to provide a sound basis for their management. Therefore, significant gaps exist in

assessing and understanding SVG's marine resources in empirical terms. To strengthen SVG's climate change adaptive capacity, it is a priority to ***establish a model for regularly and reliably collecting, analyzing, and utilizing scientific data with the full participation of local people over long periods about its marine areas.***

SVG's marine protected areas were established explicitly to ensure their conservation and provide a basis for tourism. Yet even the Tobago Cays Marine Park, one of the most valuable tourist assets in the country, lacks sufficient scientific data upon which to base management decisions. No current activity is assisting SVG to collect, analyze, and utilize scientific data with the participation of local people in the Tobago Cays Marine Park. The NGO Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Cays Marine Park in particular. We recommend, therefore, that USAID ***finance Sustainable Grenadines to assist the Tobago Cays Marine Park to establish regular, adequate, locally based research and monitoring of the ecosystems within the park.***

PRIORITY ISSUE 5: LACK OF INSTITUTIONAL CAPACITY FOR MANAGING MARINE ECOSYSTEMS

To strengthen its climate change adaptive capacity, SVG must develop its institutional capacity for planning, implementing, monitoring, and evaluating management of both its terrestrial and marine ecosystems. Its marine ecosystems are currently more threatened with degradation than its terrestrial ecosystems and provide more direct protection to the coastal areas where tourism, SVG's principal economic activity, is concentrated. Aspects of institutional capacity for marine areas include ability to coordinate effectively with other government and private institutions, utilize research, increase income from tourism, and regulate use of marine resources. SVG lacks a replicable model for how to effectively conserve marine environments from climate change effects, which would affect fishing and tourism. A needed action, therefore, is to ***establish a replicable model for strengthening institutional capacity for conserving marine areas.***

Permanent institutional capabilities to conserve marine areas can best be developed from experiences in resolving management problems in specific areas. No current project or program in SVG supports the development of a replicable model for strengthening institutional capabilities in a marine environment. The Tobago Cays Marine Park supports tourism but also provides important ecological goods and services that increase SVG's resilience to the effects of climate change. However, it lacks institutional capacity to achieve effective conservation of its ecosystems. The NGO Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Marine Park in particular. We recommend, therefore, that USAID ***finance Sustainable Grenadines to develop and implement a model program to strengthen the institutional capacity of the Tobago Cays Marine Park.***

PRIORITY ISSUE 6: LACK OF NEEDED POLICIES, LAWS, AND REGULATIONS TO PROTECT MARINE ECOSYSTEMS

Well-conceived, effective policies, laws, and regulations must underlie efforts to conserve SVG's ecosystems in order to strengthen its resilience to climate change. SVG includes 34 islands, each one somewhat different in its social structures, economy, and ecosystems. Although national policies and laws are necessary, their effective implementation requires that regulations for conservation of ecosystems be formulated and implemented at the local level so that they fit specific local situations and will be enforced with the support of local people. Moreover, SVG has a number of drafts of national laws that have never been passed and laws that have been passed but whose regulations have never been written. Therefore, a needed action to strengthen SVG's adaptive capacity to climate change is to ***draft regulations for the use of specific marine areas that local people understand, accept, and are willing to help enforce.***

Under an Organization of Eastern Caribbean States (OECS) project, a start was made on preparing regulations for the specific areas of the Grenadines, but these regulations need to be completed and implemented for specific sites with the participation of local people. The Tobago Cays Marine Park would provide an excellent place to increase SVG's experience in formulating and implementing policies, laws, and

regulations for marine areas. The NGO Sustainable Grenadines has many years of successful experience in working in marine parks in general and the Tobago Cays Marine Park in particular. We therefore recommend that USAID *finance Sustainable Grenadines to complete the drafting and begin the implementation of regulations for the use of the resources of Tobago Cays Marine Reserve.*

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APPENDIX A: QUOTATIONS FROM KEY INFORMANT INTERVIEWS AND FOCUS GROUP DISCUSSION

PRIORITY ISSUE 1: FINANCING

- Our department focuses on a very limited budget. It is virtually impossible for us to support all forestry issues [with a budget of] US\$1 million. We have been trying to attract sustainable financing for our projects ... If we can have this doubled, we could do a whole lot more; this amount of money would cover us for the actions we have identified as needed ... We have a plan with an NGO from Germany which will sustain our parrot conservation program for the next 10 years. We want to attract more strategies like this. We want to seek international funding; the government does not seem to have funds for conservation. We want outside money.
- If we could enforce our presence in the areas, we can convince the public that we are serious ... Even if we were to receive only three years of support ... and even if that resource dries up, we would have gotten the public to think we are serious. If we can get some kind of support for five years that would be major. Access to funds to implement some programs that need to be implemented is our key priority.
- We send in proposals for grants. Without grants we have no money. Groups like mine are taking on the initiative to do something for the community to raise the consciousness about climate change [but] there is no support coming in for these NGOs. US\$30,000 or 40,000 would make a big difference to our program.
- None of what is in the national park plan has been done ... principally for lacking of financing. We are supposed to be a self-financing agency, but we rely principally on consolidated funds. This is not a priority area of the government ... Since 2009, there has been drastic shortfall. Government does not provide enough budgets ... For this current 2012 fiscal year, our budget is EC\$2.4 million. We have only gotten EC\$1.4 million. Our budget has actually been cut in recent years. We receive certain allocations on paper but never actually receive the monies. Sometimes we receive the monies one quarter into the next fiscal year.
- We have our own source of the income from the park, [but] there are never sufficient funds. We have to borrow from other government agencies that give us a loan until we get the money. It is seasonal income. From May until October it is very slow. From November to March there is a lot of income.
- We really need washroom facilities within the marine park. Visitors are there and there are no hygienic facilities. It is causing pollution. People use the bushes. There is no financing from the government for such infrastructure. We have to wonder where to get the funds for this. It would cost US\$20,000 or so.
- Much of what plagues us to make this program sustainable is the ongoing availability of resources beyond the life of a particular project. When we look at what has been achieved, you get the peaks under a project when all the resources required are readily available. When it becomes up to the local government to assume responsibility, they are sometimes challenged to keep the momentum going financially. We have peaks and troughs that have to do with the financial support.

PRIORITY ISSUE 2: PARTICIPATION OF COMMUNITIES

- The history of trade unions make the private sector leery of community groups. Governments are going with the private sector because of its financial power. It would be utopic to depend on communities. Communities can lobby for things, but the government has to take the lead and organize the community.
- Community involvement in management and decision-making is really important. The reefs are being used a lot by people. But the fisheries are not involved in making decisions. How do we get their involvement at the site level and resolving conflict? That connection is with awareness and education. That is the stumbling block to effective management.

- Fishermen are not entering the Tobago Cays Marine Park because they have been educated and the regulations have been enforced. It was a process of education—a lot of training and education—and looking for alternative livelihoods such as water taxis or selling food to tourists.
- People are looking for other ways to make a living. Some of them are going into the tourism business. Now ex-fishermen buy fish from the fishermen that are left. It is costly to buy bigger boats and bigger engines and more expensive to operate. We cannot compete ... because they [Japanese fishing companies] have huge ships and spend months out at sea ... Most local people do not understand this problem [of climate change] because they lack interest in the environment ... and are looking for the almighty dollar ... I think we need to bring more awareness concerning these problems. We need a public educational forum. We need to go into the schools and have meetings. Right now the people who will be affected [by climate change] are the fishermen. The fishermen are not a large part of the population. The fishing cooperative could create more awareness on the island about the reefs and the fish.
- The [fisheries] division has been working with the dive shops. We started working with them as part of our action plan. We have come to realize that the tourism sector has more force and information in terms of going to the reefs.
- No element of community involvement ... no consideration of farmers within or periphery areas in protected areas ... Any activity in the forests on a small island must be people-centered.
- Communities that will affect, for better or worse, SVG's resilience to climate change are not necessarily rural. The group of people who obtain their water from water systems, for example, could be important for achieving resilience to climate change through the payment of water fees.
- There is never enough emphasis placed on the production of water. So the institutions have placed emphasis on taking the water and providing it, not protecting the upstream source. Gradually, the water company saw that the forestry service has the obligation to provide deliverables because of the funding they provided. They were never comfortable with that contribution. There is a chance to revive this.

PRIORITY ISSUE 3: PLANNING AND REGULATION

- We recognize how fragile and easily spoiled our environment can be. We want to make amendments to the national county and planning act to incorporate regulations to achieve the protection goal.
- They tried to unify all the agencies that have to do with land and development, physical planning unit, housing units, land-use planning unit. I think now that we are under one banner. I think this is an improvement, but there's still room for improvement.
- What would be useful would be an inventory about state lands and private lands. The search for lands takes up too much time. Constantly being updated as things change on the status of land ownership would be useful. The registry can't tell us definitively the boundaries and areas.
- The red mangroves are outside the [Tobago Cays Marine Park] and they could still be cut down. There are a lot of organizations that have interest in protecting the mangrove area but there is nothing to prevent the government from developing the area, for example for a marina. It is the largest patch of mangrove and is expanding onto a playing field.
- We see the decisions at the political level. They want a marina in every mangrove swamp. People alter the coastline at their will.
- We need to get the city back to being a place that's not as hot as it is. There are fewer trees now and it used to be cooler. We would have to identify areas where we could do a few things to improve greenery and tree coverage. Different parts of the SVG government must collaborate to make planning and regulation effective.
- We are not very ambitious in how we go about things here. We don't want to steal anyone's thunder. We like to defer and coordinate with the folks whose primary responsibility is on these matters. It's not that we are not very concerned, because we understand the implications, but we don't overstep our mandate. We defer to them.

- We developed a marine spatial plan. It looked at existing use in the Grenadines and determined what use is best for the entire area to prevent conflicts and conserve biodiversity. All of this is in GIS. The data on the marine space is available for the Grenadines. The Grenadines have the largest coral reef area in the southern Caribbean at 1,500 km² and your focus is the reef to help the Ministry of Environment develop a marine policy.
- We brought over 500 stakeholders to work on this planning exercise. We considered the people and experts know the best place for marine areas, shipping lanes, fishing, recreation, etc. We would like to see it implemented.
- There should be an authority within these islands. It needs to be decentralized. There is no active planning for the marine space around the islands. People do whatever they want. They could spill oil. People could throw their anchors anywhere.

PRIORITY ISSUE 4: DATA PRODUCTION, ANALYSIS, AND USE

- There is a paucity of the data that are needed but its availability is a problem—people do not give the data easily. The storage of data is another problem. There is no central depository for data.
- Monitoring water quality and sewage from the yachts is a critical concern that is being talked about a lot.
- Scientific monitoring of beach erosion, health, and status is not happening.
- We have data on the amount, by species, of fish landings.
- We have significant gaps in terms of assessing and understanding our marine resources in terms of being able to empirically quantify our resources.
- In terms of collected data on siltation and erosion ... we have seen tons of silt coming down, but we can't quantify the impacts. This would be needed.
- There would also need to be better coordination, collection, and storage of data. Often times, Ph.D. students collect data on coral reefs, publish reports, which they share, but the information is scattered about and can be hard to track down when needed.
- We wanted to [study] the whole marine space in St. Vincent. It is extremely important to have this kind of information to feed into our marine coastal planning, especially with siting of the national park.
- We have very little biodiversity understanding in terms of our flora and fauna and how climate change is affecting the biodiversity. We have noticed changes. However, we need to upscale our collection of biodiversity data. All we have done is to improve our ability to react and adapt to the changes anticipated from climate change. However, the capacity to prepare for climate change is not there, and first and foremost, we must know what we have in terms of biodiversity and its sensitivities to changes in climate before we can act.
- In terms of funding for research, this is critical. We don't tend to take research seriously. We look at it as tedious work, but this must be done. It is necessary. We need to capture the information that already exists. We need a central database to store the information that students, institutions have already collected. We actually did a very detailed proposal to do the biodiversity inventory, information management system, environmental education, citizens and students involved in the data collection.

PRIORITY ISSUE 5: INSTITUTIONAL CAPACITY

- We have not come to the full realization that inter-sectorial coordination is important. The Forestry and Parks department share some responsibilities on governance of resources and these folks work in isolation, and are not properly coordinated.
- It is easier for the middle manager to integrate at the field level; we meet intimately at the field level to talk about issues and figure out solutions. Things don't gel at a higher level.
- It's not gelling at the planning ministerial level. At the technical level we are good.

- People are not willing to do extra coordination work. The commission for coordination between environmental organizations and activities has died because there was no payment for these people to be on the coordination board.
- Not only do we need a policy to guide our operations, but also an agency to coordinate, that is one central unit that will coordinate all the actions.
- The ministry of rural transformation and agriculture has a technical committee and steering committee where technocrats work together. They have a steering committee that advises parliament.
- The planning authority is basically a board, constituted of a number of key players and stakeholders with wide representation from several government agencies as well as the general public. Chamber representatives are on this planning board and private-sector representatives as well. They meet once a month at one venue; all of these disciplines and interests are represented. Coordination in physical planning is working.
- We require more technical input over time. We could easily reach a glass ceiling with what is available to us. We are trying to see if we can get some more training organized and we would like to be able to share some of that with participating agencies. We need different agencies to know how to gather the information we need and feed it to us.
- We need training of the force on dealing with volatile areas, drug culture—it's not such a simple thing.
- All our managers are trained. We could use more training in mechanical engineers and police training for interception. We need a biologist. We are not completely capable of identifying all the species. We need training in water quality testing. Would it be possible to attach somebody to work with the rangers for say six months to provide technical support for a year or so? It would be very useful to have a biologist. We need training of the mechanics to maintain the engines. They are moving from two- to four-stroke. We will have to get four-stroke engines. It will be cheaper to train us than to pay a mechanic.

PRIORITY ISSUE 6: POLICIES, LAWS, AND REGULATIONS

- We are discussing now how we might amend the existing planning laws to include more environmental safeguards.
- Looking at the forest policy, there is not a forest policy per se that reaches up to the level of policy maker. There is a draft one, but it does not have elements of co-management.
- There was draft regulation for the 1987 legislation, but this was never passed. We recognize that there are some new elements that should be added to this legislation that was not taken into account when this was developed. Climate change needs to be built into the act now, international treaties and agreements. We functioned for a long time on the act that was done in early '90s, and since then we have had new forest policy drafted but it has not gone from that stage.
- The forest policy should be interactive with stakeholders. In terms of the regulations, we had some work done under the OECS project. But these regulations will need to be continued to be updated.
- Grenadines is not St. Vincent. It needs to be considered on its own, not tied up on the mainland. Because it is site-specific, in their programs they should ensure that implementation is site-specific. A portion for the Grenadines that is specific for the Grenadines. There is a long history of not getting attention from the mainland.

RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 10: SURINAME

LIST OF ACRONYMS

CBO	Community-Based Organization
CCCCC	Caribbean Community Climate Change Centre
CDM	Caribbean Disaster Management (CDM) Strategy
CI	Conservation International
DRR	Disaster Risk Reduction
EIA	Environmental Initial Assessment
GEF SGP	Global Environmental Facility Small Grants Programme
GPD	Gross Domestic Product
NGO	Nongovernmental Organization
NIMOS	National Institute for Environment and Development
RPP	Readiness Preparation Proposal
SCF	Suriname Conservation Foundation
SLR	Sea Level Rise
SS	Storm Surge
UNDP	United Nations Development Program
UNESCO	United Nations Educational Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
USAID	United States Agency of International Development
WWF	World Wildlife Fund

SUMMARY

Suriname is able to avoid the climatic events that devastate Caribbean island states. Nevertheless, it faces its own challenges, including excessive flooding and high winds. Suriname is considered by the UNFCCC to be one of the most vulnerable countries to sea level rise (SLR). A rise in sea level of 1 meter by 2080 would cost Suriname a predicted US\$69 million in annual costs, and US\$673 million in capital costs (e.g., relocation/repair and lost land-value). Along with roads and ports, tourism is predicted to suffer the greatest losses as a result of SLR in terms of percent of the industry affected: tourist resorts would have capital costs of US\$158 million due to a 1-meter SLR (CARIBSAVE, 2012) (see Tables 1–3). Although tourism accounts for a relatively small portion of GDP, it is the only sector to experience continuous growth in the last decade, and its economic importance should not be understated. Suriname’s political class and government agencies are slowly accepting that climate change is occurring and action is required, as demonstrated by their increased involvement in regional climate and disaster risk-reduction-related initiatives with organizations such as the Caribbean Community Climate Change Center (CCCCC). However, the country does not have a viable climate change strategy. The Second Communication on Climate Change is expected shortly but research will still be needed to guide the development of useful vulnerability-reducing activities. There is a serious lack of technical expertise in Suriname and there is a critical need to recruit, train, motivate, and create opportunities for technical experts for employment within the government, NGOs, academia, and the private sector. Overall capacities related to policy, administrative, and managerial matters also have to be improved. A clear priority for Suriname is improving land-use planning in light of growing climate vulnerability. Efforts should be made to encourage participation surrounding climate change issues and pushing to the forefront the notion that climate change adaptation has to be integrated into the daily habits of the Surinamese people. We recommend that USAID assist Suriname to: (1) develop awareness raising and communication strategies on climate change and vulnerability; (2) establish a national climate change strategy with a focus on contributing to matters related to its practical implementation; (3) increase the availability both in terms of numbers and permanency of climate change expertise in the country; (4) improve land-use planning practices in Suriname; and (5) carry out research and pilot activities in the agricultural sector that promote climate change-resilient agriculture.

BACKGROUND AND PURPOSE

Suriname is located in the northern part of South America. It is a former Dutch colony and Dutch remains the national language. Language and Suriname's particular experience of colonization have acted to distinguish—and to a certain degree, isolate—Suriname from surrounding South American and Caribbean countries. Suriname is the smallest country in South America and has a land mass of just under 165,000 km². Suriname has a population of approximately 560,000, with most living on the country's north coast close to the capital of Paramaribo. It is known for its unique biodiversity and high rate of forest coverage. This report identifies the vulnerabilities of Suriname to climate change and the priority actions recommended to be undertaken by the USAID Eastern Caribbean Regional Program which are required to increase resilience.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the range of changes in climate predicted for Suriname by 2080. Under the higher emissions scenario, average annual temperature may increase by 4.8 degrees Celsius by the 2080s. Precipitation may decrease by as much as 61 percent or increase by as much as 19 percent per month by 2080. The report provides no data on a rise in sea surface temperature off the coast of Suriname but indicates that there is likely to be an increase in the intensity and number of extreme weather events.

Table 1 Predicted effects of climate change in Suriname

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase of 4.8°C by 2080s under higher emissions scenario
Precipitation	Increase and decrease, from -61% to +19% per month, by 2080
Sea Surface Temperature	Increase between 1.0°C and 3.1°C
Tropical Storms/Hurricanes	Increase in number of extreme events

Source: CARIBSAVE, 2012

The predicted effects of climate change indicated in Table 1 are likely to affect Suriname's economy, especially along the coast where most of Suriname's agricultural land is located. Increased frequency and intensity of droughts, for example, could require more irrigation, raising the costs of agricultural production. Temperature and rainfall have already become more variable in some locations in Suriname, reducing crop production and quality (CARIBSAVE, 2012). Farmers have reported the loss of fertile land, shortening of the growing season, and intrusions of salt water. Changes in temperature and precipitation also may have varying effects on the types and patterns of human diseases, including dengue, malaria, cholera, and diarrhea, by increasing the number and types of pathogens and disease vectors. More intense tropical storms and hurricanes could cause severe damage to physical infrastructure, crops, and trees, as well as put human lives at risk and generally affect costs of living and economic output.

The Second National Communication on Climate Change describes a number of changes that are expected in the estuarine coastal zone of Suriname. Although sea-level rise is the impetus for these changes, it is not expected to create large problems for the existing mangrove-mud coasts. The report claims that the ongoing alternation of accretion and erosion will be maintained, with possible increases in the erosion and deposition rate. Under these circumstances, the report states it is expected that the ecosystems will not change dramatically, although some shifts will occur, especially where hard manmade structures are found (Ministry of Labour, Technological Development, and Environment, 2013). This scenario does not account for the damage that is currently being inflicted to mangrove reserves along the coastline because of poorly planned development activity that is very apparent around the capital Paramaribo. The current and future threat to Suriname's marshlands through coastal development has to be better understood as considerable damage is currently being inflicted.

Table 2 indicates the predicted effects on land uses and infrastructure of a SLR of 1 meter and 2 meters. No data was available about the effects of a 1-meter SLR combined with a 1-in-100-year storm surge in Suriname.

Table 2 Effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080	
	1 M	2M
Area	<1%	<1%
Population	1	3
Urban Area	1	2
Wetland Area	<1	1
Agricultural Land	<1	1
Crop and Plantation	<1	<1
Major Tourism Resorts	5	11
Airports	0	0
Road Network	7	8
Protected Areas	0	0
Sea Turtle Nests	0	0
Power Plants	0	100
Ports	100	100

Source: Simpson et al., 2010

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1- and 2-meter rise in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value. While effects on industry and dryland loss would result in the greatest total annual and capital costs respectively, annual costs to tourism is greatest in the 1-meter SLR scenario and tourist resort losses in capital costs is significant.

Table 3 Predicted economic losses by 2080 due to sea level rise

VARIABLE	COSTS US\$ MILLION	
	1 M SLR	2M SLR
<i>Annual Costs</i>		
Tourism	36	39
Agriculture	0	0
Industry	33	43
TOTAL	69	83
<i>Capital Costs</i>		
Airports	*	*
Ports	38	107
Roads	78	240
Power Plants	*	309
Property	111	767
Tourist Resorts	158	635
Dryland Loss	237	779
Wetland Loss	50	302
TOTAL	673	US\$3.1 billion

Source: Simpson et al., 2010

Tourism is not currently a central component of Suriname's economy, but the government would like to increase international tourism. Currently, eco-tourism facilities are not considered to be up to standards to withstand floods and high winds. This, combined with the health risks that could increase due to climate

change, could make Suriname less attractive as a tourist destination.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

In 2011, the **Climate Compatible Development Agency** was created with the purpose of consolidating and streamlining climate change-related efforts by government departments. It acts as the lead agency on climate change. The **Directorate of the Environment in the Ministry of Labour, Technological Development, and Environment** coordinates all matters in the environment sector, including policy development. Areas of responsibility include biodiversity, climate change, chemicals, waste management, environment legislation, and renewable energy. The **National Institute for Environment and Development** (NIMOS) is responsible for the development of a national legal and institutional framework for environmental policy and management. It is also charged with promoting EIA legislation¹². The encompassing **Environment Framework Law** and EIA legislation have been stalled in Cabinet for a number of years. **SBB or the Foundation for Forest Management and Production Control** is under the **Ministry of Physical Planning and Forestry** and is a strong agency that theoretically could contribute to climate-related programming. Attempts have been made to develop a practical and useful national climate change strategy but to date, this has not occurred. The **CCCCC** is currently providing support to Suriname on this matter. Forestry, fisheries, national parks, protected areas management, and agriculture are areas where legislation requires updating.

The **Initial National Communication on Climate Change** was published in 2005. The final draft of the **Second Communication** has been accepted and is currently in limited circulation. The **Readiness Preparation Proposal (RPP)** for the **United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries UN-REDD** was recently published. Donors will be encouraged to consider supporting aspects of its implementation. There are five major NGOs, including CI, WWF, and the Suriname Conservation Foundation (SCF) operating in Suriname, and they report relations with the government are improving. There are also community-based organizations such as those in Maroon communities that can be very well-organized and are sought out as local partners by development agencies and NGOs. Housed in the Ministry of Defense, the **National Coordination Centre for Disaster Relief** is the lead agency on matters related to disaster risk reduction.

Until recently the only documents of substance on climate change and Suriname were the **Initial National Communication on Climate Change** and the 2008 **UNFCCC Capacity Self-Assessment**. These were recently complemented by CARIBSAVE's 2012 **Climate Change Risk Profile for Suriname**, the **Second National Communication** that should soon be available, and the RPP. At the managerial and technical level there is a considerable absence of pertinent research, studies, and technical guidelines. This corresponds with an absence of experience in assessing and monitoring development activity (infrastructure, food production, land-use planning, etc.) through a climate vulnerability lens. There is little information on climate-specific concerns and the vulnerabilities faced by local communities within Suriname. There is one local study entitled the *Impact of Climate Change on Agriculture and Housing on Indigenous Communities in Suriname* that was commissioned by UNDP, but this type of information is rare. There are next to no learning platforms in the form of pilot or demonstration activities that could serve to inform policies and practices on climate-related matters. There are obstacles in maintaining data and information networks and continuous dialogue among stakeholders on climate change as a means to improve the knowledge base as Suriname professionals have an unfortunate reputation for keeping information to themselves. From Suriname's **First National Communication on Climate Change** of 2005, as well as the **UNFCCC National Capacity Self-Assessment**, several gaps in meeting the convention's requirements were identified and a number remain today. This includes targeted research that could be used to validate the updating of relevant legislation. Suriname has ambitious plans to develop its agricultural sector, but without specific knowledge and experience in relation to developing and promoting policies and institutional support for climate-resilient

¹²NIMOS and SBB are Dutch abbreviations.

crop types and other complementary inputs like introducing suitable water conservation practices, this will be a difficult challenge.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

Economic development in Suriname is taking place at a very quick pace and large housing projects are an important part of this equation with most construction in the coastal area to the north of Paramaribo in flood-prone sensitive marshlands. Civil engineering undertakings such as the construction of large canals, dams, and roads are also more common. There are also increasingly larger agriculture projects. Suriname is considered one of the worst countries in terms of clarity on the issue of legal directions on land tenure. This is complicated by the fact that there is very little formal planning in Suriname, with most everything done on an ad hoc basis. EIAs that could play an important role in introducing climate-related development criteria are undertaken purely on a volunteer basis. Suriname has seen a boom in small- to medium-size enterprises and industrial operations. The concern over the lack of sound planning capabilities in these circumstances has obliged international NGOs with conservation mandates to react. Conservation International (CI), for example, has conducted training in spatial planning as a response to housing development around Paramaribo. The World Wildlife Fund (WWF) has made a similar engagement to promote improved local planning.

Among all Caribbean countries Suriname has the least dependency on fossil fuels, due in part to the country's enormous potential for renewable energy resources, including solar, biomass, and hydropower. As of 2005, demand of energy in Suriname was based mostly on hydrocarbons at around 69 percent, followed by hydropower (~26 percent) and biomass (~5 percent) (National Institute for Environment and Development, 2005). Hydropower currently supplies 96 percent of the electricity of the country and is the most viable green energy source with a potential supply of 2,590 megawatts (REEGLE, n.d.). Solar energy, with an average radiation of 1,635 kilowatts per hour/square meter per year, is also a viable source of renewable energy for villages that are far away from hydropower sites or lack connection to the national grid. Thus far, some small-scale solar electrification projects have been carried out, such as the Kwamala Samatu project for housing and buildings.

Climate change will likely negatively impact the country's ability to utilize clean energy. For example, certain water resources of Suriname may be altered with climate change due to less rainfall and an increase in evaporation, potentially affecting the generation of hydroelectricity in the country. Vulnerabilities also exist in the infrastructure of power generating stations on the coastline, which are prone to damage from flooding and inundation resulting from SLR and storm-induced surges (CARIBSAVE, 2012). Suriname is not an industrialized country and there are essentially no industries which are serious energy users. As a result, the country has few policies, laws, or measures in place for the mitigation of greenhouse gas emissions. As new energy demands are met by fossil fuels, there is no legal pressure for the implementation of clean energy from the business sector. Barring any economic incentives, the existing industries will likely not implement clean energy policies on their own.

CLIMATE CHANGE PROJECTS

In the Coronie District there is a pilot mangrove rehabilitation project led by a faculty member at Anton de Kom University. This project is the most cited example of a climate change-related project in Suriname but it is currently dormant. It was funded in part by the SCF. The **Environment Directorate** mentioned that an application has been sent for GEF funding to scale up the project. The CCCCC is currently doing a **Climate Risk Integrated Planning** exercise in Suriname. Suriname is also a part of a CCCCC effort to develop a regional approach to climate change risk management. Some US\$14.3 million was budgeted for preparations of Suriname's REDD+ program. There have been a number of GEF/SGP projects in Suriname, most having

an energy focus. The GEF/SGP was used to develop the national strategy for the **Small Island Developing States Community-based Adaptation Programme**. Through this initiative, Suriname participated in a special program for community-based adaptation to climate change challenges funded by the **Australian Overseas Development Aid**. The strategy was to be implemented from 2012 to 2016. No clear determination was available on its status. Suriname is also participating in the **Caribbean Disaster Management (CDM) Strategy**. The National Coordination Centre for Disaster Relief has established a presence across the country and is overseeing the development of Suriname's own **Comprehensive Disaster Management Strategy**. The **National Coordination Centre for Disaster Relief** has a partner project with the State of South Dakota on flooding. The **Environment Directorate** also has been working on a sustainable land-use planning strategy. In the past, the Dutch embassy has supported a number of environmental projects, including providing support through the UNDP to the Suriname government and the SCF to manage the Central Suriname Nature Reserve, a UNESCO Heritage Site. However, relations between the Dutch and Suriname governments are currently strained. Moving forward, the UNDP would need to be seen as a potential international development partner agency which through the GEF and its regional program has already focussed on climate change and DRR issues in Suriname.

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of Suriname. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist Suriname to correct more than a few of these legal and institutional weaknesses. This section identifies issues that are both important for Suriname to address and appropriate for USAID support and the needed actions to resolve those issues.

PRIORITY ISSUE 1: CHANGING ATTITUDES ABOUT CLIMATE CHANGE

Positive attitudinal changes regarding the environment and climate change are taking place in Suriname but it is a slow process. An encouraging sign has been Suriname's effort to better integrate itself into the Caribbean mainstream on DRR and climate change. The CCCCC credits Suriname for becoming a constructive regional partner. Suriname has proactively introduced changes, such as a disease-monitoring system in the aftermath of natural disasters that occurred in 2006 and 2008. Overall, however, there is a critical absence of technical capacity that matches with weak institutional capacity and policies with questions surrounding the government's ultimate willingness to advance the climate agenda. Therefore, it is recommended that USAID considers *supporting activities to develop awareness raising and communication strategies on climate change and vulnerability*. This could include support for the coordination and implementation of a national climate change public awareness strategy. The presence of a strong national public awareness campaign on climate change would be helpful in building a collective consensus and the process should be designed to encourage dialogue at all levels. Part of the communication strategy should be targeted at a very senior level.

A practical addition would be to support the implementation of pilot activities and targeted research to promote better understanding through visible examples demonstrating the utility of climate vulnerability reduction practices. There are questions regarding the **Climate Compatible Development Agency** and its ability to manage climate-sensitive matters. The stalling and still not enacted **Environment Framework Law** should be viewed as a cautionary tale on how internal non-environmental interests can impede the environmental agenda of Suriname.

PRIORITY ISSUE 2: MAKING CLIMATE POLICY RELEVANT

It is unclear exactly when, but in the near future, Suriname will have a national climate change policy. The Environment Directorate is currently working with support from the CCCCC to update and adopt legislation and laws to account for changing climatic circumstances. It would be both timely and expedient for USAID

to support this strategy to improve the legal framework and perhaps provide support in its enactment and demonstrate its usefulness to the general population. USAID is therefore encouraged to support efforts to ***establish a national climate change strategy with a focus on contributing to matters related to its practical implementation.***

PRIORITY ISSUE 3: ADDRESSING THE LIMITED POOL OF TECHNICAL EXPERTISE

Suriname lacks sufficient numbers of trained and experienced professionals in the various fields of management of natural ecosystems, such as foresters and marine biologists. The human resource pool is highly limited and there is little incentive available for aspiring or established professionals to work in the environmental sector as a long-term career option. Career opportunities have to be created that correspond to the needs of government departments, national organizations, and the private sector that could contribute to the climate change, and more broadly, the environmental field. For these reasons, it is recommended that USAID considers how it could contribute to ***increasing the availability of climate change expertise in the country, both in terms of numbers and permanency.***

PRIORITY ISSUE 4: IMPROVING LAND-USE PLANNING

Suriname shares the same challenges related to land-use planning that affect other Caribbean island states. The situation is most critical in the highly populated northern part of the country where industry, commerce, and housing is becoming increasingly dense in an environmentally sensitive area that is highly exposed to sea level rising. Detailed and consensus-based land-use planning exercises would be an important contribution to Suriname, as would demonstrating activity on matters such as building standards. To this end, USAID is encouraged to consider support for efforts to ***establish better land-use planning practices in Suriname.***

PRIORITY ISSUE 5: ESTABLISHING CLIMATE-RESILIENT AGRICULTURAL PRACTICES

There is a need for targeted research in many areas but focusing on agriculture practices is a good starting place for introducing how climate-related research can be beneficial. Stakeholders from small-scale producers in indigenous communities to larger agricultural operations could be targeted. If Suriname is truly working toward being a net producer of agricultural products in the region, it will have to understand how to do so in an era of increasing climatic vulnerability. USAID is therefore encouraged to contemplate ***supporting research and pilot activities in the agricultural field that promote climate change-resilient agriculture.***

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RAPID CLIMATE CHANGE VULNERABILITY ASSESSMENT

CHAPTER 11: TRINIDAD AND TOBAGO

LIST OF ACRONYMS

ECLAC	Economic Commission for Latin America and the Caribbean
EMA	Environmental Management Agency
CANARI	Caribbean Natural Resource Institute
CBO	Community-Based Organization
GDP	Gross Domestic Product
GEF SGP	Global Environmental Facility, Small Grants Programme
GHG	Greenhouse Gases
ICZM	Integrated Coastal Zone Management
IDB	Inter-American Development Bank
IMA	Institute of Marine Affairs
NAMA	Nationally Appropriate Mitigation Action
NGO	Nongovernmental Organization
PROECOSERVE	Project for Ecosystem Services
SLR	Sea Level Rise
SS	Storm Surge
TEMA	Tobago Environmental Management Agency
T&T	Trinidad and Tobago
UNDP	United Nations Development Program
USAID	United States Agency of International Development

SUMMARY

Climate change will affect Trinidad island and Tobago island differently, with Tobago being especially susceptible to loss of its coral reefs, which are important to its tourism industry and to its resilience to climate change. Nonetheless, climate change is predicted to increase Trinidad and Tobago's (T&T's) mean average annual atmospheric temperature, increase or decrease its monthly precipitation, and increase its sea surface temperature. Although the country lies outside of the Caribbean hurricane belt, an increase in the intensity of its tropical storms is expected. A 1-meter rise in sea level is predicted to affect one-third of its tourist resorts, 50 percent of its airports, and 100 percent of its ports, while a 2-meter rise in sea level is predicted to affect 63 percent of its tourism resorts. A rise in sea level of 1 meter by 2080 is predicted to cost T&T US\$1.9 billion in annual costs (e.g., additional operation and maintenance costs) and US\$8.2 billion in capital costs (e.g. repair/relocation). Rises in sea level would impose the highest costs on tourist resorts, dryland loss, and property (CARIBSAVE, 2012) (see Tables 1–3). These costs may make T&T less competitive in international tourism markets, causing its economy to create fewer well-paying jobs than otherwise would be possible. We recommend that USAID assist T&T to (1) perform targeted research on climate change vulnerability that is tied to concrete action and could subsequently lead to improved government, NGO, or private-sector capacity; (2) explore and support programming options in the area of land-use planning; (3) support activities that build on the Integrated Coastal Zone Management process; (4) work with the government of T&T to assist with its strategic orientation toward the environment, and in particular climate change vulnerability; and (5) enable the Green Fund to become a more constructive attribute for T&T.

BACKGROUND AND PURPOSE

The two islands of Trinidad and Tobago (T&T) lie off the northeastern coasts of Venezuela and south of Grenada in the Lesser Antilles. The country covers an area of 5,128 km² (1,980 mi²). The country is a Caribbean anomaly in that it is the only country with an industrial-based economy, with a strong focus on petroleum and petrochemicals development.

This report describes the vulnerabilities of T&T to climate change, identifies the priority actions which are required to increase resilience and reduce vulnerability, and recommends actions to be undertaken by the USAID Eastern Caribbean Regional Program.

PREDICTED EFFECTS OF CLIMATE CHANGE

Table 1 indicates the predicted effects on the climate of T&T from climate change.

Table 1 Predicted climatic effects of climate change in T&T

CLIMATE VARIABLES	PREDICTIONS OF CHANGE
Average Annual Temperature	Increase between 2.4°C to 3.1°C
Precipitation	Decrease of 34 mm/month to an increase of 6 mm/month
Sea Surface Temperature	Increase between 0.9°C to +3.0°C
Tropical Storms/Hurricanes	Increased intensity

Source: Simpson, et al., 2010

Projections show that trends of increasing temperature and decreasing precipitation for Tobago tend to be more extreme than for those for Trinidad. This means that higher temperature and less precipitation is anticipated for Tobago than for Trinidad. The mean annual temperature for Tobago is projected to increase by 0.7 degree Celsius to 2.6 degrees Celsius by the 2060s, and 1.1 degrees Celsius to 4.3 degrees Celsius by the 2090s. The range of projections by the 2090s under any scenario is around 1 degree Celsius to 2 degrees Celsius (Government of T&T, 2011).

Historically, T&T avoids the hurricanes that wreak havoc on other Caribbean countries, but according to the **Institute of Marine Affairs** (IMA), T&T is the Caribbean country most impacted by coastal erosion. According to the IMA, from 1994 to 2007, 20,000 square meters of coastal land were lost during this period. Another 30,000 square meters were lost from 2007 to 2011 (Hassonali, 2011). The complete biological implications of this situation have not been documented. T&T's forests are experiencing shifts in flowering and fruit-bearing times. Mango trees, for example, are being found to have three series of fruit ripening rather than a single ripening time. Furthermore, in relation to agricultural production, there are increased challenges on the horizon as saline water increasingly interfaces with inland freshwater due to sea level rise (SLR).

The conclusion of the **Economic Commission for Latin America and the Caribbean's** (ECLAC's) economic impact of climate change study was that over the long-term, root crop, fisheries, and vegetable production would suffer under both the A2 (economically focused, regional policies) and B2 (environmentally focused, regional policies) climate change global emissions scenarios (ECLAC, 2011). This will be brought on in part by increases in ambient air temperature that would result in increased aridity of soils.

According to T&T's **Water and Sewerage Authority**, there also will be growing challenges related to managing the country's water in a context of too much rain during the wet season and not enough rain in the dry season. According to the **National Policy on Climate Change** in terms of human health risks, projected increases in ambient air temperature are likely to result in the increased spread of vector insects. At the same time, predicted decreases in rainfall will affect the availability of potable water; and projected increases in sea level and precipitation intensity are likely to result in increases in the incidence of water-borne diseases. Availability of surface water is also expected to diminish. Human settlements in coastal zones and in the flood

plains are at great risks because of increasing flooding where a great deal of the country's population and economic infrastructure is located (Government of T&T, 2011).

Studies on the breeding behavior of catfish and black river conch have noted changes corresponding with changes in the rainy season. It also has been observed that black currants now have a tendency to grow early and die off rapidly. The coral reef of Tobago is said to be in serious decline, which is accelerating due to climate change. The coral reefs are relied upon to provide natural coastal protection and are of prime concern for the tourist industry. With the extent of coastal erosion taking place, the tourism sector of T&T will be challenged.

Table 2 Effects of sea level rise on land uses and infrastructure by 2080

PARAMETER (PERCENT AFFECTED)	SEA LEVEL RISE (SLR) BY 2080	
	1 M	2M
Area	1%	2%
Population	1	2
Urban Area	1	2
Wetland Area	<1	<1
Agricultural Land	3	6
Crop and Plantation	*	*
Major Tourism Resorts	33	63
Airports	50	50
Road Network	1	2
Protected Areas	0	0
Sea Turtle Nests	15	24
Power Plants	0	0
Ports	100	100

Source: Simpson, et. al., 2010

Table 2 indicates that SLR will severely damage T&T's tourism resorts, airports, and ports.

Table 3 indicates the predicted annual costs and capital costs in 2080 of a 1-meter and 2-meter rise in sea level. Annual costs capture the ongoing costs to the economy from the impact of sea level rise (SLR) damages, while the capital costs identify the rebuild/relocation costs due to the direct damage from climate change as well as the lost land-value.

Table 3 Predicted costs by 2080 due to sea level rise

VARIABLE	COSTS US\$ MILLION	
	1 M SLR	2M SLR
<i>Annual Costs</i>		
Tourism	1,835	1,512
Agriculture	13	10
Industry	35	51
TOTAL	US\$1.9 billion	US\$1.6 billion
<i>Capital Costs</i>		
Airports	119	199
Ports	80	146
Roads	5	17
Power Plants	-	-
Property	726	3,155
Tourist Resorts	1,261	4,759
Dryland Loss	5,968	10,283
Wetland Loss	-	-
TOTAL	US\$8.2 billion	US\$18.6 billion

Source: Simpson, et. al., 2010

Tourism would suffer the greatest annual and capital costs. Capital costs to airports (upon which tourism depends), ports, and dryland also would be substantial.

The predicted physical and economic effects of the potential changes in T&T's climate indicated in Tables 1, 2, and 3 would be likely to decrease the international competitiveness of its tourism industry, by raising its costs and reducing its attractiveness when compared with alternative regional and international tourist destinations. To the extent that there are fewer income opportunities in T&T over the coming decades, the potential consequences of changes in T&T's climate could disproportionately decrease the income and welfare of its youth and women.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The government of T&T has created a **Green Fund** to finance environmental restoration, conservation, and reforestation activities implemented by nongovernmental organizations (NGOs) and certain state bodies such as the **Environmental Management Agency**. Due to the complex procedures involved in applying for the **Green Fund** combined with the lack of NGO capacity to write effective proposals and demonstrate the necessary capacity to carry out planned activities, the fund has gone largely unused and grown to more than US\$500 million with very few projects implemented. The development of an **Integrated Coastal Zone Management (ICZM)** strategy is currently underway with the guidance of the **Institute of Marine Affairs**. The ICZM should create a point of reference for the development of climate-focused project activities and to identify areas for targeted research. The ICZM will invariably promote the concept of sustainable land-use planning, an area identified as a priority by stakeholders for T&T.

The initial **National Communication on Climate Change** was published in 2001. The **Second National Communication** has just been approved by the Cabinet and the government is working on preparing the final document. A process has started to apply to the GEF to facilitate the **Third National Communication** and the first **Biennial Update Report**. In 2011, T&T enacted its **National Climate Change Policy**, although there are concerns that during the development of the policy an opportunity was lost to build broader engagement on climate change. The Cabinet appointed a committee on **Integrated Coastal Management** which, among other responsibilities, is expected to develop an ICZM strategy. Expectations

are that there will be a draft strategy in April 2014. The ICZM process has heightened expectations regarding broad stakeholder engagement led by the Institute of Marine Affairs (IMA). The ICZM is expected to develop a set of realistic policies and strategies to address issues such as coastal development, public coastal access, coastal hazards/risks to climate change impacts, and improving coastal water quality. The **Department of Environment and Coastal Resources** is the main environmental agency. There is one senior climate change specialist on staff.

There are no climate change focal points in ministries such as agriculture, health, and tourism, where a greater focus on climate change is required. A movement is underway to create a **National Forestry and Protected Area Authority** that would be similar to the **Environmental Management Agency** (EMA) that has greater flexibility than T&T government ministries to undertake and support project activity. The EMA is working toward developing its own CC-related capacity. In general, there is a lot of overlap of jurisdictions between government departments and constant staff turnover as civil servants move from one agency to the next. The **Plant Protection Act** of 1975 is currently being updated as is the **Animal Pests and Diseases Act**. There is a **National Wetlands Policy** and a **Wildlife Authority** is being developed. There are a few strong NGOs such as the **Caribbean Natural Resource Institute** (CANARI), but generally speaking the sector is very weak. **The University of West Indies** has some staff members engaged in matters related to climate change, including a past Nobel Prize winner. The two islands have their respective disaster management agencies. For Tobago, it is the very well-organized and equipped **Tobago Environmental Management Agency** (TEMA) that USAID is assisting with the construction of a new building and ambulances and tractors.

CURRENT PROJECTS AFFECTING VULNERABILITY TO CLIMATE CHANGE

DEVELOPMENT AND CLEAN ENERGY PROJECTS

T&T has a robust oil and gas sector that has been cooling off a bit in recent years. In 2008, the share of the energy sector in gross domestic product (GDP) amounted to approximately 48 percent while contributing 57 percent to total government revenue. Gas and oil development occurs mostly in the southern and western parts of Trinidad (Global CCS Institute, 2012). According to the GEF-funded PROECOSERVE project, of which T&T is a pilot country, T&T is the fifth largest producer of greenhouse gases (GHG) on a per capita basis. Although this is not to suggest that GHG reduction should be the center of a climate change strategy for T&T, the situation is worth monitoring. Natural gas is the primary source of power generation (UNEP, 2013) and existing renewable energy production is minimal. A major barrier to the development of clean energy is the domestic energy subsidies which make renewable energy less competitive (UNEP, 2013). However, the Ministry of Energy and Energy Affairs (MEEA) is attempting to encourage renewable energy development in the country through the establishment of a Renewable Energy Committee (REC) in 2009, which is currently developing a Renewable Energy Policy Green Paper to provide a framework for renewable energy development in the country (CIPORE, 2013). The ministry also is developing financial support mechanisms such as tax credits and import duty exemptions, legislative support, and promoting the installation of solar panels in government buildings (MEEA, 2009). Another concrete example of government support to the clean energy sector is the solar water heating demonstration project, which aims to demonstrate the use and benefits of solar water heating to the public by installing systems in 10 host homes and conducting technical workshops for homeowners about technical and financial aspects of the system (CIPORE, 2013).

Land-use planning is a key consideration with a great deal of development taking place along the coast. The construction pertains to the housing, tourism, commercial and industrial sectors, and is evolving without any definable approach to planning. Evidence and experience show that poor planning is having a negative impact on T&T's development in regards to climate change adaptability. There is not a good understanding in the country of the role of planning standards. Professional planners in T&T see training in climate change issues for built environment professionals at the local planning level as a priority.

CLIMATE CHANGE PROJECTS

Since joining the GEF, Trinidad and Tobago has received grants totaling US\$3.8 million that leveraged an additional US\$12 million in co-financing resources for six national projects. These include two projects related to climate change. Trinidad and Tobago was a participant in **Caribbean Planning for Adaptation to Climate Change Project**, a project that terminated in the early 2000s and had supported Caribbean countries in preparing for climate change, and in particular, SLR in coastal and marine areas through vulnerability assessment and capacity building linked to adaptation planning. The second project dealt with addressing greenhouse gas emissions (GEF, 2012). Additionally, a small number of GEF/SGP projects have also touched on climate change. T&T is part of the **Caribbean Regional Fisheries Mechanism** that is examining the impact of climate change on the Caribbean fisheries. The **University of Waterloo** from Ontario, Canada, has initiated a project in Southwest Tobago to undertake a community-based assessment on tourism and fisheries to see what climate change-related changes local people have noticed.

The NGO **CANARI** has considerable experience building consensus/awareness surrounding climate change, including its work in the Caurayk community implementing a project to build resilience to the impacts of climate change through activities such as developing community action plans. Another NGO, Environment Tobago, is attempting to launch a large-scale adaptation project in the north of Tobago. A **Nationally Appropriate Mitigation Action** (NAMA) concept for T&T is being overseen by the UNDP. It was initiated toward the end of 2012. There are a small number of mangrove restoration projects on the island. One of the better known projects is the **Nariva Swamp Restoration and Carbon Sequestration Project** managed by the **University of West Indies** that aims to sequester CO₂ through forest restoration in areas destroyed by illegal agriculture and to enhance biodiversity in a coastal wetland by restoring freshwater swamp forest. The project is funded by the **International Bank for Reconstruction and Development** as trustees for the **Biocarbon Fund**. On paper, the government of T&T has fully committed to renewable energy through the **Renewable Energy Policy Framework**. In reality, little progress has been made in pushing the agenda forward. At the same time, the **Green Fund** presents a great opportunity for funding community-level initiatives, but in reality very few organizations are able to secure funding through the fund. There is an effort to coordinate the **UNDP GEF** project in Trinidad along with the **Civil Society Board** to build the capacity of local organizations in proposal writing, program design and implementation. The **Inter-American Development Bank** (IDB) has provided a grant to T&T to assist with the integration of climate change into national policies and institutions. The grant program is titled “**Mainstreaming of Climate Change into National Development and Capacity Building for Participation in Carbon Markets.**”

PRIORITY ISSUES, NEEDED ACTIONS, AND RECOMMENDATIONS TO USAID

The data collected from interviews, focus groups, documents, and observations indicate a range of weaknesses in the institutional and legal capacity of Trinidad and Tobago. To reduce country vulnerability and successfully adapt to climate change, these weaknesses need to be addressed. USAID lacks sufficient resources to assist T&T to correct more than a few of these legal and institutional weaknesses. This section, therefore, identifies issues that are both important for T&T to address and appropriate for USAID to support and needed actions to resolve those issues.

While it is accepted that climate change poses a challenge to T&T, key ministries such as Agriculture and Forestry, where there are clear climate change implications on their respective mandates, operate without proper research capability and focused scientific information. Government department heads are unable to refer to sector-specific research examining how climate change is impacting their sphere of responsibility. There is no applied research on food production and climate change, yet it was acknowledged that there are food crops in T&T that are being impacted. There are also knowledge gaps regarding climate change and its role in coastal erosion, although priority areas for research on this topic should be clarified by the spring of 2014 when the ICZM strategy process should conclude. It is possible that more information and data is

available but a lack of coordination between ministries compounded by inter-agency competition impedes the sharing and building of a strong knowledge and information base. While better and more abundant research is desired, there is a fear that current attitudes and practices within government would make it difficult to truly benefit from the information.

PRIORITY ISSUE 1: ADVANCING THE CLIMATE CHANGE AGENDA

A nucleus of research initiatives, policy, technical capacity, and public awareness and practical experience has to be developed and carried out to ensure T&T will have a chance to deal effectively with climate change. T&T is considered by some experts as the Caribbean country with the least amount of climate change adaptation activity and capacity. This may not be completely true, but given the size and the relative wealth of the country, the situation can and should be addressed. **To this end, greater active engagement should be encouraged at all levels to directly reduce vulnerability.** A starting point would be to support targeted research to reduce climate vulnerability that is tied to concrete action and could subsequently lead to improved government, NGO, or private-sector capacity. This could include efforts that lead to protecting species at risk, minimizing threats to the tourist trade, introducing innovation in the agriculture sector, and approaches to combating soil erosion.

PRIORITY ISSUE 2: ESTABLISHING VISIBLE AND PRACTICAL APPROACHES TO LAND-USE PLANNING

Special attention has to be directed to the issue of land-use planning. Updating building and zoning standards to make them climate compatible is one area where assistance would be particularly useful. Interventions in land-use planning would be especially beneficial if they could be implemented in such a way as to engage a broad range of stakeholders to increase awareness and understanding. In a country with highly mixed areas of industry and commercial zones, tourist attractions, and housing, the climate vulnerability issue requires multi-disciplinary and careful attention. On this note, USAID is encouraged to ***explore and support programming options in the area of land-use planning.***

PRIORITY ISSUE 3: BUILDING ON THE MOMENTUM AND CAPACITY DEVELOPED THROUGH THE ICZM PROCESS

The process related to establishing the ICZM framework with its emphasis on broad stakeholder engagement should establish an important platform for subsequently developing and implementing climate resiliency-related activity. The ICZM, along with the Second Nation Communication on Climate Change, should help to define a direction for future technical assistance. As T&T coastal areas are sustaining considerable damage, the ICZM process should afford USAID an opportunity to make a highly strategic intervention. For this reason, USAID is encouraged to contemplate ***support for activities that build on the ICZM process.***

PRIORITY ISSUE 4: HARNESSING TRINIDAD AND TOBAGO'S INHERENT CAPACITY

There are attitudinal issues that have to be addressed, but it also has to be recognized that this is a country that, through the University of West Indies, graduates close to 200 professionals in environment-related fields per year, and who for the most part are unable to find work in their chosen field. This speaks to a professional interest in the area of the environment that is not being properly accounted for. At the same time, the Green Fund is as clear a sign that T&T can devote resources to addressing climate change. At a strategic level there is a need for T&T to better make connections between its needs and unsaddled capacity. It is recommended that USAID works with the government of T&T to ***assist with its strategic orientation toward the environment and, in particular, climate change vulnerability.***

PRIORITY ISSUE 5: MAKING THE GREEN FUND A CONSTRUCTIVE FORCE FOR THE ENVIRONMENT

An important consideration in terms of strategic planning is the Green Fund and as such, is deserving of special attention. The Green Fund is a tool with enormous potential to support activities to make improvements on a number of environmental fronts, including reducing climate change vulnerability. However, according to the fund's managers, only four organizations are in a position to write and carry out

successful proposals to the fund. One of these organizations is the EMA. The problems of the fund appear to be both administrative and philosophical in nature, in that there is no clear consensus and support for the fund as it was intended. It is recommended that USAID works with T&T to ***provide focused technical support and guidance to enable the Green Fund to become a more constructive attribute for T&T.*** A worthwhile priority would be to develop CBO and NGO capacity to develop project proposals for the Green Fund that they would subsequently be capable of implementing. This could also take place in a broader discussion regarding how to support efforts to develop and create opportunities for the human resource capacity (i.e., West Indies environment graduates) in relation to the environment and climate change. It also may be prudent to consider working with the government of T&T to introduce a strong governance model in support of the Green Fund.

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