

CARIBSAVE Climate Change Risk Profile for Anguilla



Summary Document

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THE CARIBSAVE CLIMATE CHANGE RISK ATLAS (CCCRA)

A practical evidence-based approach to building resilience and capacity to address the challenges of climate change in the Caribbean

Climate change is a serious and substantial threat to the economies of Caribbean nations, the livelihoods of communities and the environments and infrastructure across the region. The CARIBSAVE Climate Change Risk Atlas (CCCRA) Phase I, funded by UKaid from the Department for International Development (DFID/UKaid) and the Australian Agency for International Development (AusAID), was conducted from 2009 – 2011 and successfully used evidence-based, inter-sectoral approaches to examine climate change risks, vulnerabilities and adaptive capacities; and develop pragmatic response strategies to reduce vulnerability and enhance resilience in 15 countries across the Caribbean (*Anguilla, Antigua & Barbuda, The Bahamas, Barbados, Belize, Dominica, The Dominican Republic, Grenada, Jamaica, Nevis, Saint Lucia, St. Kitts, St. Vincent & the Grenadines, Suriname and the Turks & Caicos Islands*).

The CCCRA provides robust and meaningful new work in the key sectors and focal areas of: Community Livelihoods, Gender, Poverty and Development; Agriculture and Food security; Energy; Water Quality and Availability; Sea Level Rise and Storm Surge Impacts on Coastal Infrastructure and Settlements; Comprehensive Disaster Management; Human Health; and Marine and Terrestrial Biodiversity and Fisheries. This work was conducted through the lens of the tourism sector; the most significant socio-economic sector to the livelihoods, national economies and environments of the Caribbean and its people.

SELECTED POLICY POINTS

- Regional Climate Models, downscaled to national level in the Risk Atlas, have provided projections for Caribbean SIDS and coastal states with enough confidence to support decision-making for immediate adaptive action.
- Planned adaptation must be an absolute priority. New science and observations should be incorporated into existing sustainable development efforts.
- Economic investment and livelihoods, particularly those related to tourism, in the coastal zone of Caribbean countries are at risk from sea level rise and storm surge impacts. These risks can encourage innovative alternatives to the way of doing business and mainstreaming of disaster risk reduction across many areas of policy and practice.
- Climate change adaptation will come at a cost but the financial and human costs of inaction will be much greater.
- Tourism is the main economic driver in the Caribbean. Primary and secondary climate change impacts on this sector must both be considered seriously. Climate change is affecting related sectors such as health, agriculture, biodiversity and water resources that in turn impact on tourism resources and revenue in ways that are comparable to direct impacts on tourism alone.
- Continued learning is a necessary part of adaptation and building resilience and capacity. There are many areas in which action can and must be taken immediately.
- Learning from past experiences and applying new knowledge is essential in order to avoid maladaptation and further losses.

OVERVIEW OF CLIMATE CHANGE ISSUES IN ANGUILLA

Anguilla is already experiencing some of the effects of climate variability and change. According to the Government of Anguilla, the major issues of climate change are sea level rise (SLR) and the likelihood of more intense weather systems and periods of drought.

Detailed climate modelling projections for Anguilla predict:

- an increase in average atmospheric temperature;
- reduced average annual rainfall;
- increased Sea Surface Temperatures (SST); and
- the potential for an increase in the intensity of tropical storms.

And the extent of such changes is expected to be worse than what is being experienced now.

To capture local experiences and observations; and to determine the risks to coastal properties and infrastructure, selected sites were extensively assessed. Primary data were collected and analysed to:

1. assess the vulnerability of the livelihoods of community residents in **Sandy Ground** to climate change; and
2. project sea level rise and storm surge impacts on **Cove Bay, Rendezvous Bay, Sandy Ground** and **Island Harbour**.

The sites were selected by national stakeholders and represent areas of the country which are important to the tourism sector and the economy as a whole, and are already experiencing adverse impacts from climate-related events.

Vulnerable community livelihoods

- Tourism infrastructure dominates Sandy Ground which is low-lying and prone to flooding when the salt pond breaches.
- There is only one main access road into and out of the area.
- Hurricanes are the main concern for residents
- Since 1995, increases in the number of storms and hurricanes and their intensity have been reported, most of these occurring within the 16 year period between 1995 and 2010.
- Most of Sandy Ground's resident are older and tend not to heed evacuation warnings.

Vulnerable coastlines

- A series of tropical storms in the 1990s severely reduced many of Anguilla's beaches.
- 1 m SLR places 63% of the major tourism properties at risk; increasing to 70% under a 2 m SLR scenario.
- 0.5 m SLR places 11% of Sandy Ground's beach at risk; increasing to 48% under a 1 m scenario.
- Changes in the coastal profile due to extensive beach loss would transform coastal tourism in Anguilla, with implications for property values, insurance costs, destination competitiveness.

Climate change effects are evident in the decline of some coastal tourism resources, but also in the socioeconomic sectors which support tourism, such as agriculture, water resources, health and biodiversity.

CLIMATE CHANGE PROJECTIONS FOR ANGUILLA

The projections of *temperature, precipitation, sea surface temperatures; and tropical storms and hurricanes* for Anguilla are indicated in Box 1 and have been used in making expert judgements on the impacts on various socio-economic sectors and natural systems, and their further implications for the tourism industry.

Stakeholders consulted in the CCCRA have shared their experiences and understanding about climate-related events, and this was generally consistent with observational data.

Box 1: Climate Modelling Projections for Anguilla

Temperature: Regional Climate Model (RCM) projections indicate increases between 2.4°C and 3.1°C in mean annual temperatures by the 2080s, in the higher emissions scenario.

Precipitation: General Circulation Model (GCM) projections of rainfall span both overall increases and decreases, ranging from -34 to +13 mm per month by 2080 under the scenario with slow economic growth and technological change. Most projections tend toward decreases. The RCM projections, driven by HadCM3 boundary conditions, indicate large decrease in annual rainfall (-11%) when compared to simulations based on ECHAM4 (-1%).

Sea Surface Temperatures (SST): GCM projections indicate increases in SST throughout the year. Projected increases range from +0.7°C and +2.7°C by the 2080s across all three emissions scenarios.

Tropical Storms and Hurricanes: North Atlantic hurricanes and tropical storms appear to have increased in intensity over the last 30 years. Observed and projected increases in SSTs indicate potential for continuing increases in hurricane activity, and model projections indicate that this may occur through increases in intensity of events but not necessarily through increases in frequency of storms.

SEA LEVEL RISE AND STORM SURGE IMPACTS ON COASTAL INFRASTRUCTURE AND SETTLEMENTS



Figure 1: Erosion at Rendezvous Bay (Anguilla)

The majority of infrastructure and settlements in Anguilla, including government, health, commercial and transportation facilities, are located on or near the coast and these areas already face pressure from natural forces (wind, waves, tides and currents), and human activities, (beach sand removal and inappropriate construction of shoreline structures). The impacts of climate change, in particular SLR, will magnify these pressures and accelerate coastal erosion.

The CARIBSAVE Partnership coordinated a field research team with members from the University of Waterloo (Canada) and the staff from the Anguilla Ministry of Finance, Economic Development, Investments and Commerce to complete detailed coastal profile surveying.

To evaluate the vulnerability of beaches and coastal infrastructure to SLR and storm surge, Cove Bay, Rendezvous Bay, Sandy Ground and Island Harbour were surveyed. Additionally, 1 m and 2 m SLR scenarios and beach erosion scenarios of 50 m and 100 m were calculated to assess the potential risks to major tourism resources.

Results of these surveys indicate that 1 m SLR places 63% of the major tourism properties at risk; increasing to 70% under a 2 m SLR scenario (See Table 1).



Figure 2: High Resolution Coastal Profile Surveying with GPS

Table 1: Impacts associated with 1 m and 2 m SLR in Anguilla

| | | Tourism Attractions | | Transportation Infrastructure | |
|-----|------|-----------------------|--------------------------|-------------------------------|------------|
| | | Major Tourism Resorts | Sea Turtle Nesting Sites | Major Road Networks | Port Lands |
| SLR | 1.0m | 63% | 31% | 28% | 100% |
| | 2.0m | 70% | 43% | 30% | - |

It is important to note that the critical beach assets would be affected much earlier than the SLR induced erosion damages to tourism infrastructure. Such changes in the coastal profile would transform coastal tourism in Anguilla, with implications for property values, insurance costs, destination competitiveness, marketing and wider issues of local employment and economic well-being of thousands of employees. Moreover, the beaches themselves are critical assets for tourism in Anguilla, with a large proportion of beaches being lost to inundation and accelerated erosion even before resort infrastructure is damaged.

Table 2 highlights the beach area losses for four resorts in Anguilla: Cove Bay/Merry Wing, Island Harbour, Sandy Ground and Rendezvous Bay. With a 0.5 m SLR, over 60% of the highly valued beach resource at Cove Bay/Merry Wing would be inundated. With a 1 m sea level rise, all study sites would be more than 48% inundated. With a 2 m SLR all but Sandy Ground would become completely inundated, with all beach areas lost with a 3 m SLR. The response of tourists to such a diminished beach area remains an important question for future research; however local tourism operators perceive that these beach areas along with the prevailing climate are the island's main tourism attractions.

Table 2: Beach Area Losses at Four Major Resort and Tourism Areas in Anguilla

| | Cove Bay/ Merry Wing | | Island Harbour | | Sandy Ground | | Rendezvous Bay | |
|--------------|--|----------------------------|--|----------------------------|--|----------------------------|--|----------------------------|
| SLR Scenario | Beach Area Lost To SLR (m ²) | Beach Area Lost To SLR (%) | Beach Area Lost To SLR (m ²) | Beach Area Lost To SLR (%) | Beach Area Lost To SLR (m ²) | Beach Area Lost To SLR (%) | Beach Area Lost To SLR (m ²) | Beach Area Lost To SLR (%) |
| 0.5m | 27381 | 60% | 1130 | 21% | 2755 | 11% | 20780 | 46% |
| 1.0m | 12177 | 87% | 1650 | 53% | 9392 | 48% | 10036 | 68% |
| 2.0m | 6022 | 100% | 2487 | 100% | 11692 | 93% | 14594 | 100% |
| 3.0m | 109 | 100% | - | - | 1675 | 100% | 26 | 100% |

Figure 3 and

Figure 4 clearly illustrate that the longer term erosion response of the shoreline to a 1 m sea level rise would have significant implications for the shoreline and the loss of a total of high value properties.

Anguilla: Land Loss From Sea Level Rise Sandyground

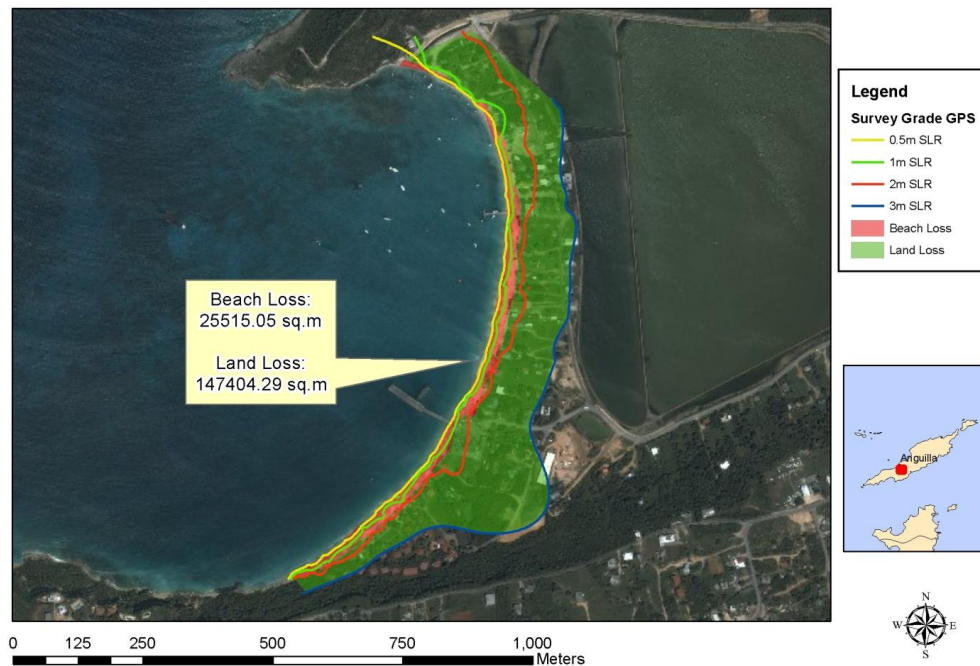


Figure 3: Total Land Loss, Sandy Ground, Anguilla

Anguilla: Land Loss From Sea Level Rise Island Harbour

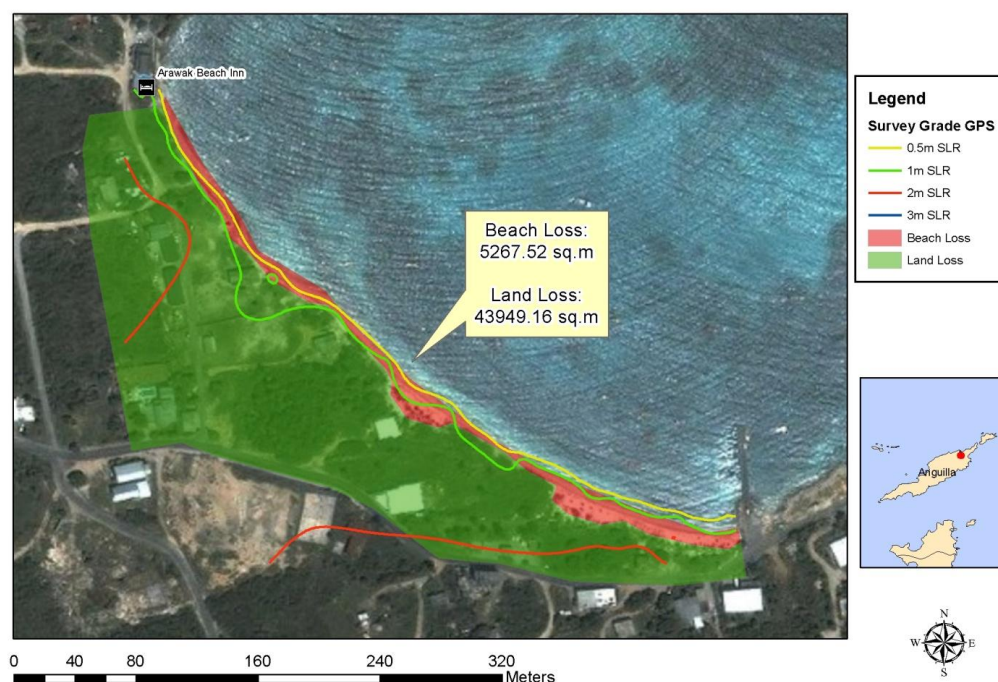


Figure 4: Sea Level Rise Vulnerability in Island Harbour, Anguilla

The high resolution imagery provided by the techniques utilised in this project component is essential to assess the vulnerability of infrastructure and settlements to future SLR but its ability to identify individual properties also makes it a very powerful risk communication tool. Having this information available for community / resort level dialogue on potential adaptation strategies is highly valuable.

Given the historical damage caused by event driven coastal erosion, as well as slow-onset SLR, the need to design and implement better strategies for mitigating their impacts is becoming apparent. There are a number of solutions that can be used to tackle beach erosion. Hard engineering structures such as levees and sea walls can be used to protect the land and related infrastructure from the sea. This is done to ensure that existing land uses, such as tourism, continue to operate despite changes in the surface level of the sea. Unfortunately, this approach may be expensive and provides no guarantee of equivalent protection following extreme events. Adaptation options should be implemented in the framework of integrated coastal zone management (ICZM) and all decisions need to take into account the broad range of stakeholders involved in decision-making in the coastal zone. Interventions should also benefit coastlines in light of both climate and non-climate stresses.

Tourism in Anguilla is clearly highly dependent on the attractiveness of the natural coastal environment, which has been shown to be vulnerable to SLR. More detailed analysis of the impacts of SLR for major tourism resorts, critical beach assets and supporting infrastructure (e.g. transportation) is needed to accurately assess the implications for inundation and erosion protection. A necessary part of this evaluation is to identify the land that can be used for tourism infrastructure and future development under a managed retreat response to SLR.

All levels of government and administration in Anguilla need to embark on a coordinated communication campaign to inform and raise awareness of SLR impacts and costs for decision makers within the tourism sector including operators, investors, planners, developers, policy makers, architects and communities.

COMMUNITY LIVELIHOODS, GENDER, POVERTY AND DEVELOPMENT

More than 50 residents and workers from Sandy Ground participated in our research which included vulnerability mapping, focus-groups and household surveys which were developed according to a sustainable livelihoods framework. This provided an understanding of: how the main tourism-related activities, including fishing and other micro- and medium-sized commercial activities located along the coast and have been affected by climate-related events; the community's adaptive capacity and the complex factors that influence their livelihood choices; and the differences in the vulnerability of men and women.

Unlike most other communities which participated in CARIBSAVE's research, poverty is not easily identified in the area. However, the climate-related issues experienced here are similar to those in other coastal communities around Anguilla and the region.

Community Characteristics and Experiences

Sandy Ground's main features include:

- It serves as the main port for the island allowing for trade, and was once a major constituent of the former salt production and export industry.
- It is currently dominated by tourism infrastructure, with a large concentration of bars, restaurants, and accommodation facilities (hotels and guesthouses)

- Large summer festivities are hosted yearly in the area, including boat racing activities and beach parties, and the popular August Day carnival – a national celebration.
- There are also some historic sites in Sandy Ground, including the Pump House (bar), the White House and an archaeological site. Other livelihood activities in Sandy Ground include snorkelling and dive operations, sailing and charter boat operations and a sailing school.
- It provides many tourism attractions which employ many of its residents such as:
 - Diving excursions to the offshore islands – Sandy Island, Prickly Pear and Dog Island (within the national marine park system)
 - Sailing and sport-fishing



Figure 5: The beautiful but vulnerable Sandy Ground in Anguilla

The diversity of infrastructure, business and activities that take place in Sandy Ground makes it a site of socio-economic, cultural and historic significance. As such, the good health and vibrant state of natural (especially coastal and marine) resources are crucial for the sustainability of the tourism-dependent businesses in Sandy Ground.

As in other communities studied, climate variability and change have already impacted natural resources. Community members have been observing changes which they have attributed to climate change such as:

- higher day-time temperatures – reportedly sometimes “unbearable”;
- an increase in the number of mosquitoes;
- increased beach erosion in Road Bay; and
- the experience of both temperature extremes in the night (very hot and very cold).

However, unlike observations in other communities, there was no marked difference in rainfall patterns. This is consistent with observed data for rainfall over the period 1960-2006.

Other concerns included the deterioration of coral reefs which is partially blamed on marine vessels since they discharge waste in the marine environment in Sandy Ground but reefs are also damaged by the passage of storms and hurricanes.

However, the main climate-related concern of Sandy Ground residents is that of hurricanes. Before Hurricane Luis in 1995, the last major hurricane to impact Anguilla was in 1960, and as a result Anguillans were relatively unprepared for the 1995 event. The accompanying winds, rough seas and most significantly, heavy rainfall caused severe damage in Anguilla generally, but especially in the Sandy Ground area where approximately 10 properties were completely destroyed, including a few homes, one beach bar and restaurant. The destruction of the restaurant resulted in the temporary disruption of services and revenue generation, however, business operations resumed shortly after as an outdoor enterprise until the new structure was rebuilt.

Since 1995, increases in the number of storms and hurricanes and their intensity have been reported by community members, most of these occurring within the 16 year period between 1995 and 2010. Hurricane Lenny in 1999 severely impacted houses on the sediment bar from storm surge and flooding, and roads were blocked temporarily. The sediment bar itself was breached during past hurricanes by the Road Salt Pond, and the force of the water flowing from the pond to the sea caused significant damage to houses that were built on the bar.

Prior to the period of heavy storm activity, pre-fabricated houses had become very popular in Anguilla, but these structures, especially the roofs, were found to be very vulnerable to damage from even the weakest storms. Since then, the building code has been more strictly enforced and it would appear that the compliance has helped to reduce some impacts, such that recent systems passing within the last decade have caused less severe damage to buildings. Damage mainly consisted of flooding damage and loss of trees (fruit trees, palm trees on beaches) and other vegetation. The lessons learnt from the impact of stronger hurricanes have therefore contributed to resilience building at the household level in Sandy Ground, but key vulnerabilities remain.

Characteristics of the Sandy Ground area that make it peculiarly vulnerable include its relatively large aging population and the fact that there is only one main access road for vehicles into and out of the community. When this was blocked in previous storms it resulted in some persons being unable to travel to and from the community for work or for personal errands. There are undeveloped pathways, but these can only be traversed by foot. This singular roadway has implications for access of emergency vehicles if needed and even though there has been a call to develop a second access path to and from the community, this path has not been completed.

Even though gender inequality is not deemed to be an issue within the community, some roles are clearly dominated by either men or women:

- Women are more vocal and visible on issues of social and community development and protection. This may stem from their traditional roles as caretakers of the family in general, but mainly of dependent householders (children, the elderly).
- Men tend to be less vocal on social issues but there are few that were identified as having particularly strong personalities and were advocates for certain community development issues.
- Male headed households had higher rates of asset ownership than female headed households; but there was little disparity in the use of natural assets, where only a slightly larger proportion of male respondents are more dependent on natural resources than female respondents.
- In the event of a disaster, men attend to more manual tasks, such as affixing shutters, and ensuring that the roof is as secured as possible, whereas women stock up on essential supplies (e.g. foodstuff, medication, water, batteries).

There is, however, a strong culture of independence amongst women in the community which transcended from previous times when many men left the country to work overseas (e.g. the Dominican Republic). As a result, women believe that they are capable of fending for themselves in hurricane events.

Residents are aware of the dangers they face from living in the area, and during the approach of severe weather, they are normally advised to evacuate. However, since Sandy Ground is home to an older demographic, most residents tend not to heed evacuation warnings and prefer to stay with their property and loved ones regardless of the outcome. This clearly poses a significant risk to them in the event of a major hurricane, and can potentially (and unnecessarily) place additional burden on emergency response and recovery resources during and after the event.

Generally, residents in Sandy Ground are able to manage the low to moderate climate-related impacts but even with little damage to property, Sandy Ground residents face other challenges to restore their livelihood activities.

- In the aftermath of hurricanes or storms, utility services often take a long time to be restored in the area.
- The Road Salt Pond becomes a concern during heavy, continuous rainfall, as this will likely result in some localised flooding.

To alleviate some of these challenges, a monitoring system for water levels in the pond including an Early Warning System and Zoning Plan would be of benefit to residents to alert them of possible breaching and areas of inundation. As the pond water rises, warnings of increasing scale/rank would be issued so that the community is aware of any precautions that need to be taken.

A strong mooring is needed for the resident Police emergency vessel which is currently harboured in St. Martin during storms and is therefore not available to the community at critical times. This department should also own a dinghy (which they do not currently have) that would allow for easier and faster response times in some cases. Regular fishing vessels also require moorings to be used at night and during storms.

Given the demographic profile of Sandy Ground, it is important to identify opportunities for, and encourage younger persons to engage in, community level disaster mitigation activities. Such a programme can be implemented through collaboration between the District Disaster body and the Community (through a community-based and –run disaster management group or council) and should include a multi-hazard warning system within the community.

AGRICULTURE AND FOOD SECURITY

Anguilla has invested very few of its thirty-five square miles towards organised agriculture such that it contributes only 2.4% to the national economy. However, over the past few years the Government of Anguilla has made plots of Crown Land in the Valley and Wallblake available for the cultivation of fruits, vegetables, and crops such as corn and pigeon peas through the use of traditional and modern methods.

As expected, the food import bill for Anguilla is exceptionally high but there are opportunities for reducing this. For example, the Anguilla Statistics Department reports that in 2010, Anguilla imported 99 tonnes (99,000 kg) of tomatoes and local farmers produced approximately 15 tonnes. Local consumption of tomatoes is about 114 tonnes per annum and with over 637 acres of arable land available in Anguilla, production potential for tomatoes and other staple foods is promising if even half of this acreage is used.

Table 3: Value of Selected Food Imports to Anguilla 2005 – 2008 (EC \$ 000)ⁱ

| Items | 2005 | 2006 | 2007 | 2008 |
|---------------------------------|--------|--------|-------|-------|
| Poultry | 3,676 | 3,723 | 4,728 | 5,424 |
| Other meat | 4,190 | 4,675 | 5,375 | 5,320 |
| Fish | 3,088 | 3,815 | 4,332 | 4,307 |
| Dairy | 4,474 | 5,059 | 6,319 | 5,974 |
| Eggs and egg substitutes | 170 | 245 | 388 | 505 |
| Vegetables | 4,829 | 5,610 | 6,452 | 5,686 |
| Fruits and nuts | 3,426 | 4,099 | 4,444 | 3,486 |
| Coffee. Tea | 388 | 396 | 423 | 450 |
| Rice | 602 | 695 | 992 | 1,356 |
| Flour | 704 | 809 | 949 | 1,444 |
| Oils and fats | 891 | 1,148 | 1,226 | 1,392 |
| Margarine | 661 | 432 | 502 | 645 |
| Sugar | 17,138 | 12,624 | 623 | 540 |
| Water | 2,305 | 3,103 | 4,328 | 4,377 |

(Source: Anguilla Statistical Department, 2010)

According to the Labour Force Survey, only 2% of the working population is employed within the agriculture and fisheries sector and this figure includes no women. However, in recent years, young persons have been slowly moving into the sector recognising that there are potentially lucrative markets which can be acquired with commitment, new technology and hard work. CalTel Farms and Island Greens are two such examples of Anguillan enterprises that are owned and managed by young men.

The main factor influencing food security in Anguilla is the poor quality of land resources available for facilitating widespread agriculture. Local arable soils in Anguilla are heavily degraded, infertile, low in organic matter, and have the potential to become unstable. Poor agricultural land management practices have also accelerated the degradation of arable soils which are reportedly sold as top soil for use in developmental projects. In terms of social vulnerability, the scarcity of agricultural communities in Anguilla is itself a threat to agriculture and food security. Farmers are economically vulnerable from the point of view that they do not have access to funding for agro-technologies that would increase production and adaptive capacity to climate change. In response to these challenges, the Agricultural Department has been helping farmers in the use of organic methods through the Soils Amelioration Project to enhance their agriculture production efficiency, build their capacity to apply agriculturally sustainable practices, and create a sector that is more resilient to the constantly fluctuating weather patterns.

Other vulnerabilities are exposed through climate-related events. Hurricane Luis, a category 4 system, hit the island in 1995 and damages to the agriculture sector at that time were estimated to be US \$98,000 in physical infrastructure; US \$30,000 for direct losses to crops; and US \$5,000 for indirect production losses. Full recovery of Anguilla's pre-disaster size and production levels took approximately two growing seasons with clear adverse economic impacts for farmers and the economy as a whole.

Policymakers for agriculture in Anguilla should be prepared to take a more proactive role in the development of climate change legislation for the implementation of adaptation projects that address the impacts of climate change. The industry should seek to increase local production of staple foods such as cassava, sweet and Irish potatoes and yams using cultivars that meet the challenges of the changing climate. The Anguilla Department of Agriculture should work with the established farmers' associations to:

- revive lands that are currently fallow and put them back into cultivation using new agro-technology as a follow-on to the Soil Amelioration Project;

- develop a local 'eat what you grow project' featuring staple foods and other produce;
- introduce grow-box projects into primary and secondary schools' programmes as part of extra-curricular activities or within integrated science courses; and
- organise farmers in the communities where they are scattered; coordinate planting and harvesting of produce for the land that is brought back into production; provide guidelines on standards and use of appropriate technology etc; and provide a centralised location for trade between farmers and local consumers.

The expected results are improved capacity of local farmers to grow climate resilient crops, increased participation of youth in agriculture, and more support and use of locally produced food.

ENERGY AND TOURISM

Tourism is an increasingly significant energy consumer and emitter of greenhouse gases (GHG) both globally and in the Caribbean. Anguilla is emitting 4.0 t CO₂ per capita, which is very close to the global annual average of 4.3 t CO₂ per capita. This high emissions rate results from a small local population and the fact that current tourism related energy use and associated emissions are estimated to be the equivalent of 76% of 'official' national emissions. Specific emissions and energy consumption come from aviation (41%), accommodation (22%) and cruise ships (20%), with lifecycle emissions accounting for 15% of overall emissions.

Anguilla currently produces its electricity with imported diesel fuel, from one central generating plant owned and run by ANGLEC. The National Energy Policy for 2008-2020 guides energy production and promotes the use of incentives and taxation to encourage energy efficiency, investment in renewable energy, purchase of efficient appliances and efficient vehicles. A related policy, the National Climate Change Policy, recommends diversifying the tourism product to promote low carbon, energy efficient and environmentally friendly development and developing a financing mechanism to facilitate that transition. These types of adaptation and mitigation initiatives will be central to Anguilla's efforts for sustainable development as a country and as a major tourism destination in the vulnerable Caribbean region. This will also become more as visitor preferences may evolve to favour low-carbon destinations.

Available statistics for electricity production show considerable growth in electricity generation and fuel consumption (see Table 4). It is unclear, how trends will develop given that tourism investments have been halted or delayed because of the global financial crisis in 2008. No further information could be found on bunker fuels, gasoline, or emissions of greenhouse gases.

Table 4: Growth trends in energy consumption in Anguilla, 2001-2009

| Year | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|-------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Gross generation (MWh) | 53,000 | 55,000 | 58,000 | 62,032 | 72,041 | 79,507 | 88,999 | 89,502 | 91,223 |
| Net generation (MWh) | | | | 55,755 | 63,601 | 70,561 | 78,854 | 78,934 | 79,918 |
| Fuel used (thousand IG) | 2,900 | 3,100 | 3,300 | 3,500 | 4,233 | 4,399 | 4,830 | 4,872 | 4,839 |

(Source: ANGLEC, 2006; ANGLEC, 2010)

The Government of Anguilla identifies its dependence on fossil fuels as a threat to its economy with the growing number of vehicles and imports of consumer goods, as well as the production of fresh water, being key issues in energy management. Wind and solar power are to be developed to reduce the island's dependence on fossil fuels in the short term and to achieve energy independence in the long term. Overall, the Government seeks to promote Anguilla as a "worldwide leader in environmental responsibility, to the benefit of local pride and competitiveness in the tourist industry, and as a model of these values among other island communities and beyond". The Government underlines its belief that its energy policy will help the island gain promotional advantage, and thus be beneficial for tourism.

Potential impacts of climate change on the energy sector include direct impacts: which affect energy resource availability, fuel and power production, transmission and distribution processes; and indirect impacts which are brought on by other sectors through forward or reverse linkages with the energy sector, and may include competition for shared resources, trends in demand and supply and pricing. These impacts are not only limited to traditional (fossil fuel based) energy systems, but renewable systems as well. While direct impacts are more visible, the costs of indirect impacts can be difficult to quantify and often exceed those of direct impacts, given the inter-relationships between energy and other sectors.

An increase in the intensity (and possibly frequency) of severe low pressure systems, such as hurricanes, has the potential to affect both traditional and renewable energy production and distribution infrastructure, including generating plants, transmission lines, and pipelines. Some of the more vulnerable components of the energy system include transmission lines, poles and other relatively light, above ground infrastructure, which can suffer significant damage from high winds. In 2008, Hurricane Omar affected both the power station and the transmission and distribution system with the switchboard at the power station out of service for 12 hours due to rainwater penetration.

In the aftermath of extreme weather, the process of restoring transmission and proper operation of generating facilities depends on road access and the amount of supplies available to replace infrastructure components that have been damaged or destroyed. The vulnerability of the sector to extreme weather events therefore has even greater implications for increasing the recovery period and extending the loss of productivity in all other sectors within the country following an event.

Model projections for Anguilla suggest an increase in mean annual temperatures, as well as the number of 'hot' days and nights to as much as 95% of the days per year by 2080, and a possible disappearance of 'cold' nights. National energy demand and consumption for heating and cooling purposes may increase in response to extremes in diurnal temperatures.

Adaptation and mitigation options in this sector are clearly outlined in the National Energy Policy and as such, are recommended here. In order to develop the renewable energy sector the Policy identifies the need for establishing and updating legislation and regulations for promoting energy efficiency and utilisation of renewable energy as well as implementing appropriate pricing policies to ensure that adequate energy supplies are delivered to all economic sectors efficiently. The use of incentives to encourage private sector investments in renewable energy technologies and the promotion of renewable energy through the educational system and public awareness campaigns are also considered to be important strategies. It is also recommended that the feasibility of blending fossil fuels with bio-fuels for electricity generation should be assessed to reduce consumption of fossil fuels. However, there are notably no specific policy recommendations for cruise ship or air transportation, two of the largest contributors to emissions and energy consumption in the tourism sector.

There are additional policy recommendations regarding the administration and promotion of the energy independence campaign and accessing international financing sources through the carbon credit market. An important component of the former is developing a 'brand' for the awareness campaign based on an analysis of all stakeholder groups requirements; creating a network among civic, church, educational, and community groups to gain input, support, and participation in the Plan and its implementation; and coordinate efforts with the Anguilla Tourist Board and the Anguilla Hotel and Tourism Association toward marketing and educating tourists about Anguilla's Energy Independence Plan.

The impacts of climate change energy systems will vary. However, an assessment of the vulnerability of Anguilla's systems should be prioritised, especially in the case of renewable energy sources that are being planned and which depend on specific climate parameters and priority coastal infrastructure such as power plants.

WATER QUALITY AND AVAILABILITY

Freshwater resources in Anguilla exist only subterranean, below which is located denser layers of salt water. As a consequence, this water is described as brackish and is generally considered to be unfit to drink. In addition, the groundwater yield is insufficient to meet the long-term needs of the island. Anguilla has therefore utilised a mixture of ground water and desalinated water to supply its water needs over the years. The Crocus Bay Water Treatment Facility owned by the private company Aqua Design was the main water provider which sourced water from Crocus Bay on the west of the island and processed it into potable water through reverse osmosis. There are also a number of desalination plants run by the private sector, specifically geared towards tourism.

Table 5 shows the cost per 1,000 gallon for water in Anguilla which has one of the highest water rates in the Caribbean. The cost of water increased when the Anguilla Water Authority became a private entity and this has had a direct effect on the ability of the poorest sector of the territory to purchase potable water. It is therefore not surprising that some of the water which is unaccounted for is lost to theft.

Table 5: Water tariff for domestic and non-domestic users in Anguilla

| Category | Water Usage (Imperial Gallons per Month) | Rate \$EC (\$US) |
|------------------------------|--|---|
| Small 'Domestic' Customers | ≤ 1,000 | \$ 40.00 (\$14.80) minimum |
| Small 'Domestic' Customers | 1,000-3,000 | \$60.00 (\$22.20) per 1,000 gallons |
| Small 'Domestic' Customers | 3,000-5,000 | \$80.00 (\$29.60) per 1,000 gallons |
| Small 'Domestic' Customers | > 5,000 | \$100.00 (\$37.00) per 1,000 gallons |
| Large 'Commercial' Customers | 0-10,000 | \$1,200.00 (\$444.00) per 1,000 gallons |
| Large 'Commercial' Customers | 10,000-20,000 | \$10.00 (\$3.70) per 1,000 gallons |
| Large 'Commercial' Customers | 20,000-40,000 | \$80.00 (\$29.60) per 1,000 gallons |
| Large 'Commercial' Customers | >40,000 | \$60.00 (\$22.20) per 1,000 gallon |

(Source: Anguilla Water Authority, 2011)

Conversion rate utilised: EC \$1=US \$0.37

Limited ground water resources are not the only concerns in this vulnerable sector. The Government of Anguilla closed down wells on the island due to pollution from dumped batteries, waste oil from toxic power station and gas station used oils, waste from package plants, pesticides and from septic tanks which could be easily leaked due to the porous nature of the soil^{ii,iii}. Subsequently, plans have been made to develop a series of new bore wells in the Valley Bottom area to increase potable supply.

To manage water resources the Water Corporation of Anguilla Act 2008 was devised to transform the Water Authority of Anguilla in to a state-owned water corporation. Almost 80% of the 2008 Budget for The Ministry of Infrastructure, Communications, Utilities, Housing, Agriculture and Fisheries was allocated to the Water Corporation. This demonstrates the priority placed on water resources as well as the high costs involved in management of this resource and its demand on the island. In recent years expenditure has focused on road works and simultaneous replacement and installation of water pipelines and the improvement of drainage infrastructure in some areas.

The main factor of concern to water resources is Anguilla's proneness to drought conditions. Rainfall in Anguilla is generally low , experiencing average annual rainfall of approximately 960 mm per year but this can range between as low as approximately 450 mm to as high as 2,000 mm depending on the number and intensity of storms affecting the island in a given year. Increased frequency of drought could cause "Such environmental change [that it] would increase the vulnerability of Anguilla communities and might constrain sustainable development over the next few decades, unless adaptive measures are taken now"^{iv}.

During heavy rainfall events freshwater supplies are vulnerable to flooding and contamination from sewerage systems. Past weather patterns and climate regimes have also reduced mobility and services for extended periods of time, which has had an effect on fuel delivery due to poor sea conditions. This in turn has the potential to affect the operational costs of water produced from desalination.

As a means of coping with historically low rainfall, the use of cisterns is traditional and extensive on the island. While the quality of water is considered to be good, installing and refilling cisterns incurs additional costs to consumers. Water may also be purchased from water trucks and again stored in cisterns but this is considered to be a very expensive option.

An assessment undertaken in the Draft Green Paper: a working document to assist with the formulation of a Climate Change Strategy for Anguilla has provided an impact rating for climate change in the water sector and has a suite of recommendations which should be implemented. Stakeholders have identified drought as a future 'certainty', with 'extremely severe' impacts and 'already happening'. A water quality monitoring programme, particularly for groundwater should be established in tandem with efforts to protect aquifers from surface contamination through increased land owner responsibility. The Department of Environment recognises several issues which affect water quality, including sand mining, hill capping or slope reduction, pond filling, soil relocation, water table penetration and pollution, and land clearing.

COMPREHENSIVE NATURAL DISASTER MANAGEMENT

Anguilla has been quite fortunate in that it has not had many direct hurricane impacts but there are still cases of damages that suggest some level of vulnerability, such that in the last decade Anguilla's disaster management system has been reviewed and evaluated. Since these hazards are hydro-meteorological, climate change is likely to increase the occurrence of disasters, or at least emergency situations, in Anguilla.

The Valley, the capital city, is located in a sinkhole; a common feature of limestone topography. This location makes the city prone to flooding as water is likely to sit in the large sinkhole during, and following, heavy rainfall events as it did during Hurricane Lenny in 1999. The flood map in Figure 6 shows a large, contiguous part of the main city is vulnerable, necessitating the planning of evacuation routes.

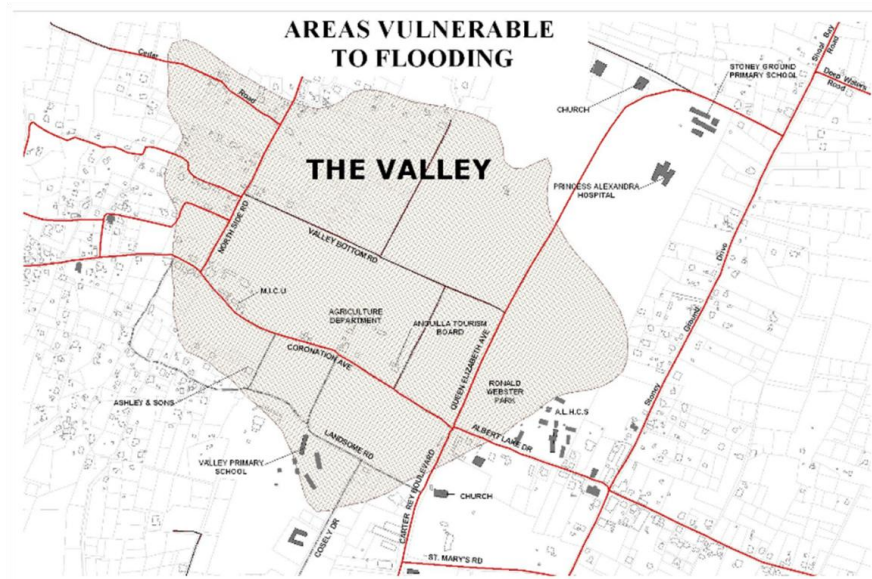


Figure 6: Flood map of The Valley, Anguilla

(Source: Forward Planning Unit, Physical Planning Department, Sept, 2005)

Despite its limited experience with hurricanes, on August 30, 2010 Hurricane Earl battered Anguilla causing damages to roofs at the airport, a primary school and cultural centre as well as some housing. Only 9 persons required shelter for a short time but electricity was off island-wide (including the hospital, desalination plant, the sea port and government secretariat). Tropical Storm Fiona followed closely behind but only 30% of the island had power restored by then. Further damages were also experienced in the agricultural sector where a hydroponic farm roof was damaged and all plants were lost. Seven boats also ran aground. Housing damages were quite minimal with only 2-3 houses destroyed and over 25 damaged.

Preliminary assessments by the Caribbean Disaster Management Agency (CDEMA) estimate damages to the tourism sector at EC \$135,000,000. Lenny also caused extensive coastal erosion resulting in the construction of a seawall in Maunday's Bay the next year. See Figure 7.



Figure 7: Seawall under construction in Maunday's Bay, Anguilla

Disaster management in Anguilla is led by the Department for Disaster Management (DDM). Since 2004, Anguilla's Department for Disaster Management (DDM) has fully embraced the Regional Comprehensive Disaster Management (CDM) Strategy into the national CDM Strategy (CDMS). Much of the challenge of the DDM

office is its small budget and the small number of staff. The National Disaster Management Act was reviewed in 2008 and is a well developed document. A notable strength of the Act is that enforcement powers are well defined and not limited to a single authority but spread to police officers as well. Another area where Anguilla has made good progress is disaster preparedness. The development of an integrated early warning system that reaches all of Anguilla is an important investment in technology that will provide on-going reduction of the risks from natural hazards. Other initiatives aimed at the reducing the effects of disasters exist.

The Department for Disaster Management (DDM) has a Public Outreach and Education Plan and Strategy and the Hazard Inspection Programme and Strategy that operate throughout the communities on the island. The recent Tsunami Ready programme aims to prepare communities for tsunami hazards specifically, but given the small size of the island and the location of The Valley near to the coast this programme will prepare for other hazards as well. A Tsunami Evacuation Map has been made for the launch of a month-long awareness campaign of the tsunami hazard.

Despite these efforts, more remains to be done in order to develop effective responses to climate change. Improvement of national level data availability and collect, manage and update databases within a national agency is critical. There is no meteorological service available in Anguilla and so weather forecasts are provided by Antigua and Barbuda. Data must be readily available to local decision makers and should not be left depending on diplomatic relations with other countries. Especially in emergency decision making, the availability of good data quickly is imperative to successful response.

It is also important for the Government of Anguilla to work with relevant tourism stakeholders to develop and implement the existing sustainable tourism plans with a focus on diversification of the tourism product toward the least vulnerable areas.

HUMAN HEALTH

Health is an important issue in the tourism industry because tourists are susceptible to acquiring diseases as well as potential carriers of diseases. The effects of climate-related phenomena on public health can be direct or indirect. The former includes weather related mortality and morbidity arising from natural disasters (e.g. hurricanes) and high temperatures (e.g. 'hot' days/nights). Indirect impacts are more extensive, including vector borne diseases such as dengue fever and malaria.

Anguilla's propensity for drought conditions has implications for the health sector as episodes of dry weather and drought conditions can contribute to the spread of disease linked to inadequate water supply and sanitation, as well as asthma and other respiratory diseases.

There is very limited formal research or documentation of climate change and its potential impacts in Anguilla but an increase in illnesses due to airborne pollutants, contamination of water supplies, increase demand for healthcare and medical services, resurgence of certain communicable diseases, increase in water-borne diseases and increased thermal stress have been identified as the main vulnerabilities of the country's health sector in the document "The Potential Effects of Global Climate Change on Anguilla, British West Indies". Other diseases associated with climate change include ciguatera poisoning, legionnaires and leptospirosis, which can become more prevalent as seas warm and precipitation increases.

While climate change was not directly mentioned in the National Strategic Plan for Health 2009 -2014, by strengthening the areas of vector surveillance, mosquito control, rodent control, and surveillance of diarrhoea-related morbidity, as well as food safety, air and water quality as well as waste disposal, the ability of the health sector to adapt to changes in diseases patterns and any other impacts will also increase. This comprehensive study of the various health issues that Anguillans face is a positive indication of the type of valuable information which will help in climate change adaptation.

Anguilla has also experienced increasing heat waves in recent times. Gridded temperature observations have shown an increase at an average rate of 0.1°C per decade over the period 1960-2006 which is expected to increase by at least 0.8-2.9°C for the GCM ensemble by the 2080s. RCM projections indicate the potential for more rapid increases. Though these predicted changes up to the 2080's are averaged and

dispersed over a relatively long time span, episodic increases in temperature could impact vulnerable groups at a given point in time. The potential impacts may be multi-sectoral as water supplies and the agriculture sector also have implications for health.

Despite its dry climate, mosquitoes are prevalent - breeding in cisterns and rock holes. Climate change projections indicate the potential for overall decreases in rainfall events which might decrease mosquito proliferation once water storage facilities and infrastructure do not contribute to mosquito breeding sites. Anguilla is therefore undertaking a number of initiatives to control the spread of infestations.

Respiratory infections in Anguilla have been on the rise in the last four years. If air quality can have a significant impact on the health of the local population then, it is reasonable to expect similar effects on vulnerable travellers particularly those with respiratory diseases and those with pulmonary and cardiac diseases.

Sanitation concerns and drought are mainly linked to food-borne diseases such as gastroenteritis. Gastroenteritis cases have been reported since 1981 but increases in trends have been seen reported since 2000. The Country Poverty Assessment for Anguilla states “It should also be noted that, in Anguilla, the incidence of health conditions (e.g. infectious or waterborne diseases, low birth weights, infant diarrhoea) is almost non-existent”. Therefore emphasis is not placed on food- and water-borne diseases known to be prevalent in the rest of the region. However, it is important to consider that there may be a rise of such diseases if water resources become scarcer coupled with higher unemployment rates and deterioration in the social condition. A constant threat exists with cholera being transplanted into the port via the ballast water. Consequently, continuous surveillance is required to monitor this situation.

Table 6: Reported cases of gastroenteritis in Anguilla between 2000 and 2009

| Year | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|--|------|------|------|------|------|------|------|------|------|------|
| Sum of Gastroenteritis < 5 yrs | 79 | 42 | 24 | 67 | 41 | 72 | 158 | 114 | 68 | 45 |
| Sum of Gastroenteritis ≥ 5 yrs | 68 | 47 | 28 | 129 | 63 | 122 | 345 | 317 | 218 | 209 |

(Source: Caribbean Epidemiology Centre (CAREC), 2008a; 2008b; 2010)

Health indicators reveal that Anguilla has a health status comparable to that experienced in other westernised countries with next to no instances of the diseases or conditions traditionally associated with poverty. However, vulnerable groups exist.

There have been two strategic health plans in recent years. The 2003–2008 National Strategic Plan for Health was developed in 2003 and among its designations was provisioning for the operation of the Anguilla Health Authority. This plan has been followed up by the National Strategic Plan for Health 2009 - 2014 which was prepared in 2009.

To enhance Anguilla’s efforts in maintaining a high standard of public health in the face of climate change it is important to improve the use of technology with regard to vector-borne diseases. An Early Disease Warning System that considers temperature signatures for vector borne diseases can be considered, however this must be validated. Also, given the importance of tourism to the economy, an assessment of tourism, health and climate change linkages would provide an indication of destination substitution if tourism related health problems increased as a result of climate change.

MARINE AND TERRESTRIAL BIODIVERSITY AND FISHERIES

Anguilla is described as being “embraced by unrivalled white beaches and breathtaking turquoise seas”; an ideal vacation destination. This description highlights the importance of the Anguilla’s natural resources to tourism. The importance of biological diversity to the national economy is also reflected in the relative contributions to the Gross Domestic Product (GDP) of economic sectors such as fisheries and construction that are dependent on natural resources. Subsequently employment, livelihoods and the well-being of the Anguillan population is inseparably tied to the protection and management of its biodiversity.

Approximately 550 species of vascular plants (321 of them are native) grow on the island and one of these species, the Anguilla Bush *Rondeletia anguillensis* in the Rubiaceae family (coffee), is unique to Anguilla. The type of vegetation on the island has limited the terrestrial vertebrate fauna to 14 species of reptiles (12 lizard species, one species of snake and one species of land tortoise), five species of bats (Anguilla’s only native terrestrial mammals) and about 135 species of migratory and resident birds. At least 3 species of marine turtle nest on various beaches around the coastline and numerous fish and other marine life may be found around seagrass beds and along one of the most important largely unbroken reefs in the eastern Caribbean.

Anguilla’s wetlands, consisting of mangroves and salt ponds, are of significant local importance to its biodiversity and provide invaluable goods and services to the population. Formerly widespread mangrove areas have been reduced to a few small areas. On the mainland, mangroves occur in 10 sites on the margins of seven saline ponds covering just 0.9 km² in total.

Although the natural environment forms the foundation of the island’s economic activity, food security, and livelihoods it is being subjected to a combination of complex localised threats as well as the global threat of climate change. Over-exploitation and indiscriminate clearing of land for development have replaced much of the natural vegetation on Anguilla with degraded evergreen woodland consisting of small trees, scrub brush and cacti, interspersed with scattered areas of grassland. Run-off from construction sites also contributes to the degradation of coral reefs, which are themselves an important source of beach sand and play a role in the dynamics of sand movement. Such activities have had negative impacts that increase the vulnerability of Anguilla’s wetlands to climate change.

Extensive reefs are found around the island, with the 17 km-long reef along the north-east coast considered to be one of the most important largely unbroken reefs in the eastern Caribbean and are very important to Anguilla’s dive tourism. See Figure 8.

Anguilla’s shallow reef habitats are generally in a poor state of health with low hard coral cover and high levels of macro-algae. A recent report from The Anguilla Marine Monitoring Programme (AMMP) notes that over the last 20 years

hard coral cover has declined by 70% from an average 13.95% in 1990 (an average over nine sites), to only 4.1% in 2010 (an average over 10 sites). In some areas such as the Forest Bay and Sandy Hill Bay, the decline in coral cover is 90% and 74% respectively^v. The cumulative effects of a number of natural and



Figure 8: Location of valuable coral reef ecosystems surrounding Anguilla

(Source: UNEP-WCMC)

human-induced factors, including a proliferation of coral diseases, coral bleaching events, nutrient loading, hurricanes and the regional die-off of the long-spined sea urchin *Diadema antillarum* have resulted in the degradation of coral reefs.

The fisheries sector contributes an average of 2.5% annually to GDP, which may initially seem to be a small figure; but when the dollar value (Table 7) and number of persons employed are taken into consideration the significance of the fisheries sector becomes more apparent. However, since the mid 1980s lobster fishers have been reporting a decline in catches and fishers have to travel further distances to maintain or increase their catches.

Table 7: Fisheries contribution to GDP in Constant Prices 2000-2009 (EC \$M)

| Economic Activity | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|-------------------|------|------|------|-------|-------|-------|-------|-------|-------|-------|
| Fishing | 8.63 | 8.90 | 9.08 | 10.20 | 11.21 | 12.32 | 12.70 | 13.81 | 14.84 | 13.64 |

(Source: Anguilla Statistics Department, 2009)

Observed mean annual temperatures over Anguilla have increased at an average rate of 0.1°C per decade over the period 1960-2006. Anguilla's vegetation is adapted to the dry weather and saline conditions and may be better able to tolerate these changes in climate than many of the plant species found on other islands in the region. However, prolonged periods of drought and salt water intrusion as a result of SLR will likely have adverse impacts on vegetative cover and by extension the terrestrial animal species that inhabit these areas. SLR also poses the greatest threat to mangroves and wetlands potentially confining and even overcoming wetland vegetation if it is obstructed from migrating inland due to coastal infrastructure. Coral reefs and seagrass beds are critical ecosystems for Anguilla's fisheries and are highly sensitive to localised changes in climate.

Hurricane Luis in 1995 caused an almost total loss of mangroves in Anguilla. One mangrove stand that was severely damaged by Hurricane Luis and again by Hurricane Lenny was the mixed mangrove stand found in Little Harbour. Mangrove species exhibit different responses to storm damage and a forest's community structure could thus be changed by tropical storms and hurricanes. The long term effects of extreme events on mangrove stands are uncertain but will most likely mean a reduction in the many important services provided by these ecosystems. The recommended approach is therefore to actively preserve and restore mangrove communities in order to maintain the economic and ecological benefits they offer.

During the 1990s Anguilla's beaches appeared to be experiencing net erosion attributable to a series of tropical cyclones that affected that region. Hurricane Luis struck in 1995 and caused much damage to coastal and marine ecosystems including extensive erosion of the beach at Mead's Bay where it retreated inland by 30 m. Four years later, in 1999, Hurricane Lenny caused even further damage to those same dunes. The beaches have shown signs of partial recovery but have still not returned to the pre-hurricane state. Changes to the beachscape will affect recreation activities as well as the livelihoods of those employed in fisheries, water-sports and other such related activities. Intensified tropical cyclones and accompanying storm surges will also impact on nesting areas and threaten the survival of species such as marine turtles, iguanas and shore birds.

Several national agencies share the responsibility for environmental management. In recent years Anguilla has made progress in some areas of environmental management. Using aerial photography the Government of Anguilla has undertaken a mapping exercise of coastal and sub-littoral habitats of all islands in order to develop an accurate method of marine habitat mapping for the analysis of the marine

ecosystem in order to develop a procedure for marine and coastal resource management. Such information needs to be fully integrated into environmental and tourism policy and practices.

Since little is understood about the long-term effects of climate change on Caribbean fisheries, assessments on the potential impacts on fishing, fish processing, trade and fisheries technical support services related to artisanal fisheries should be carried out. The establishment of marine protected areas (MPAs) is also of benefit to help the marine environment adapt to climate change. A strategy could be developed and employed which:

- establishes a more effective fish sanctuary management and enforcement system for coastal communities;
- enhances the capacity of resource managers and users to be more resilient to climate change; and
- establishes a sustainable finance mechanism for supporting fish sanctuary management.

The strategy should increase the involvement of the tourism sector in supporting community-based MPAs, as well as provide opportunities for alternative livelihoods and technologies for public education.

Mangrove restoration and protection around Anguilla will improve the health of fish nurseries and coral reefs thus benefitting the livelihoods of those engaged in marine-based activities. Proposed MPAs will also benefit from the presence of mangrove trees, which filter pollutants and provide protection to fish and crustaceans allowing them to increase in size and abundance.

CONCLUSION

Anguilla has a strong dependence on the tourism industry and the many natural assets that enable tourism to be successful. Terrestrial and marine ecosystems and water resources are already facing serious pressures from increasing development and poor land use practices and climate change is exacerbating these impacts. It is evident that the Government of Anguilla is committed to adapting to climate change. Many policies and plans for action are in place but serious financial resource shortages along with limited technical capacities hinder the successful adaptation efforts across most government ministries and other stakeholder groups.

The CCCRA explored recent and future changes in climate in Saint Lucia using a combination of observations and climate model projections. Despite the limitations that exist with regards to climate modelling and the attribution of present conditions to climate change, this information provides very useful indications of the changes in the characteristics of climate and impacts on socio-economic sectors. Consequently, decision makers should adopt a precautionary approach and ensure that measures are taken to increase the resilience of economies, businesses and communities to climate-related hazards.

Including Anguilla, the CARIBSAVE Climate Change Risk Atlas has worked with 15 countries, a multitude of stakeholders and a wide variety of sectors across the Caribbean. As a result, in addition to the crucial national stakeholder sectoral analyses and practical strategy development the CCCRA provides robust and meaningful cross-regional comparisons in communities and sectors which lead to the identification of effective actions, skills and knowledge transfer, lessons learnt and the opportunities for increased future resilience and sustainability.

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This document provides a synopsis of critical *sectoral* vulnerabilities and capacities and highlights challenges, opportunities and strategies for action. The complete, 250+ page, Climate Change Risk Profile for Anguilla is also available from www.caribsave.org and provides detailed climate modelling for various climate parameters, sectoral assessments, and analyses using proven, scientific methodologies to inform pragmatic strategies specific to key sectors in Anguilla.

NOTES

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