

CARIBSAVE Climate Change Risk Profile for St. Kitts



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 the UK 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 ST. KITTS

St. Kitts is already experiencing some of the effects of climate variability and change through damages from severe weather systems and other extreme events, as well as more subtle changes in temperatures and rainfall patterns.

Detailed climate modelling projections for St. Kitts 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 the **Old Road** area to climate change; and
2. project sea level rise and storm surge impacts on **Irish Bay, Basseterre Bay, Frigate Bay and Sugary Bay**.

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

- The Old Road Town community is in the parish of St. Thomas which has just over 25% of its population living in poverty.
- Some of the existing vulnerabilities have been self-imposed through environmental degradation and unsustainable practices.
- Employment is an important factor in the community's adaptive capacity at the household level.
- Consideration of the underlying power relations and gender equalities which create vulnerability both to poverty and climate hazards is essential.

Vulnerable coastlines

- 1 m SLR places 64% of the major tourism properties at risk and under a 2 m SLR scenario, 77% are at risk in Frigate Bay and Basseterre.
- With only 50 m of erosion, 79% of turtle nesting sites, a popular tourist attraction, would be at risk.
- SLR considerations are not currently incorporated into local land use development plans or tourism master plans.
- Rebuild costs for tourist resorts damaged and inundated by SLR amount to over US \$936 million in 2050.

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 ST. KITTS

The projections of *temperature, precipitation, sea surface temperatures; and tropical storms and hurricanes* for St. Kitts 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 St. Kitts

Temperature: Regional Climate Model (RCMs) projections indicate increases ranging from 2.4 - 3.2°C by the 2080s in the higher emissions scenario.

Precipitation: General Circulation Models (GCM) projections indicate overall decreases in annual rainfall of between -41 to +13 mm per month by 2080 for the higher emissions scenario. RCM projections indicate a decrease of 7-22% in *total annual* rainfall.

Sea Surface Temperatures (SST): GCM projections indicate increases from +0.7°C and +2.8°C by the 2080s.

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 the Marriott Resort (St. Kitts)

The majority of infrastructure and settlements in small islands, like St. Kitts, are located on or near the coast, including government, health, commercial and transportation facilities. This high density of development (particularly related to tourism) increases the risk of degradation of coastal and marine biodiversity thereby reducing its resilience to climate change impacts including SLR and storm surge.

The CARIBSAVE Partnership coordinated a field research team with members from the University of Waterloo (Canada) and the staff from the Department of Development Control and Planning Authority to complete detailed coastal profile surveying at Irish Bay, Basseterre Bay, Frigate Bay and Sugary Bay.

Results for field study sites in Frigate Bay and Basseterre indicate that 1 m SLR places 64% of the major tourism properties at risk and under a 2 m SLR scenario, 77% are at risk. Critical beach assets would be affected much earlier than the SLR-induced erosion damages to tourism infrastructure; indeed, once erosion is damaging tourism infrastructure, it means the beach, a vital tourism asset, has essentially

disappeared. With a projected 100 m of erosion, 82% of all the resorts in St. Kitts and Nevis would be at risk. In contrast, with only 50 m of erosion, 79% of turtle nesting sites, a popular tourist attraction, would be at risk. Table 1 shows the different survey sites and their specific impact results under the various scenarios. The amount of beach lost demonstrates the great need for SLR considerations to be incorporated into local land use development plans in St. Kitts, but also into tourism master plans.

Table 1: Beach Area Losses at Four Resorts in St. Kitts

Irish Bay/Basseterre Bay			Frigate Bay		Sugar Bay - 1		Marriott Resort	
SLR Scenario	Beach Area Lost To SLR (m ²)	Beach Area Lost (%)	Beach Area Lost To SLR (m ²)	Beach Area Lost (%)	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	3,768	43%	5,677	36%	11,340	54%	8,394	25%
1.0m	1,628	61%	10,053	100%	3,383	70%	4,198	37%
2.0m	3,117	96%	-	-	5,382	95%	20,806	98%
3.0m	331	100%	-	-	1,055	100%	597	100%

St. Kitts: Land Loss From Sea-level Rise

The Marriott St Kitts Resort & Royal Beach Casino, Frigate Bay

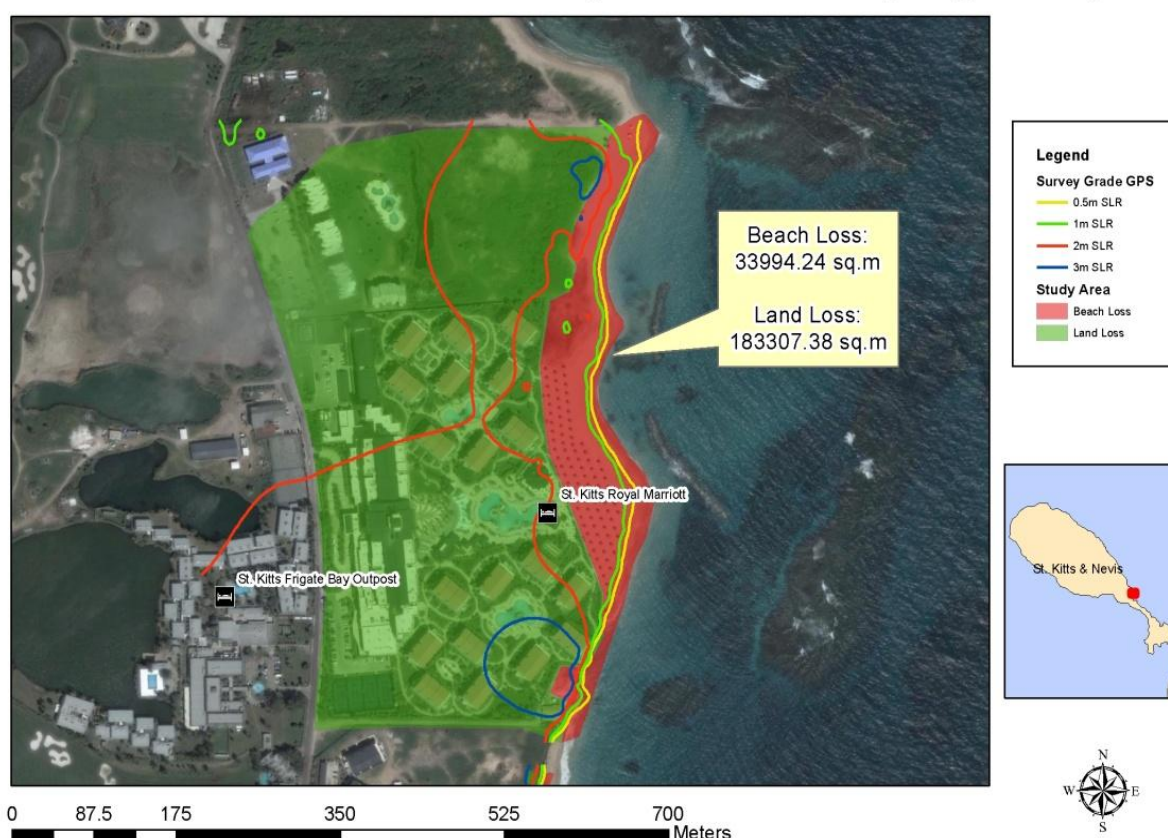


Figure 2: Sea Level Rise Vulnerability at The Marriott St. Kitts Resort and Royal Beach Casino, Frigate Bay, St. Kitts

St. Kitts is highly dependent on international tourism and the country will be particularly affected with annual costs as a direct result of SLR. Figure 2 (above) clearly illustrates that the longer term erosion

response of the shoreline to a 1m SLR would have significant implications for the shoreline and the loss of a total of high value commercial tourism properties.

Hard engineering structures such as dikes, levees, revetments and sea walls can be used to protect the land and related infrastructure from the sea to ensure that existing land uses, such as tourism, continue to operate despite changes in the surface level of the sea. Unfortunately, the effectiveness of this approach may not withstand the test of time nor withstand against extreme events. Protection could also be implemented through the use of soft engineering methods, which require naturally formed materials to control and redirect erosion processes. For example, beaches, wetlands and dunes have a natural buffering capacity that can help reduce the adverse impacts of climate changeⁱ. Although less expensive and less environmentally damaging, soft engineering protection is only temporary and a variety of implications need to be considered.

Adaptation through managed retreat can have the benefit of saving on infrastructure defence costs (hard and soft engineering measures) while retaining the aesthetic value of the coast. However, for many tourist destinations in St. Kitts, retreat is both difficult in terms of planning, as well as expensive to implement. But without action St. Kitts is estimated to face annual losses between US \$30 million in 2050 to over US \$101 million in 2080 (based on a mid-range scenario). Rebuild costs for tourist resorts damaged and inundated by SLR amount to over US \$936 million in 2050 up to US \$2.2 billion in 2080 and estimated capital costs to rebuild the airport are between US \$44 million by 2050 to US \$132 million by 2080 and between US \$15 million in 2050, to US \$44 million by 2080 for rebuilding portsⁱⁱ. Given these costs, it is recommended that a cost-benefit analysis of coastal protection be conducted at the local level, along with an inventory of existing coastal protection defences, their design range and maintenance status. This information will inform decision-making and planning for the tourism industry and other coastal development.

COMMUNITY LIVELIHOODS, GENDER, POVERTY AND DEVELOPMENT

More than 50 residents and workers from The Old Road Town, St. Thomas participated in CARIBSAVE's vulnerability assessment which included a vulnerability mapping exercise, focus-groups and household surveys which were developed according to a sustainable livelihoods framework. This research an understanding of: how the main tourism-related activities, including fishing, vending 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.

Community Characteristics and Experiences

The Old Road Town is located on the western side of the island in the parish of St. Thomas. St. Thomas itself has a population of approximately 2,395 persons, which represents roughly 6% of the total population. Tourism and fishing are the main industries in St. Thomas. Several tourism attractions and points of interests located in this parish, and a fisheries complex was recently established in the area, providing a base for local fishermen and housing Government officials working with the fisheries sector. St. Thomas has a moderate level of poverty by parish when compared to other parishes, as just over one-quarter of the persons living in St. Thomas are poor.

Community residents are most concerned with flooding, hurricanes/tropical storms and storm surge because of the current impacts these events have on their livelihoods. As a result, a review of drainage and engineering infrastructure with the goal of reducing flooding would be of great value to this community.

However, there is a clear understanding that some of the existing vulnerabilities have been self-imposed through environmental degradation and unsustainable practices which have compromised the community's ability to effectively manage some types of disasters. For example, it has been reported that some community residents who had been relocated by government have returned to areas that were designated as 'at-risk', or have even rented out these properties to other locals. Such decisions are likely as a result of perceived (and possibly actual short-term) benefit of that location combined with a low level of awareness about climate change risks.

The climate-related changes which have been noted by residents of Old Road Town, include:

- hotter days;
- reduction in rainfall;
- declines in biodiversity; and
- coastal erosion.



Figure 3: Community workshop in Old Road Town

Some results for The Old Road Town include:

- Employment is an important factor in the community's ability to adapt to climate change and reduce their own vulnerability at the household level.
- All community members reported that they know what to do in the event of a hurricane; 70% for flooding; and 25% for landslides.
- In the event of a catastrophic event or job loss, across the community household financial reserves would last between one and six months.

In Old Road there are small, non-governmental organisations or community-based groups that promote community cohesion and development. Community-focused or bottom-up adaptation planning to include capacity building and education programmes for such groups will therefore lend itself to greater consideration of local circumstances and inputs.

Challenges of poverty reduction and climate change need to be addressed in a coherent and synergistic way. Achieving sustainable and effective responses to climate change, therefore, requires attention to the

underlying power relations and gender equalities which create vulnerability both to poverty and climate hazards.

AGRICULTURE AND FOOD SECURITY

The close of the sugarcane industry in St. Kitts and Nevis in 2005 signalled a significant change in the agricultural landscape of The Federation, which depended on this crop for its prosperity for a period of 350 years. The Government's Adaptation Strategy in Response to The New EU Sugar Regime 2006 – 2013 is an intensive diversification programme that has resulted in increased production of non-traditional crops, livestock, fruits and vegetables. Some of the projected impacts from climate change are however already being felt.

In particular, changes in precipitation (increases and decreases) are having devastating impacts on crop production seasonally. The single most important contributing factor to land degradation in St. Kitts and Nevis is accelerating erosion caused by:

- overuse of lands for mono-crop, sugar cane agriculture;
- clearing of lands for residential and tourism development;
- farming above the 1,000 ft contour; and
- squatting or unregulated settlements.

In order to specifically deal with agriculture and climate change, a project involving farmers' cooperatives and the Government owned Capisterre Farm, can be used to model the impact of climate change on production and help to develop new, varieties of selected crops that respond to a changing climate.

Climate change concerns for agriculture are presently dealt with at the farm-level, but there is the need for more public discussion, supporting policies and an institutional framework to strengthen adaptive capacity of local farmers to mitigate the negative impacts.

The high level of public debt, the high cost of imported food to meet local needs, the global financial crisis and weak inter-sectoral linkages have caused persistent challenges for local farmers in St. Kitts, who bear costly production inputs for their crops. Furthermore, the low wages paid for farm work contributes to the vulnerability of this sector through declining interest. The island is facing agricultural land shortages because of the small physical size but also due to competition for land with tourism, housing, services and other facilities. Land use policies need to better consider agriculture so as to provide farmers with adequate land to provide a local food supply, but also to ensure agricultural practices do not have negative impacts on other land uses.

ENERGY AND TOURISM

Tourism is an increasingly significant energy consumer and emitter of greenhouse gases (GHG) both globally and in the Caribbean. St. Kitts and Nevis belong to the region's low emitters having per capita emissions just over half of the global average of 4.3 t CO₂. In the case of tourism in St. Kitts and Nevis, cruise ships (40%), aviation (24%) and accommodation (15%) were identified as the major direct consumers of energy and sources of emissions. When compared to national emissions of 196,000 t CO₂, the tourism sector accounts for about 88%.



Figure 4: Wind turbines as alternative energy source in Nevis

A detailed energy assessment of the tourism sector is needed, however, to confirm these figures, which in part are based on estimates with considerable uncertainties in assumptions. There is also uncertainty how emissions are divided between St. Kitts and Nevis, although approximately 80% of fuel imports are for St. Kitts and a comparison based on arrival numbers would suggest that about 80% of tourism-related energy use and associated emissions fall on the island.

St. Kitts' energy production is currently entirely based on diesel powered plants with a contribution of wind power likely to be included sometime in 2012. In St. Kitts, electricity prices have historically been kept artificially low through a government subsidy scheme, with the removal of the fuel surcharge in 2005 for residential electricity clientsⁱⁱⁱ. This policy should be reviewed so as not to counteract efforts at energy efficiency (demand side), since lower costs encourage greater use.

Rising oil prices will affect tourism in particular since aviation has limited options for using alternative fuels and increases in fuel costs will inevitably be passed to the passengers. Tourism's share in energy use and emissions is likely to grow in the future, leading to growing vulnerabilities in a business as usual (BAU) climate scenario. At the same time, the sector holds great potential for energy reductions and should thus be one of the focus points of policy considerations to de-carbonise island economies.

The National Energy Action Plan for St. Kitts and Nevis has a section that speaks to the tourism sector, focussing on energy efficiency through technology and renewable alternatives, recycling, capacity building and a potential levy for high energy uses. Although the current Policy and Plan do not specifically refer to the sustainability of the sector under climate change, it does make it clear that the aim is to develop sustainable energy solutions. To improve the achievement of those goals the Government of St. Kitts and Nevis is encouraged to conduct energy audits to better understand where energy is used and where emissions occur.

Opportunities for collaboration with the agriculture sector exist with integration of renewable energy into farms in St. Kitts being a possibility. A greenhouse project for improving growing performance by directly using the carbon dioxide present in geothermal steam is a possible option worth exploring. Similar work is already being attempted because wind and geothermal energy have been identified to have the greatest short to medium term development potentialⁱⁱⁱ. In the period 2010-2012, 5.4 MW of wind power on St. Kitts and 2.2 MW on Nevis, as well as a 10 MW geothermal plant on Nevis are planned. Exploration of these joint sector projects is needed for economic efficacy with the limited resources available. To this end, St. Kitts and Nevis is planning considerable action that could make them a leader in renewable energy development in the region.

WATER QUALITY AND AVAILABILITY

In St. Kitts, the majority of water comes from groundwater wells and currently, all residents of St. Kitts have access to water 24 hours per day, all of which is supplied by the St. Kitts Water Department. Over 50% of

water supplies are consumed by the domestic sector, while the tourism, agriculture and commercial sectors each use between 10 and 15% of the island's water resources (Figure 5). No central sewerage system exists in either St. Kitts or Nevis; however, there is one treatment plant at Frigate Bay (St. Kitts). Soak-aways and septic tanks are the primary waste disposal method used by households. For the Basseterre aquifer, threats to water quality include contamination from oils spills, fertilisers and agrochemicals and bacteria.

To combat water pollution, it is recommended that the Water Department collaborate with the agricultural sector and planning department to develop land use policies that centre on water conservation and also protect against SLR and salt water intrusion.

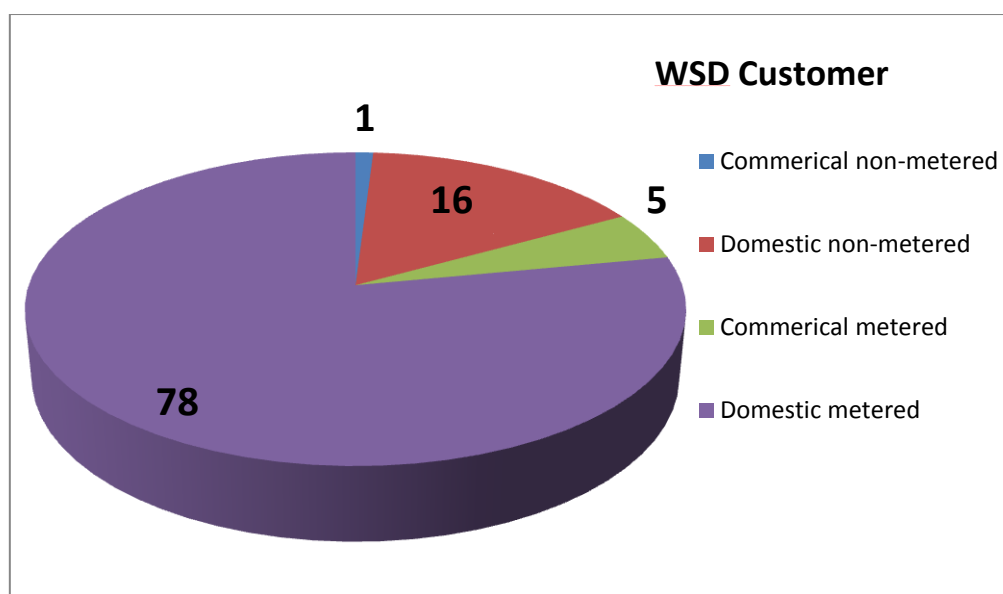


Figure 5: Distribution of Metered and Non-Metered Customers of the St. Kitts Water Services Department (%)

(Source: Dr Sahely, personal communication, April, 12, 2011)

Demand for water is expected to increase as the economy of St. Kitts and Nevis expands, particularly in the tourism and agriculture sectors where water requirements could double in the next 10 years. To exploit groundwater resources that are not currently exploited will require substantial capital investments to gain access to these aquifers. St. Kitts Water Services Department (WSD) executes government policy objectives, implements water conservation programmes (particularly during drought conditions) and carries out public education and awareness initiatives related to water resources. However, conflicting and growing demands for water from various sectors place pressure on the limited financial resources available to the WSD. This shortage is an acute problem during the dry season when natural springs are subjected to periodic water shortages as a result of high tourism water demand. In these episodes, water is sourced from areas that have wells.

Drought frequency is not well documented so monitoring of collection and water storage is recommended to enhance management regulations. Water infrastructure should also be developed to reduce vulnerability during drought events and after major storms and hurricanes. In particular:

- water storage should be encouraged through incentives and every new building should have its own stored water infrastructure;
- the viability of additional storage should be assessed, allowing improved access to potable water in different communities; and
- losses in water distribution should be reduced through pipe replacement.

To help with these types of initiatives, public-private partnerships have been considered to manage various infrastructure projects such as maintenance and deep water drilling projects.

COMPREHENSIVE NATURAL DISASTER MANAGEMENT

Flooding and tropical storms are the most frequently occurring natural hazards in St. Kitts, but the threat of volcanic eruption from Mt. Liamuiga (previously Mt. Misery) also exists, especially in the northern part of the island.

Studying impacts and damages from recent events can provide helpful tools and lessons in vulnerability reduction.

- Hurricane Georges in 1998 brought high winds, damaging 80-85% of homes and caused the evacuation of 3,000 persons^{iv}. Infrastructure damages were also extensive: many schools reported damages; the main hospital, Joseph N. France General Hospital, lost 90% of its function^v; and the power plant and many power lines and poles across the island were damaged. The vulnerability of built structures is thus quite high.
- The private sector is not immune to this vulnerability with tourism infrastructure suffering extensive damages and lost revenues when some facilities had to be closed for at least 2 months^{vi}.
- During dry periods, the risk of wildfires and drought also threaten agriculture and food security.
- After a recent flooding event, the National Emergency Management Agency (NEMA) made the statement that “significant funding is needed to mitigate flooding in several communities and in the central business district of Basseterre the capital city”^{vii}.



Figure 6: Hurricane Georges damage in St. Kitts

(Source: Elmes, 2001^{vii})

Efforts to better understand the vulnerability and adaptive capacity in St. Kitts have been evident in recent years. Post-disaster mitigation projects following Hurricane Lenny and Hurricane Georges have been aimed at advancing disaster response and preparedness, as well as improving building and construction

techniques and the management of shelters. These storms were a reminder that all sectors and areas of St. Kitts are at risk to extreme weather events.

The tourism industry, because of its economic importance, must have a disaster management plan and a sustainability plan for future developments. It is recommended that such a plan be implemented in conjunction with the National Emergency Management Agency (NEMA) with parallel efforts in Nevis so that combined efforts achieve widespread results and prevent future losses and damages from storms, hurricanes and other hazards.

There should be greater integration of community groups in disaster management and mitigation where possible since there are communities, such as Old Road Town, which have not only the need for such initiatives but also interested residents and groups.

HUMAN HEALTH

The potential effects of climate change on public health can be direct or indirect and can be conferred onto residents as well as visitors to a given destination^{viii}. The acquisition of an infection can have consequences for persons visiting a destination and can have significant impacts on the economies of SIDS. The Initial National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) highlighted the following communicable diseases and their relationship to health as follows, *"weather and climate influenced health care problems continue to constitute major sources of morbidity including gastrointestinal diseases, dengue and influenza"*^{ix}. A recent study highlighted that heat stress was considered the most important issue related to climate change and climate variability to residents of St. Kitts and Nevis.

In addition, mortality and morbidity rates due to injuries sustained during natural disasters are important considerations when assessing the vulnerability of a country to climate change. Further concern exists for vector-borne diseases including dengue fever and malaria:

- St. Kitts' tropical climate and its central forested peaks are suitable conditions for mosquito proliferation and the conditions could become more favourable as a result of climate change^{ix}. On average there has been one reported case of imported malaria every year between 2003 and 2010^x. While this number is small, the possible re-emergence of malaria is considered to be a real threat to the region^{xi}.
- Dengue fever is endemic to St. Kitts and Nevis and the total number of confirmed cases in both islands between 1995 and 2010 was 305; most cases occur in St. Kitts^x.

Further health concerns arise from poor hygiene and sanitation practices:

- The use of pit latrines in localised areas can contribute to the spread of water-related diseases such as gastroenteritis, acute haemorrhagic conjunctivitis and leptospirosis.
- Approximately 8.2% of the population use pit latrines (5.7%), ventilated pit latrines (1.2%) or have no access to toilet facilities (1.3%), thus many households are at great risk to such diseases.

The Ministry of Health should embark on a continuous health education and health promotion campaign aimed at locals and tourists. With good information on health and sanitation Kittitians can protect themselves and advocate for better national sanitation and health infrastructure. Similarly, policies and related funding strategies geared towards poverty reduction (such as the proposed Poverty Reduction Strategy) are key factors in climate change because of the link between disease transmission, environment

and living conditions, which by extension affects the ability of communities and St. Kitts on the whole to adapt.

MARINE AND TERRESTRIAL BIODIVERSITY AND FISHERIES

Very small islands, like St. Kitts, are at greater risk of losing their remaining natural resources and thus are particularly vulnerable to the projected impacts of climate change. For example:

- Increases in SSTs of about 1 to 3°C are projected to result in more frequent coral bleaching events, weakened coral structure and widespread mortality.
- Negative impacts on coral reefs, seagrasses and mangroves have serious implications for the country's fisheries sector as these ecosystems are critically important to the various life stages of many commercial species, including conch and lobster that are in high demand within the local and export markets.

To alleviate these stresses it is recommended that St. Kitts explore the feasibility of establishing fish sanctuaries, and create a strategy that should:

- establish an effective fish sanctuary management and enforcement system for coastal communities;
- enhance the capacity of resource managers and users to make the sanctuaries more resilient to climate change; and
- establish a sustainable finance mechanism for supporting fish sanctuary management.

The strategy should also 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. The Federation has various laws and plans such as the National Environmental Management Strategy and Action Plan 2005-2009 (NEMS) and the National Conservation and Environment Protection Act No. 5 of 1987 to inform and guide the implementation of best practice approaches to environmental management. However lack of enforcement of legislation and the failure to incorporate environmental costs into action plans and national budgets has limited the country's ability to live up to its obligations of ecosystem conservation. However, such a strategy provides an opportunity to assist in strengthening environmental management and building resilience in coastal ecosystems by empowering coastal communities to take



Figure 7: Sargassum seaweed accumulation on beaches in 2011

part in monitoring the natural resources on which they depend.

Even though the main challenges facing biodiversity protection in St. Kitts are related to management and policy, technology may assist in building the resilience of biodiversity to climate change by reducing non-climatic stresses and improving conservation and management activities. The St. Kitts Department of Marine Resources is currently promoting the use of alternative fishing methods to reduce fishing pressure on near shore areas. The technology and telecommunications sectors have been identified as having a key role in the sustainability and

development of the Federation, and are therefore upgrading infrastructure, hardware and software, as well as human capacity with the intention of applying cutting edge technology to various sectors.

Education and awareness projects using films on inbound flights can be effective tools in influencing human behaviour. The short videos would focus on positive actions that visitors can take to minimise negative impacts on the environment by decreasing energy and water consumption and wastage and by taking necessary precautions during marine-based recreation (e.g. diving, snorkelling, boating).

Although not confirmed as a climate change related event, large quantities of Sargassum seaweed have been washing ashore on the islands of the Eastern Caribbean in July and August 2011. These floating mats of vegetation arrive in the Caribbean region annually but this year (2011) they appear to be doing so in unusually large quantities. Fishers are complaining that their nets and lines become entangled in the Sargassum and there is concern over the risk of disease and invasive species that may accompany the seaweed. The large volume and weight of seaweed washed up on some beaches poses a serious problem for the tourism industry as well as a major expense and logistical challenge for agencies that collect and dispose of the Sargassum. If this event is indeed related to cyclonic storms that have formed in the Atlantic during the 2011 hurricane season then coastal and marine environmental managers should prepare for the likelihood of these events occurring with increased frequency in the near future.

CONCLUSION

St. Kitts has a growing dependence on the tourism industry, supported by a diversity of natural assets which enable it to be successful and many local livelihoods are also very dependent on these resources. Coastal ecosystems and water resources in particular, are already facing serious pressures from increasing (and sometimes poorly planned) development and poor land management practices thereby decreasing the resilience of plant and animal species. The natural resource base is also affected by climate-related events. St. Kitts has a history of damages and losses from natural disasters that not only interrupt development progress at the national level, but also result in the investment of much time and resources into rebuilding homes and livelihoods after an impact. Since there is high confidence that climate change will result in more intense hurricanes and extreme events, posing even greater threats to ecosystems and the population, preparedness for disasters and climate change adaptation become common goals.

The CCCRA explored recent and future changes in climate in St. Kitts 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 now to increase the resilience of economies, businesses and communities to climate-related hazards.

It is clear that the Government of St. Kitts and Nevis is committed to adapting to climate change, as evidenced by some policy responses, current practices and planned actions; particularly the planned renewable energy initiatives. However, financial resource shortages along with limited technical capacities hinder successful adaptation efforts across most government ministries and other stakeholder groups. Additionally, resource users with little or incomplete awareness of their risks and alternative courses of action continue to degrade or over-extract from marine and terrestrial ecosystems in an effort to sustain themselves. Enforcement of laws to protect biodiversity remains a challenge, as does land use planning and regulation of settlements. Continued work in data collection, monitoring and evaluation of climate change

adaptation policies, plans and activities will be key to successful development of a sustainable tourism industry in St. Kitts but also for development in the country as a whole.

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- The Institute for Gender and Development Studies, University of the West Indies, Mona Campus
- The Health Research Resource Unit, Faculty of Medical Science, University of the West Indies, Mona Campus
- Royal Utilities, St. Kitts Marriott Resort
- Ministry of Public Works, Housing, Energy and Utilities, St. Kitts Energy Department
- Nevis Island Administration, Ministry of Finance, The Statistics Office
- Ministry of Sustainable Development, Statistics Department
- Ministry of Health, Health Information Unit and Chief Medical Officer

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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 St. Kitts 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 St. Kitts.

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- ⁱ IPCC. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability*. In M. Parry, O. Canziani, J. Palutikof, P. van der Linden, & H. C.E., *Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, UK: Cambridge University Press.
- ⁱⁱ Simpson, M. C., Scott, D., Harrison, M., O'Keeffe, E., Sim, R., Harrison, S., *et al.* (2010). *Quantification and Magnitude of Losses and Damages Resulting from the Impacts of Climate Change: Modelling the Transformational Impacts and Costs of Sea Level Rise in the Caribbean (Summary Document)*. United Nations Development Programme (UNDP), Barbados, West Indies.
- ⁱⁱⁱ MOPWUEH (2011a) Draft Energy Sector Digest St. Kitts and Nevis. Ministry of Public Works, Utilities, Energy and Housing, Federal Government of St. Kitts and Nevis.
- ^{iv} PAHO. (n.d.). *Impact of Hurricanes on the Health Sector*. Pan-American Health Organization
- ^v UNISDR. (2009). *Hospitals Safe from Disasters 2008-2009 World Disaster Reduction Campaign*. United Nations International Strategy for Disaster Reduction.
- ^{vi} NEMA. (2010). *Saint Kitts and Nevis: National progress report on the implementation of the Hyogo Framework for Action (2009-2011) interim*. National Emergency Management Agency, Prevention Web.
- ^{vii} Elmes, L. (2001). Construction Principles and Practice as related to small buildings in St. Kitts and Nevis. Antigua: USAID/OAS PGDM building inspector training.
- ^{viii} Ebi, K. L., Lewis, N. D. and Corvalan, C. (2006). Climate Variability and Change and their Potential Health Effects in Small Island States: Information for Adaptation Planning in the Health Sector. *Environmental Health Perspectives*, 114(12), 1957-1963.
- Confalonieri, U., Menne, B., Akhtar, R., Ebi, K. L., Hauengue, M., Kovats, R. Sari, *et al.* (2007). Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. In M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden & C.E. Hanson (Eds.), (pp. 391 - 431). Cambridge, UK: Cambridge University Press.
- Gubler, D. J. (2002). Epidemic dengue dengue hemorrhagic fever as a public health problem. *Trends in Microbiology* 10(2), 100-103.
- Patz, J. A., McGeehin, M. A., Bernard, S. M., Ebi, K. L., Epstein, P. R., Grambsch, A. *et al.* (2000). The potential health impacts of climate variability and change for the United States. Executive summary of the report of the health sector of the U.S. National Assessment. *Environmental Health Perspectives*, 108(4), 367-376.
- ^{ix} MOE (2001). St. Kitts-Nevis Initial National Communication. Basseterre, St. Kitts-Nevis: Ministry of Environment, Government of St. Kitts Nevis
- ^x P. Martin, Ministry of Health, personal communication, September 2011
- ^{xi} Rawlins, S. C., Hinds, A. and Rawlins, J. M. (2008). Malaria and vectors in the Caribbean: The continuing challenge of the disease forty-five years after eradication from the islands. *West Indian Medical Journal*, 57(5), 462-469.

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