

Commonwealth Marine Economies Programme

Enabling Safe and Sustainable Marine Economies across Commonwealth Small Island Developing States

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Impacts of Climate Change on Tourism in the Coastal and Marine Environments of Caribbean Small Island Developing States (SIDS)

Davina Layne, Regional Project Coordinator, USAID Caribbean Clean Energy Program (CARCEP)

EXECUTIVE SUMMARY

Regionally, tourism is worth over US\$53 billion to the economies of Caribbean countries, and is therefore vital as an economic sector.

Tourism is also considered to be a highly climate sensitive industry (NCCARF, 2013), and climate change continues to be a cause for concern for the small island developing states (SIDS) of the Caribbean where strong evidence of warming has been observed since 1961 (Stephenson et al., 2014).

Climate change is already having a negative impact on the tourism sector in the Caribbean, with temperature increases causing coral bleaching and an increase in the frequency of droughts which affects the availability of water.

Damage and loss caused by storms and hurricanes has also risen and in 2015 damage from Tropical Storm Erika cost 90% of the GDP of Dominica.

Major tourism infrastructure including seaports and airports are at risk from a 1m rise in the sea level.

The costs of rebuilding damaged infrastructure located along the coasts is disproportionately high for Caribbean SIDS.

What is Already Happening?

Tourism is the engine of economic growth for the Caribbean Region and its biggest foreign exchange earner. In 2014 direct contribution to regional Gross Domestic Product (GDP) (including wider effects from investment, the supply chain and induced income impacts) was USD\$51.9bn in 2015 and rose to USD\$53.1bn. The direct contribution to employment was 709,000 jobs.

The Caribbean ranks 1st in tourism's relative contribution to GDP out of 12 regions, which confirms its place as the most tourism dependent region of the world. The Caribbean tourism industry must therefore remain strong and vibrant for the region to grow and prosper.

Tourism is seen as a climate-dependent industry and because many countries owe their popularity to their pleasant climate (Amelung et al, 2007), climate change effects and impacts can prove debilitating in many ways to this important Caribbean industry. Changes in temperature, water and drought issues, and changes in coral reefs are some of the effects already being observed here in the Caribbean.

Temperature

According to analysis by the World Meteorological Organization (WMO), 16 of the 17 warmest years have been recorded this century and the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA) have stated that the ten warmest years on record since 1880 (the year when record keeping officially began) have all occurred since 2000. At the time of writing, 2016 was on track to surpass 2015 as the warmest year on record. Indeed, the first nine months of 2016 were the warmest on record, with the WMO stating that these months have averaged 0.88°C above the average of the years 1961 - 1990. (New York Times, 2016)

Table 1 below summarises the climate change impacts which will all have varying effects (both positive and negative) for Caribbean countries.

Figure 1 shows the temperature data from four international science institutions, which all report rapid warming in the past few decades and further corroborates that the last



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Table 1: Main impacts of climate change and their implications for tourism. Adapted from: WTO-UNEP-WMO (2008) Climate Change and Tourism: Responding to Global Challenges

Impact	Tourism implications
Warmer temperatures	Altered seasonality, heat stress, cooling costs, infectious diseases
Increasing frequency and intensity of extreme storms	Risk for tourism facilities, insurance costs, business interruption
Changes to precipitation and evaporation	Water shortages, desertification, competition for water
Increased heavy precipitation	Flooding damage, altered seasonality precipitation
Sea level rise	Coastal erosion, loss of beach area, costs to maintain and protect sea defences and waterfronts
Sea temperature rise	Coral bleaching, marine resource degradation in tourism destinations
Changes in biodiversity	Loss of natural attractions

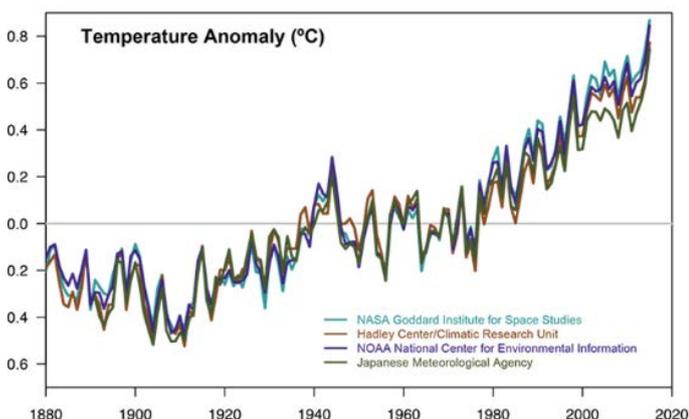


Figure 1: Temperature Data 1880 and beyond.

Data sources: NASA's Goddard Institute for Space Studies, NOAA National Climatic Data Center, Met Office Hadley Centre/Climatic Research Unit and the Japanese Meteorological Agency (NASA, 2016).

decade has been the warmest on record. In the Caribbean this warming has been validated by Stephenson et al, (2014) whose study concluded that between 1961 and 2010 strong evidence of warming has been observed for the entire Caribbean. Specifically, all temperature extremes have been increasing and additionally cold nights have been getting warmer.

As temperatures in Caribbean SIDS increase those who do travel to these island nations may find the heat uncomfortable and this may spoil their holiday and inhibit their return. Tourists may view the Caribbean as an undesirable place to visit because of the high temperatures. Restaurants, hotels and other tourism establishments will need to increase their cooling needs to combat the extreme heat. This presents an opportunity for resource efficiency and the use of renewable technologies in

order to create such efficiencies especially since the Caribbean hotel sector is currently seen as the largest electricity consumer sector in the region.

Oceans and Coral Reefs

The oceans are changing too; not only are their temperatures rising, but ocean chemistry is changing due to increased amounts of carbon dioxide dissolving into the water resulting in ocean acidification. Both of these changes have important consequences for coral reefs (Mumby et al, 2014). Globally the 3rd coral bleaching event was declared in October 2015. This event, which lasted for more than a year, also extended into 2016 and caused concern because corals can generally survive mild and/or short bouts of bleaching, but long term bleaching such as this is fatal as the coral's susceptibility to disease is heightened (NOAA, 2015).

For tourism, loss of corals increases the vulnerability of the beach to erosion during strong wave events since coral reefs provide a natural shoreline buffer and help to slow wave action. In addition corals are aesthetically pleasing and coral damage will affect the dive tourism sectors of major dive destinations such as Bonaire, Dominica and Cayman Islands which are heavily dependent on this aspect of their tourism. Healthy reefs allow the beach to accrete and allow for fish to thrive which is positive for local fisheries. Fisheries and agriculture are important linkage sectors for tourism and impacts which hamper the tourism industry negatively will also have a domino effect on these sectors. This is not good news for the livelihoods of many local persons who work in these two sectors.

Water and Drought

Coral based islands have limited water supply and managing the supply of fresh water in these islands is further complicated by the threat of climate change, which has the potential to significantly affect the hydrological cycle. Globally there is high confidence that the negative impacts of climate change on freshwater systems will outweigh the positive (Bates et al., 2008).

There is an immense requirement for water within the Caribbean tourism industry and as growth is experienced in the industry this demand will no doubt increase. In addition, the demand for water in the tourism sector will also affect the demand for water in other linked sectors for example agriculture (Emmanuel and Spence, 2009).

This demand however is a challenge, since rainfall has decreased in the Caribbean in the last century (MACC, 2010) with below average rainfall being recorded across the Caribbean in 2015 (NOAA, 2015). In 2015 Antigua saw its driest year since record keeping began in 1871 (Desitin, 2016) and indeed many Caribbean nations entered a period of drought in 2015 with less rain also falling into 2016. The drought then persisted for much of 2016. There was also an extensive period of drought across the Caribbean region during 2009-2010. As an example, Grenada is already experiencing climate changes seen through the increased occurrence of drought, lengthier dry seasons and

in turn shorter rainy seasons, increased temperature and coastal degradation (Grenada Intended Nationally Determined Contribution, 2015).

Tourism depends on water as a critical input and the effects of drought on the industry can adversely affect tourist comfort and destination perception. When water is unavailable it may mean, for example, that tourists are unable to have showers and baths. In the Caribbean which is typically a warm weather destination, this may prove to be an unpleasant experience. Other inconveniences such as being unable to flush the toilet or prepare a meal may also take a toll on guest experience.

During the tourist season, a drought can also place a greater demand on already stressed water resources as the number of persons on island has increased and there will therefore be a greater need for water per capita.

Since 2006 hotels on the West Coast of Barbados were experiencing water outages once or twice a month. The West Coast of Barbados is considered the affluent coast and these outages will have a negative perception in the minds of guests who stay at these hotels. In addition, hotels will need to implement coping strategies to deal with these outages (Emmanuel and Spence, 2009), which may include the purchase of water tanks and the installation of water saving devices and other water conservation measures.

In Barbados since the end of 2015 until 2016 water outages have persisted in various parts of the island especially in the North due to low water reserves and other issues (Nation News, 2016). This has also presented a challenge for the 2015-2016 tourism season.

Antigua and Barbuda has already witnessed saltwater intrusion and drought due to the worst drought in recent history, dating back to at least 1928. Between 1960 and 2000, there were eight years in which rainfall for Antigua fell below 30.74 inches. During the period 1965 to 2000, annual rainfall fell below 27.79 inches in Barbuda on 10 occasions.

Indeed, July 2013 to February 2016 was the driest such period on record, translating to Antigua and Barbuda missing about a year's worth of rainfall (Desitin, 2016).

Sea level rise (SLR)

Increases in sea levels can cause flooding, soil erosion, inundation and wave damage to coastlines, particularly in small island states and countries with low lying deltas. In the specific case of the Caribbean, sea levels have risen at a rate of approximately 1 mm/year during the 20th century (Cashman et al., 2010).

Studies on SLR in the Caribbean conducted by Simpson, 2010 show that SLR is significant for all states with nearly one-third of major tourism resorts and airports being at risk to 1m SLR. In addition a large majority of the land surrounding seaports is also susceptible to flooding from 1m SLR. Such a threat to key tourism and other infrastructure (such as seaports, airports, power plants and coastal tourism resorts) could be destructive to

this important industry, especially when you consider that rebuild costs for such infrastructure are disproportionately high for these small states and can represent as much as 28% of Gross Domestic Product (GDP) in the future.

Anthropogenic pressures

The United Nations Environment Programme (UNEP) states that the Caribbean and other SIDS produce less than 1 per cent of global emissions but are extremely vulnerable to changes in the climate.

Multiple studies published in peer-reviewed scientific journals show that 97 percent or more of actively publishing climate scientists agree: climate-warming trends over the past century are extremely likely due to human activities (Cook et al., 2016). In addition, most of the leading scientific organizations worldwide have issued public statements endorsing this position (NASA Global Climate Change, 2016).

Anthropogenic pressures, such as inadequate regulation and legislation, which among other things leads to poor coastal development, overfishing, land based pollution, sand mining and poor land use practices (including those of agriculture and mining), undermine the integrity of critical marine and coastal ecosystems which contribute to the quality of the tourism product. They weaken the ecosystem and lessen its ability to cope with the added stresses of climate change.

These are explained briefly below:

- Poor coastal development

Often (and due to the poor regulation and legislation described above) developers will destroy forests, coral reefs, mangroves and other areas along the coast which not only provide shoreline protection but also sequester carbon. In this regard the vulnerability of the coastline increases and it becomes exposed to erosion and storm surges.

- Land based sources of pollution

Dumping of garbage and overuse of chemicals in agriculture also pollute and disturb the marine environment when these then run off into the sea. This can lead to damage to reefs which in turns reduces the buffer that healthy reefs provide to coasts.

- Sand mining

Removal of sand from the beach destabilises the beach and exacerbates coastal and beach erosion which is already a problem on many islands.

These human activities, and the interplay between them, which have been detrimental to the natural and built environment can prove to intensify the effects currently being felt by climate change.

What Could Happen?

Despite being a highly responsive and flexible industry which adapts to demand for new destinations, activities and markets; tourism is also volatile and sensitive to economic, social,

ecological and technological changes. As such, for the Caribbean SIDS in particular, climatic changes can severely affect the travel and tourism industry (NCCARF, 2013). Moreover, changing climate and weather patterns at tourist destinations and tourist generating countries can significantly affect the tourists' comfort and their travel decisions (UNWTO, 2016). It is at this point questions of when, why, how and where tourists travel surface. Climate also determines the nature and location of tourism attractions, and shapes the marketing of many destinations. It further shapes tourists' expectations, experience and memories - determining whether they become returning tourists (NCCARF, 2013). For coastal and marine environments such as the Caribbean SIDS, where tourism is a major economic activity, any significant reduction in tourist arrivals will have serious employment impacts and generate further poverty (UNWTO, 2016), thus confirming the extent to which SIDS and tourism industries are vulnerable to short and long term climate variability and change (NCCARF, 2013).

In addition to specific climate related events that will affect tourism in coastal and marine environments of Caribbean SIDS (receiving countries), there also needs to be mention made of the effects of warming in source markets. Temperature increases in the United Kingdom and the USA for example can mean that fewer tourists will leave their homes to travel abroad for a holiday. This will no doubt have an effect on the foreign exchange earnings of Caribbean tourism destinations.

Coral bleaching and coral diseases have also become more frequent and the magnitude of the bleaching increased. This is expected to continue and from as early as the 2030s signs of severe coral stress and an inability for corals to recover will be evident (Simpson, M. C. et al., 2011).

Likely climate change impacts on tourism in the coming decades include:

- 10 years

In the near future (over the next 10 years) it is expected that climate change impacts will be aggravated. For example in Guyana there is expected to be an increase in flooding and salt water intrusion into aquifers due to sea level rise and in Antigua more coastal and beach erosion is expected. (Van Meerbeek, 2016)

- 20 years

Irrespective of the sensitivity threshold chosen, and irrespective of the emissions scenario, by the year 2040, Caribbean coral reefs are expected to experience annual bleaching events. While some species and particular locations appear to be more resilient to such events, it is clear that the marine ecosystems of the Caribbean are facing large-scale changes with far-reaching consequences for associated livelihood activities such as dive tourism and other marine and watersports activities as well as for the coastal protection provided by healthy coral reefs.

- 30 years and beyond

According to the World Bank, by the year 2050 coastal flooding with a sea-level rise of 20 cm could generate approximately \$940 million of mean annual losses in the 22 largest coastal cities in

the Latin America and Caribbean region, and about \$1.2 billion with a sea-level rise of 40 cm. The Caribbean region's tourism sector is particularly vulnerable to climate change due to its low-lying coastal areas and the population's dependence on coastal and marine economic activity – often related to tourism. In a scenario leading to a 4°C world increase and featuring 0.89–1.4 m of sea-level rise, tropical cyclones in the Caribbean alone could generate an extra \$22 billion by 2050 (and \$46 billion by 2100) in storm and infrastructure damages and tourism losses, compared to a scenario leading to a 2°C increase. This represents between 1% and 35% of GDP depending on the country, and many small islands would be unable to handle this disproportionate cost. The potential upsurge in tropical cyclone intensity may increase port downtime for ships and, therefore cause a rise in shipping costs. Beach tourism is particularly exposed to direct and indirect climate change stressors, including sea-level rise, modified tropical storm patterns, heightened storm surges, and coastal erosion. Coastal tourist resorts will be potentially two-to-three times more exposed to climate change-related stressors such as extreme weather events and salt water intrusion than inland touristic resorts (World Bank, 2014).

Until the end of the century it is expected that rainfall will decrease in the early part of the wet season therefore extending the dry season. Tourism and tourist facilities are large consumers of water, with visitors often consuming at least three times as much as the local population. (Charara et al., 2011) This fact will mean that the impacts of an extended dry season will also be more intense. More and more projections show that although the number of hurricanes will not increase, what will happen is that they will be more extreme which suggests greater damage (Van Meerbeek, 2016).

These in fact have already begun to occur, as demonstrated by the examples below:

Hurricane Ivan – Grenada

On September 7, 2004, Hurricane Ivan, a category 3 storm, struck the Caribbean island of Grenada, causing widespread destruction. The financial cost of the disaster was estimated at more than US\$900 million, more than twice the country's GDP. The hurricane damaged more than 80 percent of the country's building structures, and only two of the 75 public schools remained undamaged.

Severe disruption of the health sector also occurred, including the almost complete destruction of Princess Alice, the island's second largest hospital. An estimated 80 percent of the power distribution grid was lost, and nearly 70 percent of the tourism infrastructure was rendered uninhabitable. Hurricane Ivan also badly damaged the agricultural sector, with widespread damage to nutmeg crops, the island's principal agricultural export.

Tropical Storm Erika – Dominica

On August 27, 2015 Tropical Storm Erika passed over Dominica producing extraordinary rainfall with high intensity. Owing to the mountainous island topography and the saturated condition of the soil, the heavy rainfall resulted in intense and rapid flooding. Dominica suffered severe infrastructural damage, primarily

related to transportation, housing and agriculture with the worst damage occurring in the south and south east parts of the island.

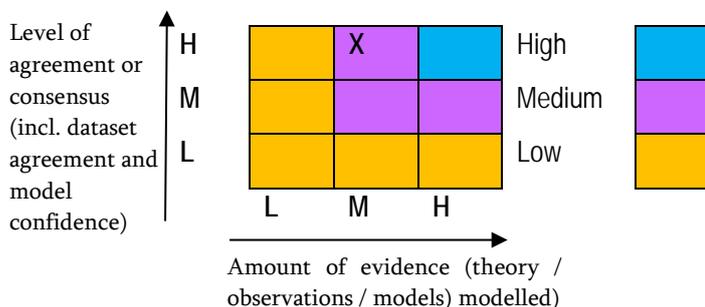
The major damage caused to roads, bridges, houses and agricultural land effectively eroded much of the socio-economic gains that the country had made over the previous decade. The total damage and loss was estimated at US\$483 million, equivalent to 90 percent of Dominica's Gross Domestic Product (GDP), according to the rapid damage and impact assessment conducted by the government of the Commonwealth of Dominica in collaboration with the World Bank, UN, and other development partners with funding support from the EU and the World Bank Global Facility for Disaster Reduction and Recovery. (World Bank, 2015)

Out of a total population of 72,340 persons, 11 persons were confirmed dead, 22 missing, 574 homeless and 713 evacuated with approximately 7,229 impacted by the event in disaster declared areas.

All in all, tourism suffers greatly from these climate change effects which cause disruption, damage to infrastructure and even death. The vulnerability of tourism to climate change is real and much attention needs to be directed to the sector to put the necessary legislative and infrastructural changes in place so that tourism could be bolstered as a sector.

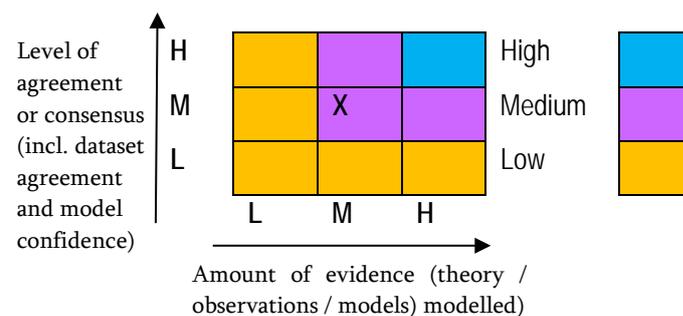
Confidence Assessment

What is already happening



The assessment here is based on the fact that climate change science as well as the study of climate change impacts on environments of Caribbean SIDS especially as it relates to coastal tourism is still quite new. The science is pretty clear that climate change has begun to affect SIDS including those in the Caribbean and many persons in the public domain do not discount that it has indeed started to affect this region. However, more needs to be done to identify specifically how these impacts will be felt. In particular, focus should be paid to any positive effects which may ensue from climate change as research on this area is currently lacking. With a bit more evidence in this region the level of confidence can be moved from medium to high.

What could happen in the future



The assessment here is based on the fact that although the science is able to show with great certainty that climate change will continue to have an impact (mostly negative) on the Caribbean region, the level of agreement and certainty regarding what this impact would look like as well as the effects of such an impact still need to be more robust (see Knowledge Gaps below).

Knowledge Gaps

In order to help support evidence based decision making the following gaps need addressing as a priority.

Lack of data and research

Across the Caribbean there needs to be an increase in data collection and research into the specific impacts of climate change as it relates to tourism. More work needs to be done in the area of data collection to monitor trends, so that statistically significant judgements can be made in relation to climate changes. In this regard, at present there is still a level of uncertainty about how the Caribbean tourism sector will cope with climate change and/or adapt to these changes. Further research also needs to be done to see how:

1. Sea level rise will affect coastal developments and hence livelihoods,
2. A warming of source countries will affect tourism arrivals and receipts in Caribbean nations
3. Increased temperatures in this region will impact on health of tourists as well as the local populace including tourism workers. Although some studies on economic loss have been done, these are often not incorporated into policy so that real and tangible change can be made. Specifically, there is a lack of information and research to make statistically significant conclusions, which presents a problem when the information is needed for studies such as this. In addition, many Caribbean SIDS have constructed large tourism developments along the coast.

Some studies of the potential socio-economic costs which will be incurred due to losses from climate change effects have been done, but many more Caribbean SIDS need to address the lack of studies of this topic in their nation. This needs to be corrected, so that the right perspective and importance can be placed on

climate change and so that the right adaptation measures can be put in place to build economic and social resiliency.

In addition, data and research will often bring to the fore what has been lacking and especially in terms of what is needed (for example equipment and protocols) to improve climate and climate change research.

Limited capacity

In the Caribbean there is a limited local awareness and capacity regarding climate and climate science and as such, decision makers are often not in a position to make robust decisions applicable for the local context. This also affects the ability to enact tough policy and legislation on climate change and its related impacts especially as relates to coastal and marine planning and development which could help to build climate resiliency. In Placencia in Belize, for example, many residents sense that the changes they have been seeing in the environment are due to the changing climate. On the other hand, they have also stated that human development has affected wildlife distribution and abundance (especially in the marine environment) and altered the physical landscape. For example, tourism and residential developments have been responsible for the clearing of extensive mangrove areas and still more expansion and mega developments are being planned. Building the capacity of decision makers and empowering them to enact robust laws, and to support the enforcement of the same, can reduce negligence and improve development decisions.

Socio-economic Impacts

The impacts of climate variability, extremes and change pose a serious threat to the social and economic development of the Caribbean region (Farrell, 2012).

There is robust evidence and high agreement that climate change will affect tourism resorts, particularly ski resorts, beach resorts, and nature resorts (Field et al, 2014).

A 2010 study from the Caribbean Catastrophic Risk Insurance Facility (CCRIF) showed that annual expected losses from wind, storm surge and inland flooding amount to up to 6 percent of GDP in some countries. Climate change has the potential to greatly exacerbate these risks, and could increase expected losses by 1-3 percent of GDP by 2030 (CCRIF, 2010).

Economic losses

In the Caribbean research reveals that weather and climate-related events are associated with more economic damage and loss cumulatively than other types of natural hazards. CDEMA (2013), has stated that for the period 1950-2008, wind storms have accounted for 60%, flooding for 25% while drought accounted for 5% of natural hazard events in the Caribbean. In 2004, Hurricane Ivan caused losses equivalent to 200% of national Gross Domestic Product in Grenada; floods in Guyana in 2005 were associated with losses of 60% of country GDP; while Hurricane Tomas accounted for losses in the order of 60% of GDP in Saint Lucia in 2010 (Farrell, 2012; WMO, 2013). Furthermore, in 2009/2010, the most severe drought in 50 years

reduced crop production, increased bush fires, and led to widespread water shortages and an increase in food prices across many islands (Farrell, Trotman, & Cox, 2010).

Simpson (2010) in a study on the magnitude of losses and damage of climate change in the Caribbean determined that a mid-range (1m) sea level rise (SLR) scenario will cost the Caribbean Community (CARICOM) US\$3.9billion in 2050 rising to US\$13.5billion in 2080. These costs will reach as high as \$US\$19.4 billion by 2080 under a high (2m) sea level rise scenario. In addition SLR is expected to cause almost full port inundation of infrastructure in all CARICOM states for a 1m SLR scenario. Under this scenario CARICOM countries can see a rebuild costs of between 1% and 35% of GDP depending on the country. In certain cases the impact cost is quite disproportionate to the GDP of these small islands.

Agro-tourism linkages

In the drought of 2009-2010 in St. Vincent and the Grenadines agricultural production reduced by 20% with prices on tomatoes rising from \$2.35/lb in February to \$6.00/lb in March. In Antigua and Barbuda during the same drought 25% of the onion crop and approximately 30% of the tomato crop were lost. Cases of high prices and reduced production such as these described here will affect availability of local produce at hotels.

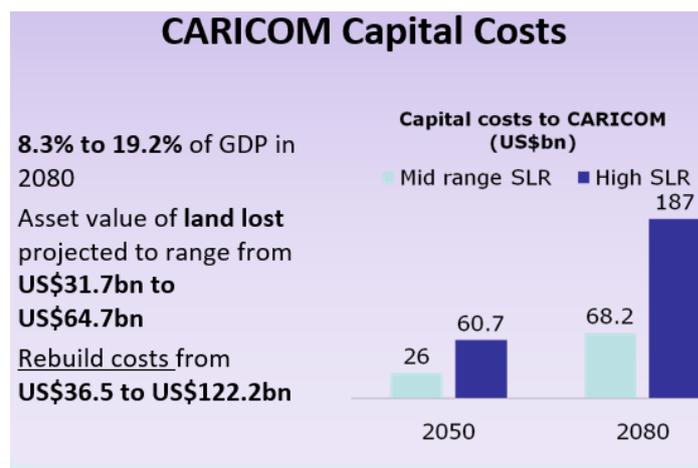


Figure 2: CARICOM Capital Costs re Sea Level Rise (SLR)
From: Simpson (2010) Quantification and magnitude of the losses and damages of climate change: Modelling the transformational and Costs of sea level rise in the Caribbean.

Total Annual and Capital Costs of SLR in CARICOM Countries*

	2050s		2080s	
	Annual Costs (US \$ billion)	Capital Costs (US \$ b)	Annual Costs (US \$ b)	Capital Cost: (US \$ b)
Mid-Range SLR Scenario	3.9	26	13.5	68.2
High SLR Scenario	6.1	60.7	19.4	187

(in 2010 USD)

*Plus undeveloped land loss of \$70 Billion

Figure 3: Total Annual and Capital costs of SLR in CARICOM countries

From: Simpson (2010) Quantification and magnitude of the losses and damages of climate change: Modelling the transformational and Costs of sea level rise in the Caribbean.

Human Health

With regard to temperatures beach oriented tourists will be vulnerable to adverse health effects when exposed to higher than normal temperatures and humidity levels. Heat related health issues such as extreme sunburn, heat stroke, and dehydration can all ensue from such temperature increases. A rise in temperatures may also create an increased guest demand for more water-intensive hotel facilities such as showers, swimming pools and bars. This will pose a significant challenge in areas which are already water stressed. The Technical Summary of the Intergovernmental Panel on Climate Change 5th Assessment Report (IPCC AR 5) states with very high confidence that there is a greater likelihood of injury, disease, and death due to more intense heat waves and fires. There is very high confidence that until mid-century, projected climate change will impact human health mainly by exacerbating health problems that already exist (Field et al., 2014).

This fact will be significant for employees in the tourism sector who will also be affected by temperature rise. Increases in illnesses will mean more sick days and may lead to the inability of the hotel to meet the needs of guests.

Destination perception

Degradation of coral reefs, higher sea levels and storm surge affect the recreational value of beaches; indeed, some studies in the region from Barbados, Bonaire and Martinique show that degraded beaches reduce the desirability of the destination (European Climate Foundation et al., 2014). In cases, such as this accommodation providers may be forced to reduce the prices they can charge guests.

When guests have a horrible destination or accommodation experience due to water shortages, beach erosion or other factor they may take to social media or another internet platform to express their frustration and dismay. This can damage a company's and country's brand. Some guests may even submit

claims for compensation or law suits which can create a marketing and financial nightmare for a hotel.

Adaptation Responses

For small islands, practical actions to manage the risks from climate impacts, protect communities and strengthen the resilience of the economy are important ways forward in adapting to climate change.

Two responses are discussed below; one which addresses a lack of capacity, and the other energy supply and use.

1. United States Agency for International Development (USAID) Building Regional Climate Capacity in the Caribbean (BRCCC)

To address these and other impacts going forward, the United States Agency for International Development (USAID), are funding a new Programme to build regional climate capacity in the Caribbean. This programme is called Building Regional Climate Capacity in the Caribbean (BRCCC) for adaptation to climate variability and change. Its primary focus is on Guyana and the islands of the Eastern Caribbean. Among other things, the Programme is a partnership and collaboration between the World Meteorological Organization (WMO) and the Caribbean Institute for Meteorology and Hydrology (CIMH) to develop seasonal forecasting capabilities in six climate sensitive sectors, namely, Agriculture and Food Security, Water, Disaster Risk Management, Health, Energy, and Tourism.

Climate variability and change occur on timescales ranging from sub-seasonal, through seasonal and inter-annual, to decadal and beyond. Climate information then, is related to specific timescales and can be short-term (decadal, monthly, seasonal, annual), mid-term (annual to multi-year) or long-range (decades in the future) in nature. Appropriate and timely sector specific, environmental, and climate information at relevant spatial and temporal scales can be particularly helpful to anticipate, prepare for and respond to climate-related risks and opportunities.

Sectoral Early Warning Information Systems across Climate Timescales (EWISACTs) hold the potential to be of great value because they can provide early warning of potential impacting climatic events that may have implications for a wide range of climate sensitive sectoral decisions. Three (3) specific objectives of developing sectoral EWISACTs are:

1. To design, develop and deliver an increased range of sector driven climate products and services;
2. To design, develop and deliver integrated decision-support processes and tools; and
3. To design, develop and deliver capacity building and training programs in support of climate services.

Four (4) short-term outcomes that are expected as a result of this process under the BRCCC Programme are as follows:

1. Established relationships between meteorologists/climatologists, scientists from other sectors and policymakers from across sectors;

2. Initiation of the development, deployment and platform integration of sector specific forecasting/planning models in the form of early warning systems;
3. Enhanced institutional capacity; and
4. Enhanced adaptive capacity.

For the Caribbean region, the formalisation of the development of sectoral EWISACTs is a landmark initiative and a positive step which will contribute to the implementation of the five pillars of the Global Framework for Climate Services (GFCS) and enhance the capacity of institutions to respond and adapt to the expected climatic changes.

2. The United States Agency for International Development (USAID) Caribbean Clean Energy Program (CARCEP).

The USAID Caribbean Clean Energy Program (CARCEP) an initiative which is largely directed at the beneficiary countries of Antigua and Barbuda, Barbados, Dominica, Grenada, Jamaica, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines, aims to assist these countries in establishing effective policy, legislative and regulatory environments as well as incentives for energy efficiency and low-emission growth in the energy sector.

This programme advances the work done under the Caribbean Hotel Energy Efficiency and Renewable Energy Action (CHENACT) Programme funded by the Inter-American Development Bank (IDB) and conducted through the Caribbean Hotel and Tourism Association (CHTA) and its regional public sector counterpart organization the Caribbean Tourism Organization (CTO). CHENACT and its advanced programme CHENACT-AP focused on Barbados, Jamaica and the Bahamas.

Sustainable growth in the region is one major benefit of the programme as reductions in energy consumption will deliver environmental benefits as well as improve regional economic competitiveness. There are approximately 2,500 hotels that can profit from this initiative. CHENACT worked with more than 150 hotels in the region, but through USAID CARCEP the number of hotels will be expanded and more countries will benefit.

Sound energy savings initiatives make good business sense, and protect the rich natural resources of the region which are an essential part of the Caribbean's touristic appeal.

One major output of CARCEP is the energy benchmarking tool. The tool, which was developed by USAID CARCEP, will allow hotel operators to analyse their electricity, fossil fuel and water usage; compare the energy and water intensity with similar hotels in their area; and learn about energy and water efficiency strategies they can employ to reduce hotel operating costs. Hotel owners in the CARCEP beneficiary nations will be equipped with access to technical tools, training and other resources to help them understand and adopt energy efficiency best-practices to reduce their energy consumption. This tool will allow hotel owners to gain valuable insight that can ultimately help them learn how best to maximize their return on investments. The tool

can highlight abnormal energy and water demands and unearth opportunities for savings and investments.

The next step is the roll out of USAID CARCEP's training program in each beneficiary country. This began in Jamaica in January 2017 and is aimed at demonstrating how to use the tool as well as how to implement energy saving measures at hotels and resorts.

Energy consumption in the region is as much as three times higher per USD \$1 of GDP generated than other regions of the world, putting this region at a real competitive disadvantage. For both climatic and economic reasons, it is imperative that we reduce fossil fuel consumption and turn those savings into jobs and industry for the region that will drive economic development and future growth.

Conclusion

It is hoped that these adaptation measures will bode well for the future of Caribbean SIDS and aid in reducing the potentially adverse impacts of climate change.

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