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Protecting and enhancing the livelihoods, environments and economies of the Caribbean Basin

CARIBSAVE Climate Change Risk Profile for The Turks & Caicos Islands

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 THE TURKS AND CAICOS ISLANDS

The Turks and Caicos Islands economy relies primarily on tourism and fisheries. These sectors, and others, are dependent on the state of the natural environment, so climate change impacts will adversely affect the livelihoods based on these sectors.

Detailed climate modelling projections for the Turks & Caicos Islands 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 **Lower Bight** area to climate change; and
2. project sea level rise and storm surge impacts **on Grand Turk Cruise Centre, Grand Turk West Shore and Historic Cockburn Town**.

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

Vulnerable community livelihoods

- Flooding of Lower bight main road creates access problems.
- Even small storm surges results in beach erosion.
- Community residents depend on natural resources which are impacted by climate change.
- Very few fishermen and craft vendors have insurance.
- Women and men have unique vulnerabilities that are determined by their choice of livelihood.

Vulnerable coastlines

- Natural sand dunes have been lost to development in East Grace Bay, Pelican Point and Emerald Bay, making them more susceptible to SLR and storm surge
- 0.5m of SLR results in the loss of 53% of the beach at Grand Turk, West Shore; and 65% of the beach at Historic Cockburn Town.
- Coral reefs are already impacted by sedimentation and overfishing.
- 1m of SLR results in the loss of 61% of the beach at Grand Turk Cruise Centre.

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 MODELLING PROJECTIONS FOR THE TURKS AND CAICOS ISLANDS

The projections of *temperature, precipitation, sea surface temperatures;* and *tropical storms and hurricanes* for The Turks & Caicos Islands 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.

Box 1: Climate Modelling Projections for the Turks and Caicos Islands

Temperature: Regional Climate Model (RCM) projections indicate an increase spanning 2.3˚C to 2.9˚C by the 2080s in the higher emissions scenario.

Precipitation: General Circulation Model (GCM) projections for annual rainfall span both overall decreases and increases ranging from -29 to +8 mm per month by the 2080s across three emissions scenarios. Most projections tend toward decreases. RCM simulation driven by HadCM3 boundary conditions indicates a large decrease (-35%) whereas that driven by ECHAM4 indicates a small increase (+2%) in annual rainfall.

Sea Surface Temperatures (SST): GCM projections indicate increases in SST throughout the year. Projected increases range from +0.9˚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

The Turks and Caicos Islands are two groups of 40 islands and cays separated by a deep water channel. Only 8 islands are inhabited. The majority of infrastructure and settlements in the Turks & Caicos Islands, 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, and in particular SLR, will magnify these pressures and accelerate coastal erosion.

Figure 1: High Resolution Coastal Profile Surveying with GPS

The CARIBSAVE partnership coordinated a field research team with members from the University of Waterloo (Canada) and the staff from the Department of Environment and Coastal Resources (DECR) of the Government of the Turks and Caicos Islands to complete detailed coastal profile surveying. To evaluate the vulnerability of beaches and coastal infrastructure to SLR and storm surge, Grand Turk Cruise Centre, Grand Turk West Shore and Historic Cockburn Town 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.

Figure 2: Erosion at Cedar Grove Beach, TCI

The field study sites include notable resorts, ports and an airport that are at less than 6 m above sea level. Beach area losses in Turks and Caicos were also calculated for 0.5 m, 1 m, 2 m and 3 m scenario (Table 1**Error! Reference source not found.**). At a 0.5 m SLR scenario, more than half of the beach area will be lost in Grand Turk West Shore (53%) and Historic Cockburn Town (65%). All (100%) of the beach area will be lost in Historic Cockburn Town under a 2 m SLR scenario, with all (100%) of the beach area in Grand Turk Cruise Centre and Grand Turk West Shore under a 3 m SLR scenario. It is important to note that the critical beach assets would be affected much earlier than the SLR induced erosion damages to tourism infrastructure due to SLR-induced coastal erosion. Indeed if erosion is damaging tourism infrastructure, it means that the beach will have essentially disappeared.

Table 1: Beach area losses at three beach locations in the Turks and Caicos Islands

	Grand Turk – Cruise Centre		Grand Turk – West Shore		Historic Cockburn Town	
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 (%)
0.5m	12,149	45%	30,874	53%	4,275	65%
1.0m	4,380	61%	9,887	70%	1,019	81%
2.0m	9,886	97%	13,723	94%	1,247	100%
3.0m	778	100%	3,750	100%	-	-

Table 2 shows that with projected 50 m erosion, 95% of the resorts in the Turks and Caicos Islands would be at risk, with all (100%) at risk with 100 m of erosion. Sea turtle nesting sites are also severely impacted by SLR induced erosion, with 100% of these sites impacted with a 50 m erosion scenario. Such impacts would transform coastal tourism across the Turks and Caicos Islands, with implications for property values, insurance costs, destination competitiveness, marketing, and wider issues of local employment and the economic well being of thousands of employees.

Table 2: Impacts associated with 1 m and 2 m SLR and 50m and 100m beach erosion in the Turks and Caicos Islands

EVENT	SCALE	Tourism Attractions		Transportation Infrastructure		
		Major Tourism Resorts	Sea Turtle Nesting Sites	Airport Lands	Major Road Networks	Port Lands
SLR	1.0 m	73%	44%	50%	4%	40%
	2.0 m	86%	60%	-	6%	-
Erosion	50 m	95%	100%	-	-	-
	100 m	100%	-	-	-	-

As shown in Figure 3, SLR in the historic downtown Cockburn Town on Grand Turk Island would result in a total land loss of 85,140.15 m^2, with a total beach loss of 6,541 m^2. Grand Turk Cruise Centre will face similar land loss impacts (85,140.15 m^2), with an even greater beach loss of 27,192.62 m^2. This will have significant implications for the shoreline, with a loss of high value commercial tourism properties, including the popular White Sands Beach Resort.

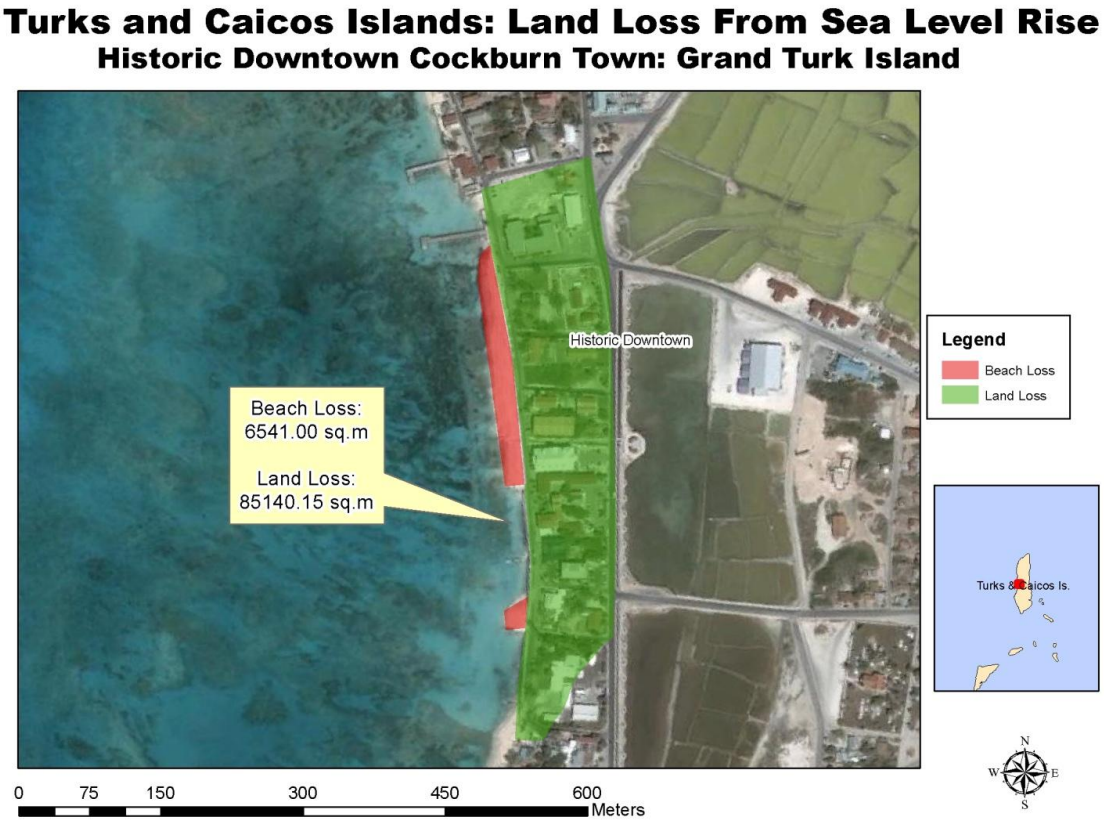

Figure 3: Total beach and land loss from SLR, Historic Downtown Cockburn Town, Grand Turk Island

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 TCI's main tourism attractions.

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.

The current and projected vulnerabilities of the tourism sector to SLR, including coastal inundation and increased beach erosion, will result in economic losses for The Turks & Caicos Islands and its people if no action is taken to minimise infrastructure losses. Adaptation interventions will require revisions to development plans and investment decisions and these considerations must be based on the best available information regarding the specific coastal infrastructure and ecosystem resources along the coast, in addition to the resulting economic and non-market impacts.

Engineered structures and natural environments (e.g. mangroves) can protect against some of these impacts to coastal regions, but the dynamics of these erosion processes will demand some adaptation of coastal infrastructure and settlements. 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.

COMMUNITY LIVELIHOODS, GENDER, POVERTY AND DEVELOPMENT

Figure 4: A small group creating vulnerability map

More than 50 residents and workers from the Lower Bight community 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 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.

Community Characteristics and Experiences

Lower Bight is located adjacent to Grace Bay along the northern coastline of the island of Providenciales, the tourism capital of the Turks and Caicos Islands and tourism is the major economic activity in this community, with numerous accommodation facilities, restaurants, arts and craft sales and marine excursions. Lower Bight Road, which is the main road and access lane in the community, runs parallel to the

coastline and divides the area into one zone with residential pockets (landward side, including some low-income households) and the seaward side where many tourism and other business entities are located. There are also some schools, churches and Government departments located in the area. Many of residents who live in Lower Bight are therefore employed by hotels or some of the smaller tourism enterprises and work as tour guides and taxi operators. Some residents are also craft vendors and are mainly patronised by tourists.

The sea, beaches, reef systems and marine life provide a basis for operating numerous enterprises within Lower Bight, mainly within the tourism and fisheries industries. However, these resources face tremendous pressures from both natural and human sources, including storms, diseases, pollution and changes in the environment. Based on its coastal location and the sloping nature of the land, people and infrastructure in Lower Bight are vulnerable to the yearly impact of hurricanes and landslide events (specifically the low-income households located on the southern side of the ridge), coastal inundation and storm surge impacts.

Community members have also observed gradual changes in weather patterns such as an increase in the frequency and intensity of hurricanes, increasing ambient temperatures (as compared to previous years) and warmer sea surface temperatures (SSTs) which have resulted in bleaching of near shore reefs. Winter months were also reported to be warmer than normal.

With regards to flooding impacts, Lower Bight experienced some flooding in November of 2008 and in summer of 2005 (two events in 2005). The community sits on a hill above the coast, but the coastal road (Lower Bight Road) is the main access road, which can be (and has been) cut off during a flood.

Light to moderate storm surge events will cause major beach erosion and affect hotel properties and facilities that are situated on the beach. However, more extreme storm surge events can cause coastal inundation and more extensive damage to coastal infrastructure. Some properties with swimming pools on the beach have been so affected by beach erosion that the pools were subsequently demolished. Small craft (yachts, dive boats, fishing boats) docking along the coast (e.g. in Turtle Cove Marina, though not in Lower Bight proper) are extremely vulnerable to storm surge impacts, and have been severely damaged during hurricanes despite heavy anchoring.

Figure 5: Kirk Delaney (far right), a community member, was trained by CARIBSAVE to conduct the livelihoods survey with other persons from Lower Bight

Of the several climate-related issues for residents of Lower bight, the main concerns include hurricanes and localised flooding (which is not always associated with a hurricane). Recent experiences with extreme weather events include Tropical Storm Hanna and Hurricane Ike, both of which occurred within a span of two weeks in 2008; and localised flooding later that year from heavy rains. In all instances, some tourism and related businesses were temporarily closed and persons working in agriculture, fisheries (although small) and craft vending were also severely impacted. Employees were compensated for the time of closure; however self-employed persons had no source of income for a period of time. There was no loss of life, or significant loss of property but extensive power outages and blocked access roads necessitated the use of traditional methods for food preparation.

Perceptions of vulnerability in the community may suggest that women tend to bear more social vulnerabilities because of the burden of family care (especially in female-headed single-parent households), and differential access to resources, whereas men bear more physical vulnerabilities owing to their attitudes about safety and precaution, and underestimation of risks. However, the extent of vulnerability appears to be more related to employment status (employed by a company; self-employed; unemployed) and less with gender since both genders have similar employment statuses even if in different areas. For example, mainly women work in hotels as ancillary staff and housekeeping, while men work as security guards, chefs and bartenders. Fishermen and craft vendors (mostly female) are self-employed. This is consistent with and generally accepted that poverty is the most contributory factor to vulnerability. Poor persons in the community (with little or no access to financial, food and other resources; and who live in vulnerable homes) lost most of their already small asset-base in the passage of Hannah and Ike.

There are no strong or formal community organisations which contribute to the running of the community in Lower Bight specifically, but smaller, less formal community groups exist to effect micro-scale community development. It would therefore be important to identify opportunities for community level disaster mitigation activities that can be implemented through collaboration between the Department for Disaster Management and Emergencies, the sub-national disaster committees and local communities. The establishment of the disaster group in Lower Bight will help build community cohesion, while at the same time increasing the community's resilience to climate-related hazards. Relationships should also be built with other organisations such as the Turks and Caicos Red Cross Society (one unit is based in Providenciales), emergency service providers and donors to facilitate training, education, mitigation and rehabilitation activities.

To accommodate those most vulnerable people in the community an official hurricane shelter in the Lower Bight area should be established, and the structural integrity of buildings that are currently used as provisional shelters should be improved. The hurricane shelter can also serve as a community centre outside of the hurricane season, and when no immediate storm threat exists. Capacity building in alternative livelihoods would also be of benefit to those who are and would continue to be impacted by climate-related events.

AGRICULTURE AND FOOD SECURITY

The agriculture sector in the Turks and Caicos has been severely neglected over a sustained period of time. National account statistics indicate that the sector's contribution to GDP is about 0.65%, and only about 2.33% of the total land mass is considered to be arable land, the majority of which is located on North and Middle Caicos as small holdings. The Turks & Caicos Islands Investment Agency has distinctly identified North Caicos as the potential "bread basket" of the islands. More specifically, the agricultural communities of Bottle Creek, Whitby, Sandy Point and Kew have been identified where local farmers successfully grow

crops such as spring onions, peppers, tomatoes, cabbages, okras, cantaloupe, aubergine, cucumbers, papayas, melons, herbs and condiments. However, there is significantly less farming activity now than before.

Figure 6: A young farmer from North Caicos
Source: http://tcweeklynews.com/boost-for-tci-farming-p1929.htm

Understandably then, more than 90% of food currently consumed in Turks and Caicos is imported from the U.S., Haiti and the Dominican Republic. The implications for food security are concerning if there is a shortage or transportation delays from source markets resulting from climate change and extreme weather events.

Although agriculture constitutes a minor industry in the Turks and Caicos Islands, the sector exhibits a high vulnerability to the existing climate, and is especially susceptible to extreme weather events. An ECLAC disaster assessment[iii] found that the passage of Tropical Storm Hanna and Hurricane Ike within days of each other in 2008 caused almost complete devastation to vegetable, fruit and root crops in Turks and Caicos. Tree crops including coconuts, sapodillas, sugar apples, avocadoes and mangoes, were also severely damaged by hurricane winds. Commercial fishers lost trap boats, traps, and sustained structural damage to three processing plants which hindered fishing activities following the hurricane and led to spoilage of some stock.

A significant factor contributing to the vulnerability of this sector is soil degradation as a result of uncontrolled land use practices, particularly the increasing number of luxury tourism developments. Social vulnerability of the farming districts is characterised by the dearth of farmers available to sustain the sector and local demand and the fragmented nature of the sector with small-farmers scattered across the various islands. Additionally, agro processing and post harvest facilities in the Turks and Caicos Islands are limited, and there are presently no commercial cottage industries on any of the islands. Equally important, many TCI farmers have little knowledge of climate change impacts on their livelihoods. These factors clearly limit the capacity for agricultural advancement and for enabling food security.

Presently, adaptive capacity for responding to climate change impacts on agriculture is severely limited. While there is a Plan for Managing the Marine Fisheries of The Turks and Caicos Islands, there is no clear policy for agricultural development. However, the action plan for climate change adaptation as outlined in the Turks and Caicos Islands Climate Change Green Paper (2011) includes the following measures:

- Promoting traditional land management practices that conserve soil fertility and biodiversity and protect ecosystem functions and processes
- Practicing aggressive management of invasive species that threaten agricultural production
- Restoration of degraded areas
- Investment in new technology such as hydroponics and biotechnology/bio-safety.

In an effort to enhance local agricultural outputs, the Government of the Turks and Caicos Islands has embarked on an initiative and made five thousand acres of land in North Caicos available to farmers. This land has fresh water lenses and will be restricted for agricultural use. The Government farm in North Caicos is to benefit from a US $150,000 cash injection to buy new equipment and modernise the 140 acre facility. While this is necessary step in addressing food security issues, an overarching policy framework should be developed to reinforce the proposed plans for improving agricultural production and will ensure a systematic approach to sustainable agricultural development.

To encourage greater participation in this sector a capacity building programme should be developed for existing and potential farmers on new agro-technologies, soil and water management, and adaptation to climate change. The Government demonstration farm can be used as a multi-purpose site for training and also for research to determine which crops can best be grown in Turks and Caicos and under what conditions. On-site experiments should incorporate organoponics, hydroponics, greenhouse and other technologies in collaboration with the farmers' association, local schools and colleges.

ENERGY AND TOURISM

Tourism is an increasingly significant energy consumer and emitter of greenhouse gases (GHG) both globally and in the Caribbean. TCI belong to the region's high emitters, producing more than the global annual average. This has resulted in part by the fact that current tourism related energy use and associated emissions in Turks and Caicos are estimated to be the equivalent of almost 150% of estimated national emissions. Cruise ships (39%), aviation (30%), and accommodation (15%), were identified as the major direct consumers of energy and emissions.

Electricity is supplied to the islands by two providers. The islands of Providenciales, North, Middle and South Caicos are supplied by Fortis Turks and Caicos who operate Provo Power Company Ltd. (PPC) and Atlantic Equipment and Power (Turks and Caicos) Ltd. The latter serves South Caicos only. Turks & Caicos Utilities, Ltd. (TCU) supplies Grand Turk and Salt Cay. Over 2,200 customers in Grand Turk and Salt Cay are supplied with electricity from two diesel-fired plants with a total installed capacity of 11.043 MW but the estimated peak demand is 4.5 MW. The relative lack of hotels on these islands means that residential and commercial customers represent the largest consumers, although given that the seat of government is on Grand Turk, they are also a significant customer. This excess capacity may also mean that introduction of renewable energy technology on these islands might not be strongly considered.

The following tables provide statistics for the growth in electricity consumption by sector for all TCI islands combined (See Table 3). No further information is available on either bunker fuels, oil imports for generators (electricity production), or emissions of greenhouse gases. In recent years, consumption has increased across sectors and across islands, doubling in 6 years for the commercial sector. Providenciales and Grand Turk have increased consumption by 82 and 71% respectively. Demand for power in Providenciales has grown consistently since the 1990s, driven by tourism and real estate development (especially hotels and condominiums)[i].

Table 3: Growth trends in energy consumption in Turks and Caicos by sector, 2002-2007

MWh	2002	2003	2004	2005	2006	2007
Residential	29,882	33,738	36,755	42,613	49,242	57,521
Commercial	17,296	18,954	22,638	26,899	34,755	41,437
Government	5,846	6,134	6,837	7,387	8,374	9,413
Street lights	821	1,174	997	1,385	1,527	2,151
Other	39,672	41,621	39,021	42,705	50,660	56,933
Total consumption	93,517	101,621	106,247	120,989	144,559	167,456

(Source: DEPS, 2008a)

Even though economic growth has slowed since 2008, it is still unclear how trends in energy use will develop, though an increase in international tourism and in particular cruise tourism, would indicate that

energy consumption in the islands is bound to see further growth once the global economic situation improves.

An increase in the intensity 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, as experienced during Hurricane Ike in 2008 when over 95% of the distribution network (poles, lines, line hardware, transformers, generator buildings) was destroyed.

Power generating stations and other major infrastructure located on the coastline are also highly vulnerable to damage from flooding and inundation resulting from SLR and storm surges. Temperature increases have been shown to reduce the efficiency of energy generation at thermal power plants and reduced precipitation may affect water availability for non-contact cooling of power generators. The impacts of climate change affecting energy systems in TCI should therefore be assessed for existing traditional sources as well as the planned renewable energy sources.

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. In Grand Turk following Hurricane Ike, the desalination plant had to borrow two generators in order to continue supplying water for the 2 weeks that electricity was unavailable. It was estimated that it would take approximately three months for the TCU rehabilitation work to be completed (up to 6 weeks for PPC) and replacement equipment would have to be sourced from North America. Following the damage to distribution infrastructure experienced during Hurricane Ike in 2008, both companies made efforts to reduce their vulnerability to future events by upgrading the replaced infrastructure.

With regard to adaptive capacity of the utility providers themselves, both electricity companies have high reserve capacity to ensure that the system can withstand unplanned outages during periods of peak demand or in the event of failure of one or more generating units. PPC has invested in higher efficiency generation plant and is actively addressing the efficiency of its fuel supply by increasing its fuel storage capacity with new infrastructure. This is the most immediate action that can be taken to improve fuel supply since it can reduce frequency of shipments, decrease costs, and increase an isolated system‘s power reliability. However it is uncertain if the physical impacts of climate change were given consideration.

Indirect climate change impacts may also be 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.

Another factor to consider is that the stability of the energy market in TCI is threatened by rising fuel prices. This is especially concerning given the high costs of transportation (no deep water ports), small market and inability to use cheaper fuels. Fuel prices are relevant for the tourism system as a whole because mobility is a precondition for tourism and rising oil prices will usually be passed on to the customer. This was evident in 2008 when many airlines added a fuel surcharge to plane tickets in order to compensate for the spike in oil prices. Increased travel costs can therefore lead to a shift from long haul to short haul destinations.

Other than off-grid, small solar and wind systems at individual premises there is virtually no uptake of renewable energy in the Turks and Caicos though there is considerable renewable energy potential. But

the country has laid the groundwork for future renewable energy and energy efficiency initiatives through the development of the Energy Conservation Policy and Implementation Strategy. In 2010, the Advisory Council on Renewable Energy recommended:

- Supporting private investment in renewable energy technologies through the use of Crown Land, tax deferral and/or concessions.
- Reviewing and considering the feasibility of renewable energy generation targets binding on utilities.
- Changing building and planning regulations to support micro-generation and water efficiency.
- Clarifying cost structures and incentives for existing suppliers to invest in renewable energy.

Since traditional tourism management is primarily concerned with revenue management, to facilitate the transformation of tourism towards becoming climatically sustainable will necessitate concerted efforts in mitigation even to the extent of aiming to achieve carbon neutrality. Emissions and revenue also need to be integrated and energy intensities need to be linked to profits. While this would demand a rather radical change from current business models in tourism, all aspects of a low-carbon tourism system are principally embraced by business organisations. An indicator in this regard can be eco-efficiencies, i.e. the amount of emissions caused by each visitor to generate one unit of revenue. However, this kind of analysis is generally not as yet possible for Caribbean islands due to the lack of data on tourist expenditure by country and tourist type (e.g. families, singles, wealthy-healthy-older-people, visiting friends and relatives, etc.).

In consideration of the renewable energy and energy efficiency potential, the Climate Change Green Paper supports the need to develop an Energy Policy as an important adaptation strategy and concludes that mitigation measures can provide useful benefits such as energy cost savings and recognition as a low-carbon destination. Through continued study, monitoring and fundraising, the barriers and resource shortages can be sourced for successful implementation of this strategy.

Given the importance of tourism in TCI and the potential for sustainable energy initiatives within this sector, it is vital for governments to engage all tourism actors in adopting a sustainable tourism policy, because tourism is largely a private sector activity. The Climate Change Green Paper identifies a number of actions related to energy use in the tourism sector in the short, medium and long term. In the short term it recommends that the tourism industry be encouraged to reduce energy use and build eco-friendly designs. In the medium term it calls for the adoption of greener technologies at tourism facilities and in the long term for attaining Green Globe, Green Key and Green Hotel certifications.

Furthermore, governments are involved in creating infrastructure such as airports, roads or railways, and they also stimulate tourism development, as exemplified by marketing campaigns. The choices and preferences of governments thus create the preconditions for tourism development and low-carbon economies. There is growing consensus that climate policy has a key role to play in the transformation of tourism towards sustainability, not least because technological innovation and behavioural change will demand strong regulatory environments.

Turks and Caicos have laid the groundwork for future renewable energy and energy efficiency initiatives through the development of the Energy Conservation Policy and Implementation Strategy. However, more effort and resources are required to develop the action plan that will lead to meaningful implementation, particularly with regard to the major energy consuming sectors currently not considered, i.e. shipping and aviation.

WATER QUALITY AND AVAILABILITY

The Turk Islands in the southeast receive low annual rainfall of 533 mm; the north west of the group, including the major islands of North Caicos and Providenciales, receive nearly double this amount. This high variability in rainfall patterns means that drought may be experienced in individual islands independent of others. According to the Country Poverty Assessment for the Turks and Caicos Islands, Grand Turk and Salt Cay are particularly affected by higher water demand in comparison to available water resources. Also, 87% of hotel rooms are located in Providenciales and as such the greatest water demand for the sector may be associated with this.

Figure 7: Small-scale reverse osmosis technology

Potable water is typically sourced from reverse osmosis desalination of brackish, underground water on the populated islands of Providenciales, Grand Turk and Salt Cay; while on the less populated islands, many homes have sizeable cisterns to store water (which have been required by law), and these may be replenished either from rainwater or via truck-borne water supplies. Non-potable water resources including sea water and brackish groundwater are also utilised for flushing toilets.

Cisterns have been an important means of reducing water shortages, especially during the passage of hurricane systems. For example, after Tropical Storm Hanna and Hurricane Ike, in islands which primarily use cisterns, water supply was not a significant problem except for temporary damage to piping, much of which was fixed rapidly by the locals themselves. However, in Grand Turk, where water is produced from desalination, water supplies were disrupted due to cuts in the electricity supply until stand-by generators were engaged.

Changes in rainfall patterns associated with climate change may lead to a decrease in fresh water availability and more frequent and severe droughts. This will affect the ability of the country to harvest rainwater and it is likely that the dependency on desalinated water will increase, leading to an increase in the cost of water supply. Among the damages that SLR may cause are the loss of agricultural land and coastal fresh water resources through erosion, and salt water intrusion into aquifers. SLR may also result in damage to infrastructure associated with desalination infrastructure. Since a reduction in precipitation is expected as a result of climate change, drought management will become a progressively large challenge, requiring a multifocal approach due to its non-structural nature and complex spatial patterns.

The institutional and regulatory framework for water management in the Turks and Caicos Islands is limited to water supply management and, to a much lesser extent, wastewater management. Water demand management, water supply planning, protection of underground water quality and the monitoring and regulation of desalination are all lacking[ii]. The National Socio-economic Development Strategy aims to address these deficiencies and deliver a sustainable water supply, as well as addressing previously neglected aspects of water resources management through new and improved waterworks infrastructure and the development of centralised wastewater system.

In the Climate Change Green Paper, the following climate change adaptation strategies are given for water resources and these should be implemented as a priority:

1. Educate the public on water conservation measures.
2. Rainwater harvesting (i.e. from rooftops) and tanks: to store rain water as an alternative source of drinking water so that communities aren't solely reliant on groundwater.

3. Increase resilience to heavy rain events by improving infrastructure design
4. Local watershed management: support institutions that have the authority to manage the local catchment in the interest of all stakeholders, including domestic water users; ensure there is proper accountability in these institutions.

Additionally, water infrastructure should be developed to increase access to sanitation facilities and safe water so as to reduce vulnerability to climate variability and extreme events including droughts and major storms or hurricanes**.** In particular, the viability of additional large public storage facilities should be assessed, allowing improved access to potable water in different communities; losses in water distribution should be reduced through pipe replacement, and monitored through the use of electronic bulk metering; adequate desalination capacity during power outages should be ensured by equipping plants with back-up power generators with a sufficient fuel supply.

COMPREHENSIVE NATURAL DISASTER MANAGEMENT

The natural hazards facing Turks and Caicos are numerous and unpredictable, therefore investments in preparedness and capacity building will improve the overall resilience to impacts when they *do* occur. TCI is located within the Atlantic Hurricane Belt, however, it is fortunate to have been *significantly* impacted by fewer than 20 storms since 1492.

Figure 8: Damaged causeway connecting Middle and North Caicos following Hurricane Ike, 2008
Source: http://www.turks-and-caicos-adventure.com/middle-caicos.html

Vulnerabilities clearly exist and were evident in the recent passage of Hurricane Irene which caused serious flooding problems in August 2011. The lack of variation in topography creates excellent conditions for flooding when there are periods of heavy rain, and storm surges also regularly impact the coastal areas when tropical storms pass the island chain. Roadways were impassable for several days even after Irene had moved away from TCI. Three feet of water in some areas not only affected transportation, but also highlighted the need for flood-proofing of homes and businesses.

Figure 9: Hurricane Ike damages in Grand Turk
(Source: Associated Press, Brennan Linsley, 2008)

However, more serious impacts had been experienced in 2008 when two storms, Hanna and Ike, impacted the Turks and Caicos in close succession. Tropical Storm Hanna circled the islands effectively impacting them twice over 4 days! These two storms demonstrated the great vulnerability of public utilities to high winds. The 2008 UNECLAC report's assessment of the damages and losses (Table 4) caused by

Hanna and Ike reveal the strong dependence on tourism economically, but also the high vulnerability of the tourism sector.

Table 4: Distribution of impacts from Hanna and Ike by productive subsector (US $)

Sector	Damage	Loss	Total	% of impacts
Tourism	$2,966,141.00	$8,849,917.00	$11,816,058.00	**57%**
Agriculture	$337,250.00	$74,025.00	$411,275.00	**2%**
Fisheries	$832,115.00	$1,220,000.00	$2,062,115.00	**10%**
Wholesale and Retail Trade	$3,951,840.00	$2,603,637.00	$6,555,477.00	**31%**
Environment (waste removal)		$4,800.00	$4,800.00	
Total	**$8,090,130.00**	**$14,772,379.00**	**$22,862,509.00**	

(Source: ECLAC, 2008, p. 15)

Damages to the tourism sector included many damaged roofs. Although Providenciales, where the majority of the hotel rooms are located, was spared any serious damages, they still had to keep 80% of the hotels closed for two weeks from the time Ike passed causing interruptions to employment and lost revenues nearing US $2,000,000[iii].

Following these storms, the UK Government provided a grant to TCI to assist with the recovery and future preparedness efforts. The focus of their funding went to health, education, housing and preparedness, while not-for-profit organisations assisted with the construction of water storage facilities and sanitation projects. Hazard and Vulnerability Assessments were also conducted to produce hazard maps which can be used to inform physical planning decisions and emergency planning procedures including sheltering and evacuation.

The Department of Disaster Management and Emergencies has support from community organisations and civil society groups and together they are slowly working toward getting more national committees on board with disaster risk reduction efforts. But in the absence of legislation for disaster risk reduction, the effectiveness of the Department of Disaster Management and Emergencies cannot reach its full potential. Still, recent public awareness efforts and hazard mapping exercises improve both disaster management efforts as well as providing valuable climate change adaptation capacity.

The TCI Department of Planning and other related ministries determined in the National Development Strategy that efforts would be made to review current Physical Planning regulations and legislation in addition to establishing a monitoring and enforcement unit. While it is unclear whether this will include consideration of hazards and climate change, regular review of planning procedures and policies is a good practice and given that this process is listed within environmental management efforts, it is likely that high-risk areas would be addressed as a priority. The establishment of a monitoring and enforcement unit is also positive as it will help control growth and ensure regulations are adhered to throughout the islands.

With limited human and other resources in times of disaster, it becomes imperative to build capacity so individuals are empowered to reduce their own risk. As such, an interactive and innovative community education and capacity building initiative designed to reach all levels of society in TCI should be implemented. Although a communication strategy *does* exist, the Department of Disaster Management and Emergencies needs to maintain regular communication with the public to keep building a 'culture of resilience'.

Given the importance of tourism to the national economy it is also important that the government works with relevant tourism stakeholders to further develop and implement sustainable tourism plans with some more attention paid to disaster risk reduction and climate change adaptation. Tourism infrastructure is

currently concentrated in the coastal zone where the risk of storm surge, tsunami and coastal erosion is greatest. These hazards will degrade the tourism product (e.g. beach, coral reefs) and also expose tourists to risks.

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.

Tropical Storm Hanna and Hurricane Ike caused significant damage to TCI's health sector in 2008 amounting to US $29.7 million, 11% was due to damages and 89% due to losses[iii]. Table 5 below gives a breakdown of the total damages and losses. Overseas treatment, particularly for persons requiring dialysis and other emergency needs, accounted for the greatest expenditure as the Grand Turk Hospital and other important institutions in the health care network were too damaged to accommodate such persons. It is also important to note that there are fewer generators than essential facilities which require them and this can put hospitals in a vulnerable position in the event of an emergency. There is therefore a need to address these vulnerabilities.

Table 5: Summary effects on the health sector from Hurricane Ike and Storm Hanna in the Turks and Caicos Islands (US $)

TOTAL EFFECT		**$29,712,660.00**
Total Damage		**$3,274,731.00**
i.	Damage to Health Facilities	$3,193,000.00
ii.	Damage to equipment and furnishings	$81,731.00
iii.	Imported component	$2,947,257.90
Total Losses		**$26,437,929.00**
i.	Environmental health including clearing of debris and public education	$944,620.00
ii.	Addition cost of generation electricity	$131,820.00
iii.	Loss due to transfer of patients to other facilities for care	$25,000,000.00
iv.	Losses due to forgone income	$25,500.00
v.	Losses to the establishment of temporary clinics	$130,000.00
vi.	Additional cost to staff services	$101,580.00
vii.	Additional cost of communications	$2,000.00
viii.	Additional cost for relocation of families in need	$56,559.00
ix.	Lost due to additional cost of water	$45,850.00

(Source: ECLAC, 2008)

Not only will extreme events like storms impact the population through the disruption in utilities such as water and electricity but flooding creates suitable environments for mosquitoes and other pests to breed. Vector borne diseases of relevance include dengue fever, malaria and leptospirosis. Also, the poor living conditions associated with immigrants is a threat to the quality of the tourism product for it can increase the risk of transmitting communicable diseases in communities where these infectious agents exist.

TCI'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 poor

sanitation, as well as asthma and other respiratory diseases. A number of food-borne and water-borne illnesses are associated with water and poor sanitation and those of relevance for the Turks and Caicos Islands include gastroenteritis, shigellosis, salmonella, cholera and typhoid fever. Table 6 below shows that cases of gastroenteritis have increased almost consistently every year from 2003 - 2009.

Table 6: Reported cases of gastroenteritis in the Turks and Caicos Islands between 2000 and 2009

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Sum of Gastroenteritis < 5 yrs	209	183	72	197	197	360	302	280	365	303
Sum of Gastroenteritis ≥ 5 yrs	-	1	22	210	207	350	426	513	571	825
Total no. cases	209	184	94	407	404	710	728	793	931	1128

(Source: CAREC, 2008a; CAREC, 2008; CAREC, 2008b; CAREC, 2010)

In the Turks and Caicos Islands if temperatures increase, there is a potential for health impacts due heat exhaustion and dehydration, especially on those persons with existing heart conditions. Other diseases of relevance with possible climate change signals include the acute haemorrhagic conjunctivitis and legionnaire's disease.

Since most of the food consumed in TCI is imported, the unavailability of food due to environmental disasters in source markets or that affect transportation could have consequences for the health of the population, particularly the poorest sectors of the society. Incidences of ciguatera fish poisoning, which are already reported in the Turks and Caicos Islands, may increase as seas become warmer due to climate change, triggering harmful algal blooms which increase the toxins that bio-accumulate in fish species.

Compared to other countries in the Caribbean, TCI is advanced in its response to climate change within the health sector. The Public and Environmental Health Ordinance and the Water and Sewer Ordinance are the main pieces of legislation that govern health care in TCI, and the National Socio-economic Development Framework (NSEDF) 2008 - 2017 is the most current document mapping the development of social concerns. The latter has in fact identified climate change as a priority area to be addressed. Also, the expenditure on health programmes for the period 2008 to 2017 accounts for 40% of the NSEDF budget indicating the priority given to health care. Other areas addressed included health threats due to emergencies, education on climate change impacts, the need for regional institutional linkages and greater data collection and the strengthening of disease surveillance for pandemics and epidemics, vector and water-borne diseases. Additionally, in 2010, two new general public hospital facilities located in Grand Turks and Providenciales were built to withstand category 5 hurricanes.

While the healthcare statistics of the Turks and Caicos Islands mirrors a more developed country, there are a number of basic issues that challenge the ability of the health care sector to cope with diseases that have climate changes cues. As such, dependence of infectious disease surveillance and disease outbreak management has been identified as a priority[iv]. Vaccination for certain diseases such as diphtheria and seasonal influenza are important adaptation measures currently employed.

MARINE AND TERRESTRIAL BIODIVERSITY AND FISHERIES

The Turks and Caicos Islands boast several exclusive attractions for visitors such as sighting Humpback whales and manta rays, sport-fishing for tunas and marlins and diving along impressive coral reefs. Encounters with exotic birds are frequent among the salt ponds and marshes that provide breeding and feeding grounds for terns, blue herons and pink flamingos. Although geographically small in scale, the

islands are a treasure trove for approximenately 200 species of waterfowl and shorebirds and provide habitat to 17 species of reptiles (seven are alien species) and four species of cave-dweling bats, the only remaining native mammals. Over 550 plant species have been identified on the islands and cays; 9 are endemic to TCI and an additional 40 species are endemic to the Bahamas archipelago.

Figure 10: A healthy brain coral attracts a shoal of small fish

With much of TCI's tourism located along the coast, beaches are at great risk to impacts from the rapid development of tourism infrastructure. Uncontrolled sand mining for construction has damaged sand dunes such as those of Booby Rock Point in Grand Turk. The introduction of the Australian pine tree, *Casuarina equisetifolia*, has also increased the vulnerability of beaches to erosive action. The tree is an invasive alien species that was initially introduced to help stabilise sandy soils; however, it is outcompeting natural vegetation and actually destabilising sand and increasing the risk of beach erosion.

Coral reefs are a significant feature of TCI's marine environment and provide a range of ecosystem services including the white sand for its famous beaches; habitat for a wide diversity of marine species and critically important coastal defences for the low-lying islands and cays. Grand Turk has a well-earned reputation as one of the finest diving destinations in the world with an outstanding protected coral reef that drops to 7,000 feet along the west side of the island. Reefs of TCI are extensive and diverse with an estimated area of almost 1,200 km^2 of bank and fringing reefs comprised of about 30 different coral species.

TCI was spared the worst effects of the 2005 Pan Caribbean bleaching episode but various coral species showed bleaching at depths of up to 15 m. Of 166 coral colonies at The Warhead, The Fishbowl and Tuckers Reefs, only three colonies (one *Montastraea annularis* and two *Agaricia agaricites*) were completely bleached; 87 colonies showed partial bleaching. By December of the following year, colonies showed signs of recovery with little evidence of coral mortality. The ability of coral reef ecosystems to withstand the impacts of climate change will depend on the extent of exposure to other anthropogenic pressures and the frequency of future bleaching events so this experience supports the findings from the World Resource Institute, that TCI possesses some of the least threatened coral reefs in the Caribbean region. However, there are still threats which must be reduced and/or eliminated. There has been damage to fore-reef corals from intense dive tourism, especially near Providenciales, West Caicos and the western drop-off on Grand Turk. Sedimentation from construction, sewage pollution, anti-fouling paints in marinas, coral breakage by anchors and ship groundings are other impacts threatening the health of coral reefs in TCI.

Within the past five years a number of groins and breakwaters have been constructed and beach nourishment projects have been undertaken in order to protect coastlines at East Grace Bay, Pelican Point and Emerald Bay. As TCI seeks to expand the tourism sector consideration must be given to establishing and enforcing adequate coastal setbacks since impermeable structures erected too close to the shoreline disrupt the natural cycle of accretion and erosion of sandy beaches, and accelerate the rate of erosion of sand. This not only makes beaches less attractive, but can be costly because reduced beach width allows waves to break further inshore and wear away at the foundation of built structures like homes, resorts and condominiums.

Intense tropical cyclones and accompanying storm surges can dramatically alter beach profiles. In 2008 Hurricane Ike impacted several beaches including Governor's Beach, one of the main public beaches in the National Park system, and East Grace Bay a significant resort area, both of which suffered substantial erosion - in particular the latter lost up to five feet of sand in height. Also, a restoration project of Emerald Beach that was completed in June of that same year was completely lost. The frequency of storms often does not allow sufficient time for beaches to recover so interventions must be made to reduce the loss in the first instance.

Fishing has long been an important activity in the economy and livelihoods of TCI. What was previously a subsistence sector, or an industry supplying the limited domestic demand has become an important export oriented sector, supplying the bulk of visible exports from the country. Lobster and conch processing operations offer the single largest sector for the employment of women in South Caicos. Meanwhile, the finfish fisheries have remained under-exploited by TC Islanders, since the country has not developed the infrastructure to ship chilled fish to the main markets. Finfish such as groupers, snappers and large pelagics are consumed locally and are part of the tourism sector's sports fishery, but these too are under threat. For example, over the past decade it has been noted that the size of conch landed has decreased and greater fishing effort must be exerted; most conch now come from more distant and deeper waters, suggesting that stocks are declining. As a result reef fish are now experiencing greater fishing pressure as fishers look for alternatives to support their livelihood.

Marine turtles have been fished from TCI's waters for centuries but have been considered of little economic importance since only a few fishermen regularly target turtles to satisfy local demand; otherwise most turtles are caught opportunistically. Considering that these turtles are part of a global stock, and are threatened species facing further pressure due to loss of habitat and climate change impacts, the TCI Government needs to enforce measures which seek to improve the management of the country's traditional turtle fishery with urgency.

Of serious concern are TCI's Pine forests even though they adapted to arid conditions. Projected climate changes indicate that Pine yards may be drastically reduced or even lost to reduced rainfall, SLR and extreme cyclonic events. This translates to the displacement and/or loss habitats and subsequently plant and animal species. Pine yards are already under threat from an invasive insect so are inherently more vulnerable to any further stresses. The Royal Botanical Gardens Kew's specialists estimate that extinction of the Yellow Pine in highly likely within the following decade if conditions are allowed to remain as they are.

SLR and hurricanes are expected to pose the greatest climate change threat to mangroves. Hurricane Ike in 2008 caused damage to several mangrove sites including those of South Creek National Park located in Grand Turk. 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, including increases in near storm rainfalls and peak winds.

TCI has generally demonstrated a positive response towards addressing biodiversity issues through environmental policies that are geared towards sustainable natural resource use and integration of tourism and other economic sectors into environmental management. The Department of Environment and Coastal Resources has undertaken the task of standardising national vegetation classification and mapping terrestrial habitats for the purposes of addressing the inconsistencies in existing habitat classifications and more effective management.

Although there is no formal integration of Government Departments, they routinely work together, particularly when addressing large-scale developments. Several policies under the DECR focus on the

marine and coastal environment and promote an integrated approach to resource management. Scrublands comprise the majority of terrestrial vegetation and are considered as an extension of the coastal ecosystem thus management of the bushes is integrated into the coastal management framework. Protected areas are one of the management tools that TCI has been using as a conservation measure. There are now 34 Protected Areas with 19 protecting marine or coral reef resources yet less than 1% of coral reefs are protected within these MPAs. Despite these initiatives the DECR is still constrained by a limited staff and finances.

Recommendations coming out of the Climate Change Green Paper include the maintenance and restoration of mangroves, upland wetlands and forests, and education of fisher folk about best practices and the need to enhance resilience of coral reefs for ensuring their livelihood, transplanting coral reefs from resilient ecological zones. Additionally, strengthening protected area networks is one way of adopting an ecosystem-based approach to adaptation, i.e. one that integrates the use of biodiversity and ecosystem services into an overall strategy to help people adapt to the adverse impacts of climate change. This strategy should:

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

The strategy should increase the involvement of the tourism sector (various hotels, the Turks and Caicos Hotel and Tourism Association) in collaboration with the Department for the Environment and Coastal Resources in supporting community-based MPAs, as well as provide opportunities for alternative livelihoods and technologies for public education.

It is also important to educate tourists who interact with TCI's biodiversity and films can be effective tools in influencing human behaviour. Short videos encouraging visitors to be more conscious of their impacts on the fragile ecosystems of the islands can be shown during in-bound international flights. The films should 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 (diving, snorkelling, boating). The films should be geared towards showing viewers how their vacation experience will be enhanced if they use environmentally friendly practices.

CONCLUSION

The Turks & Caicos Islands 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 TCI 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 TCI 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 the Turks & Caicos Islands, 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 leading 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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- The Department for Disaster Management and Emergencies (DDME)
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This document provides a snap-shot of critical *sectoral* vulnerabilities and capacities and highlights challenges, opportunities and strategies for action. The complete, 250+ page, Climate Change Risk Profile for The Turks & Caicos Islands 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 The Turks & Caicos Islands.

Notes

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