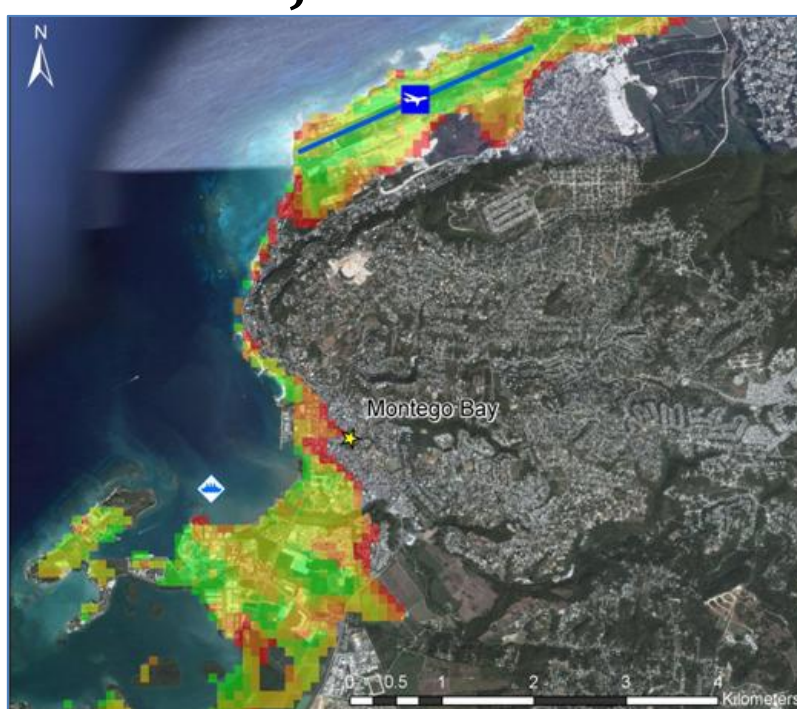


CARIBSAVE Climate Change Risk Profile for Jamaica



Summary Document

Prepared by The CARIBSAVE Partnership with funding from
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THE CARIBSAVE CLIMATE CHANGE RISK ATLAS (CCCRA)

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

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

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

SELECTED POLICY POINTS

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

OVERVIEW OF CLIMATE CHANGE ISSUES IN JAMAICA

Tourism has been and continues to be a major economic sector in Jamaica. Jamaica is already experiencing some of the effects of climate variability and change through damages from severe weather systems and other extreme events, as well as more subtle changes in temperatures and rainfall patterns. Impacts from climate change will continue to adversely affect the livelihoods based on these sectors.

Detailed climate modelling projections for Jamaica 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 residents in **Port Antonio and surrounding areas (Orange Bay, Buff Bay, Hope Bay, Boundbrook to Drapers and Snow Hill)** to climate change; and
2. project sea level rise and storm surge impacts on the coast of **Portland Parish**.

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

- At-risk residents in coastal communities make up about 60% of Jamaica's population and while community nuances are different, they are generally vulnerable to storm surges, hurricanes and flooding.
- Male-dominated livelihoods like farming and fishing are very vulnerable to climate change.
- Some livelihood practises are unsustainable and exacerbate vulnerability. However, communities are willing to adapt if resources and training are provided.

Vulnerable coastlines

- Under the smallest SLR scenario (0.5 m), 35% to 68% of the highly valued beach resources in Portland Parish would be lost.
- With a 1 m SLR, 61% of Frenchman's Cove and Winnifred Beach would become inundated and 75% of Hope Bay would be inundated.
- Ports are the most threatened of the coastal infrastructure, with 100% of port lands in Jamaica projected to be inundated with a 1 m SLR.

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

CLIMATE CHANGE PROJECTIONS FOR JAMAICA

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

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

Box 1: Climate Modelling Projections for Jamaica

Temperature: Annual mean temperature changes for Jamaica, simulated by Regional Climate Models (RCMs), indicate increases of 2.9 to 3.4°C by the 2080s under a higher emissions scenario.

Precipitation: Both RCM and General Circulation Model (GCM) ensembles, indicate overall decreases (by 10 - 41%) in annual rainfall for Jamaica as a whole, particularly throughout March, April, May and June, July and August. However, changes in seasonal precipitation simulated by the RCM vary considerably depending on the driving GCM with HadCM3-driven RCM projections indicating large decreases in precipitation.

Sea Surface Temperatures (SSTs): GCMs project annual mean SST increases of 0.9 to 2.7°C by 2080s relative to the 1970-99 average, in waters surrounding Jamaica across the three scenarios.

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

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



Figure 1: Coastal tourism resort

More than half of the population of Jamaica lives within 1.5 km of the shoreline and approximately 90% of the island's GDP (through tourism, industry, fisheries, agriculture) is produced within its coastal zone. This high density of development (particularly related to tourism) increases the risk of degradation of coastal and marine biodiversity thereby reducing its resilience to climate change impacts including SLR and storm surge.

The CARIBSAVE Partnership coordinated a field research team with members from the University of Waterloo (Canada) and the staff from the National Environment and Planning Agency (NEPA) to complete detailed coastal profile surveying at five beaches in Portland: Frenchman's Cove, Hope Bay, Long Bay, St. Margaret's Bay and Winnifred Beach.

Results from the field study sites selected in Portland Parish indicate that a 1 m SLR places 8% of the major tourism properties at risk, with an additional 10% at risk with 2 m SLR. Critical beach assets would be affected much earlier than the SLR-induced erosion damages to tourism infrastructure; indeed, once erosion is damaging tourism infrastructure, it means the beach, a vital tourism asset, has already disappeared! Ports are the most threatened of the coastal infrastructure, with 100% of port lands in Jamaica projected to be inundated with a 1 m SLR, followed by 20% of airports lands and approximately 30 km, or 2%, of road networks.



Figure 2: High Resolution Coastal Profile Surveying with GPS

Jamaica: Land Loss From Sea-level Rise Hope Bay, Portland Parish

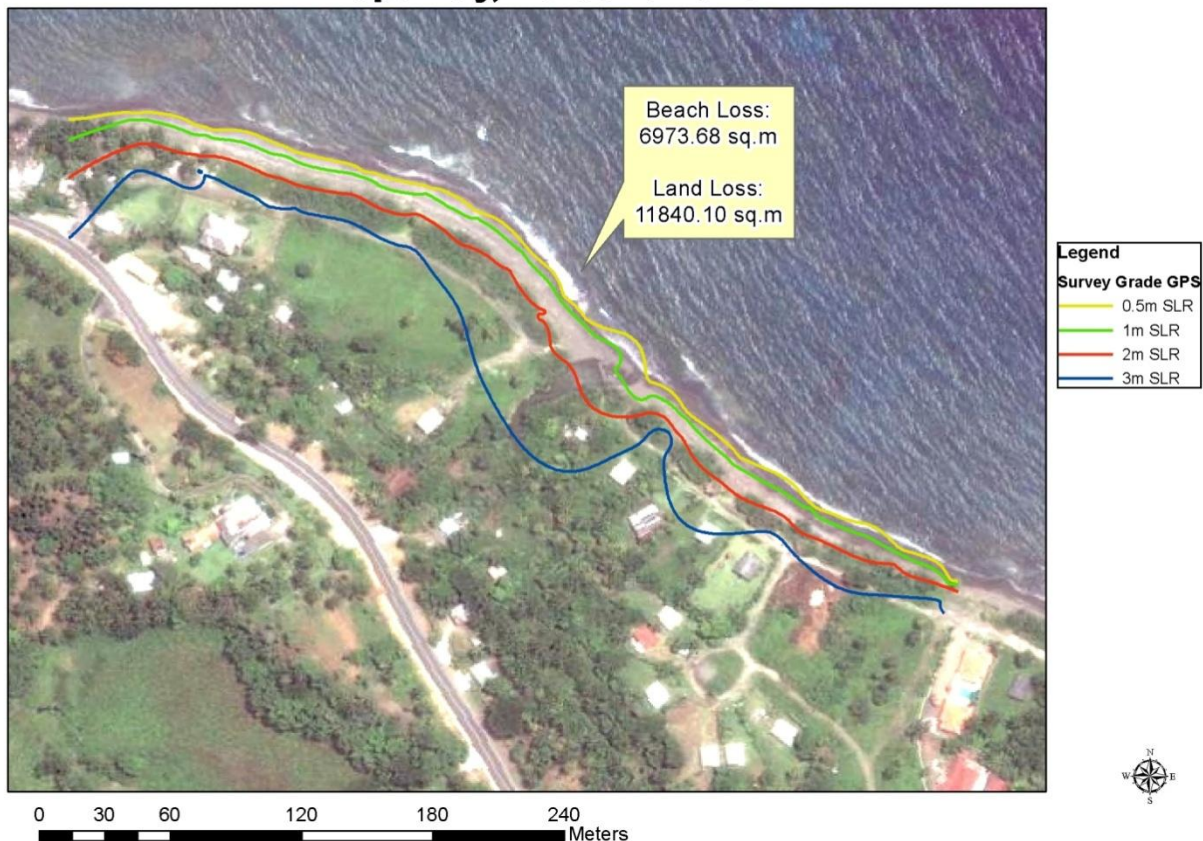


Figure 3: Extent of SLR impact

Even under the smallest SLR scenario (0.5 m), 35% to 68% of the highly valued beach resources in Portland Parish would be lost (Table 1). With a 2 m SLR, 100% of Frenchman's Cove and Winnifred Beach would become inundated and 98% of Hope Bay would be inundated. A 3 m SLR further exacerbates beach loss, four of the five beaches in Portland Parish lost (Frenchman's Cove, Hope Bay, St. Margaret's Bay, Winnifred Beach) and 93% of Long Bay beach becoming inundated.

Table 1: Beach area lost in four sea level rise scenarios across study sites in Portland Parish, Jamaica

	Frenchman's Cove		Hope Bay		Long Bay		St. Margaret's Bay		Winnifred Beach	
SLR Scenario	Beach Area Lost To SLR (m ²)	Beach Area Lost To SLR (%)	Beach Area Lost To SLR (m ²)	Beach Area Lost To SLR (%)	Land Area Lost To SLR (m ²)	Beach Area Lost To SLR (%)	Beach Area Lost To SLR (m ²)	Beach Area Lost To SLR (%)	Land Area Lost To SLR (m ²)	Beach Area Lost To SLR (%)
0.5 m	933	36%	3242.76	47%	28771	44%	14113	30%	2181	69%
1.0 m	1609	61%	5198.18	75%	30241	46%	21715	46%	2979	94%
2.0 m	2621	100%	6834.21	98%	58170	88%	43525	92%	3186	100%
3.0 m	2621	100%	6973.68	100%	61289	93%	46926	99%	3186	100%

A map of the severe risk that Long Bay, one of Portland's largest and most widely used beaches, would face under a 3 m SLR is illustrated in Figure 4: SLR Impacts at Long Bay, Portland Parish by a 3 metre flooding scenario. The response of tourists to such a diminished beach area remains an important question for future research; however local tourism operators perceive these beach areas along with climate to be the island's main tourism products.

Jamaica: Land Loss From Sea-level Rise Long Bay, Portland Parish

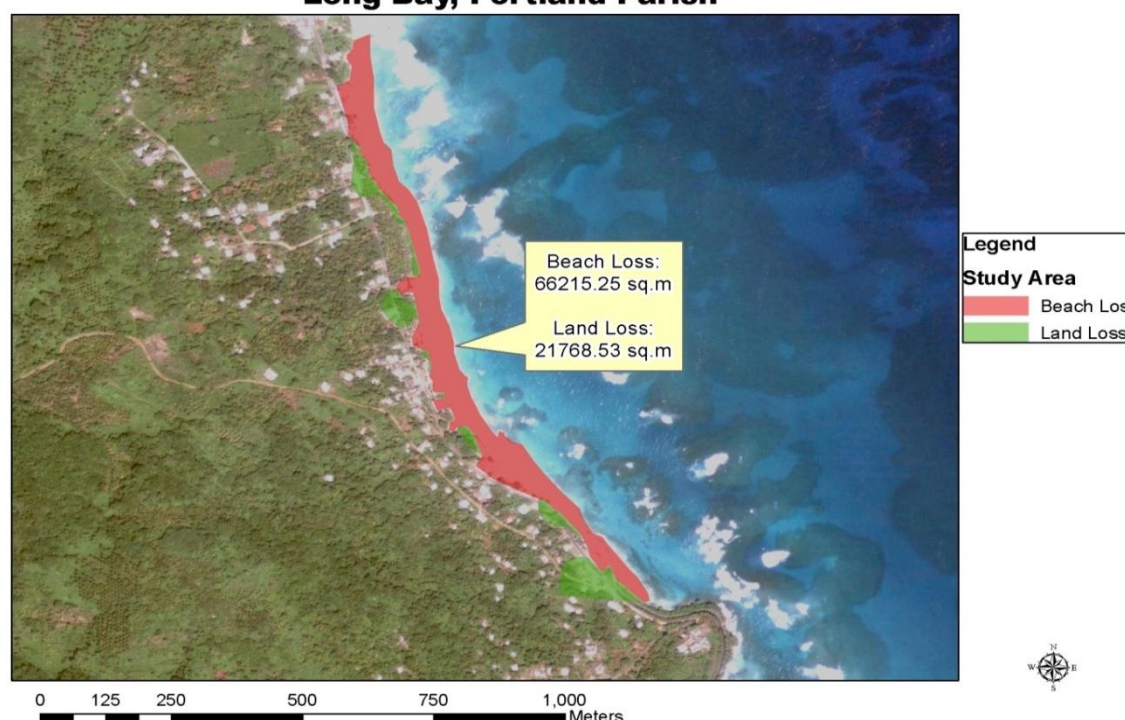


Figure 4: SLR Impacts at Long Bay, Portland Parish by a 3 metre flooding scenario.

This project component generated more coastal topographical data for the National Environment and Planning Agency (NEPA) which has responsibility for the coastal zone in Jamaica and also built capacity in that institution.

An assessment of the costs resulting from SLR and storm surge-induced damage projects that the Jamaican tourism sector could incur annual losses between US \$1 billion in 2050 to over US \$8.7 billion in 2080.

Capital costs are also high, with rebuild costs for tourist resorts damaged and inundated by SLR amounting to over US \$500 million in 2050 up to US \$6 billion in 2080.

Given the importance of tourism to the economy, it is conceivable that the Government of Jamaica would employ all measures to rebuild and support this industry. This may of course have implications for other sectors and public services and for the achievement of sustainable development goals as identified in their Vision 2030 National Development Plan (NDP). However, adaptation to minimise Jamaica's vulnerabilities will require full commitment to the implementation of the NDP and considerable revisions to some sectoral plans. It may also require major investment decisions such as 'retreat' or 'protect' policies so climate change and SLR projections should therefore be considered in the early phases of development in coastal areas and 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.

COMMUNITY LIVELIHOODS, GENDER, POVERTY AND DEVELOPMENT

More than 50 residents of Port Antonio and the surrounding communities¹ of Orange Bay, Buff Bay, Hope Bay, Boundbrook to Drapers and Snow Hill, in Portland Parish 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, vending, agriculture 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. At-risk residents in coastal communities make up about 60% of Jamaica's population and while community nuances are different, they are generally vulnerable to storm surges, hurricanes and flooding.



Figure 5: Map of Portland drawn by community members

Community Characteristics and Experiences

Popular nature-based tourism activities in and around Port Antonio include hiking, sightseeing and marine recreational activities, all of which are dependent on stable and reliable weather conditions. Extremes of either heat, rainfall or ocean turbidity will adversely affect visitor experience and even the decision to participate in these activities in the first place. Other activities in the community include farming and fishing.

Tourism provides year-long employment for locals, with peaks occurring during traditional winter months and those community members consulted indicated that tourism-related activities were the sole sources of income. So for a particularly low tourist season, these persons become very vulnerable economically. Further, livelihoods which depend directly on natural resources and climate have been adversely affected by climate change.

- Farmers in the area have observed declines in their agricultural production as a result of shifts in seasonal weather patterns, hotter temperatures, longer dry periods and more intense rain and

¹ All participating communities are collectively referred to as "the community" in this document.

wind events. This has impacted quality and quantity of output, the market price for produce (which will be more expensive when it is scarce or “out-of-season”). If such situations persist, this could likely result in reduced consumption of the local produce by tourism facilities. Local farmers may then suffer loss of markets or business to other producers who can provide a more reliable and consistent service.

- Similarly, fishermen are reporting a decline in the health of coral reefs and increased sea surface temperatures. This livelihood group is particularly vulnerable to any extreme events that destroy the physical and technical resources that support their livelihood since they are already challenged by the loss of marine biodiversity and unpredictable unfavourable weather conditions.

Men in the community indicated a stronger dependence on the natural resource base than women for their livelihoods – likely due to the larger participation of males in fishing and agriculture over women. This aspect of vulnerability is linked to the climate-sensitivity of their livelihood resources. However, one common coping strategy identified by fishers and farmers is to engage in a variety of activities to earn more income and ensure greater financial stability.

Consistent with global findings, poverty increases the vulnerability of women when there is a disaster owing to the larger proportion of women amongst the poor population (most of the females who participated in the research were unemployed) and the larger number of female-headed households, some of which are single-parents.

It is apparent that local community organisations (including Councils and Clubs) are very active in the community and act as effective mechanisms for social change, empowerment and development, particularly for youth. There is also an existing hierarchy of community based organisations which foster community governance and development.

Community residents are willing to make livelihood and lifestyle changes to reduce their vulnerability to climate change. But they also require assistance in the form of infrastructural improvements to prevent flooding; awareness and capacity building about climate change and alternative livelihoods; and support from other stakeholder groups. Additionally, mainstreaming gender and poverty into climate change and related policies to achieve sustainable and effective responses to climate change is critical. This research has provided the evidence of underlying contributing factors, power relations and gender inequalities to make such mainstreaming possible.

AGRICULTURE AND FOOD SECURITY

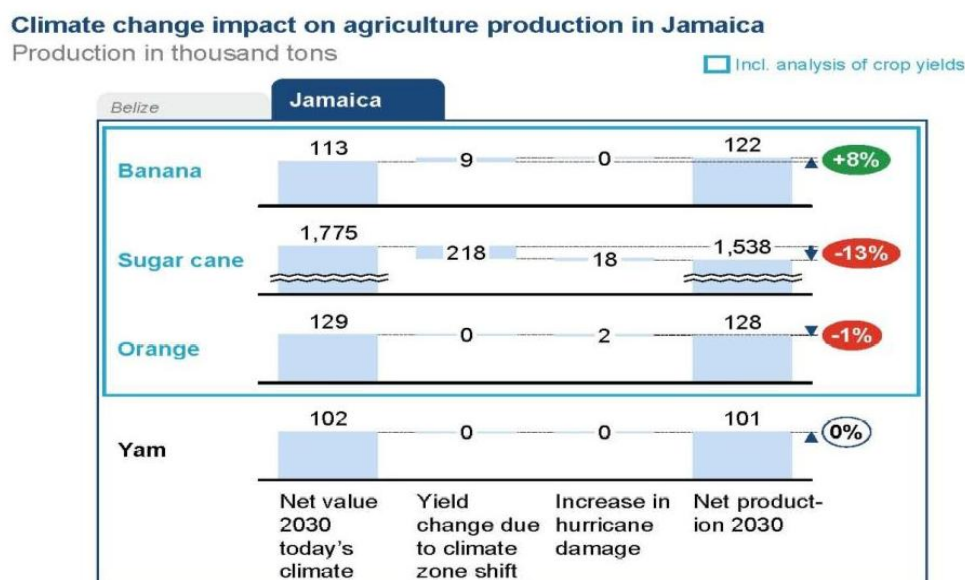


Figure 6: Climate Change Impact on Agricultural Production in Jamaica (000 tonnes)

Reproduced from CCRIF ECA Study (2010)

The agriculture sector represents a critical component of Jamaica's national development as an important contributor to GDP, employment, foreign exchange earnings and rural livelihoods. Climate change impacts are already being observed in the Jamaican agricultural sector, resulting in lower yields due to the prevalence of more pests and diseases. Coffee and banana production have faced many extreme weather events during the past years, mainly hurricanes, which have destabilised the agricultural industry and caused declining productivity and crop damage.

A significant contributing factor to vulnerability is land degradation due to the use of unsuitable farming techniques and poor land-use practices, including cultivation and development on unsuitable, unstable slopes, leading to soil erosion, massive flooding incidents and degradation of watersheds. The north-eastern region of the island, particularly the agricultural dependent parishes of St. Ann, Portland and Trelawney are critical zones in need of climate change risk management mechanisms because of the heavy reliance on farming to provide food for the household and as a means of income and these farmers are already experiencing annual recurring drought. The apparently predictability of drought conditions in these areas certainly establishes a basis for assisting farmers through mechanisms to earn a living in at such times. Awareness, capacity and technology in the areas of water storage and recycling; drought tolerant crops, integrated pest management, hydroponics and greenhouse farming would be of sure benefits.

Jamaica has greater resilience and potential for food security than most other Caribbean SIDS, in that local substitutes for imported staples are widely produced. Farmers have also implemented successful coping and adaptation mechanisms at the farm level through damage-reducing strategies such as the protection of nurseries; replanting/transplanting; crop bracing; and early harvesting and storage of produce. Sustainable food production on a national scale needs to be enhanced in the context of a changing climate, particularly with respect to water availability and diseases. Like in most Caribbean countries, there is a shift away from agriculture so to encourage farmers to stay in this sector and to attract more persons there is a need to innovate, build capacity and provide the means for changes in practices and securing markets. Tourism

entities should fully support local production and engage in agreements that are mutually beneficial, whereby the farmer has a guaranteed market for produce requested by tourism facilities.

ENERGY AND TOURISM

Tourism is an increasingly significant sector in energy use and emissions of greenhouse gases in the Caribbean. Tourism components such as aviation, accommodation facilities and cruise ships are high energy users and are vulnerable to changes in climate that will affect tourist preferences, particularly through international climate policies aimed at mitigating greenhouse gas emissions. This can therefore impact Jamaica's tourism sector resulting in changes in energy demand.

No statistics on energy use in Jamaica could be obtained directly from the national Ministry of Energy and Mining to identify energy flows on a more detailed basis, but the country published its 'National Energy Policy 2009-2030' in October 2009ⁱ. As the policy document outlines, the Jamaican economy is characterised by high energy intensity and low efficiency, while being almost entirely dependent on imported oil, which accounts for 95% of energy consumption, the remainder falling on hydropower (4%) and wind (1%). Imported oil is consumed in three main sectors, i.e. bauxite/aluminium production, power generation and transport (See Figure 7). Locally, two of the high-energy sectors, transport and electricity generation are relevant in the context of tourism. However, it is difficult to identify the share of tourism in national energy use, as it is unknown which share of electricity is used by accommodation establishments and other parts of the tourism-related service sector, for which no specific studies have been carried out. Likewise, it is difficult to know which share of energy is used in tourism-related car travel or by cruise ships (bunker fuels).

It should be noted that average emissions per tourist are comparably low, i.e. emissions of 635 kg CO₂ per tourist for air travel. This is largely because the most important market for arrivals, the USA, is comparably close. Keeping their arrival-to-emissions ratio low will demand on-going analysis of markets as climate change continues to impact tourism globally. This information could be used to strategically focus tourism marketing efforts on closer markets.

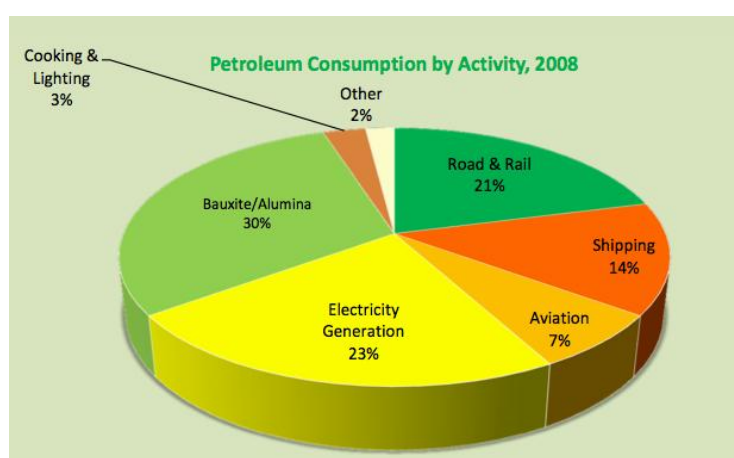


Figure 7: Petroleum consumption by activity, 2008ⁱ

Energy generation methods are currently meeting the energy demand in Jamaica, but with increasing atmospheric temperature (this observed trend is projected to continue) this supply is likely to be under pressure for at least two reasons: the increased use of energy for cooling and the likely reduced volume of

river water for hydropower. The added pressure on the energy supply will necessitate the exploration of renewable energy sources to meet both household and tourism demands on the island.

Indirect climate change impacts which are brought on by other sectors through forward or reverse linkages with the energy sector and may include competition for shared resources, trends in demand and supply and pricing are also possible. 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. Energy prices have fluctuated in the past and there is evidence that the cost of oil on world markets will continue to increase. Also, if the international communities' climate objective of stabilising temperatures at 2°C by 2100 is taken seriously, both regulation and market-based instruments will have to be implemented to cut emissions of greenhouse gases. Such measures would affect the cost of mobility, with in particular air transport being a highly energy- and emission-intense sector.

Specific measures to reduce energy consumption and emissions are outlined in Jamaica's 'National Energy Conservation and Efficiency (ECE) Policy 2010-2030ⁱⁱ'. Figure 8 shows that by 2030, the share of petroleum in the supply mix is expected to have declined from 95% to 30%, with natural gas accounting for as much as 42% of the mix and renewable energies 20%.

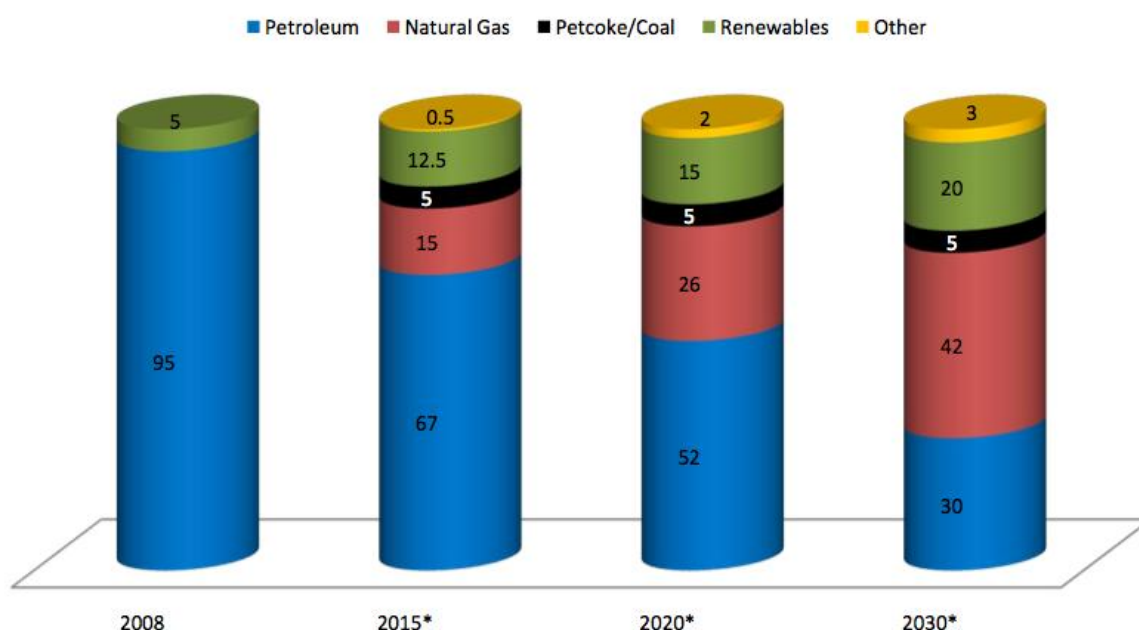


Figure 8: Jamaica's energy consumption by energy source in 2008 and to 2030ⁱ

Strategies to reduce energy dependency and emissions include:

1. Security of Energy Supply through diversification of fuels as well as the development of renewables
2. Modernising the country's energy infrastructure
3. Energy conservation and efficiency
4. Development of a comprehensive governance/regulatory framework
5. Enabling government ministries, departments and agencies to be model/leader for the rest of society in terms of energy management
6. Eco-efficiency in industries

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. Also, emissions and revenue 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 and such indicators can serve as a basis for restructuring markets, possibly the most important single measure to reduce the energy dependence of the tourism system. Further analysis is required to distinguish revenue/profit ratios, leakage factors/multipliers (to identify the tourist most beneficial to the regional/national economy). 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.).

While an energy and emissions database would thus be paramount to the understanding, monitoring and strategic reduction of greenhouse gases, it also appears clear that energy demand in Jamaica could be substantially reduced at no cost, simply because the tourism sector in particular is wasteful of energy. Furthermore, technological options to develop renewable energy sources exist and can be backed up financially by involving carbon markets as well as voluntary payments by tourists. In order to move the tourism sector forward to make use of these potentials, it is essential that policy frameworks focusing on regulation, market-based instruments and incentives be implemented.

WATER QUALITY AND AVAILABILITY

Jamaica has considerable surface and groundwater resources; however, local demand is met mainly from groundwater supplies. The country is predisposed to seawater intrusion into its coastal groundwater supplies and over-abstraction of this finite resource is already a management challenge, especially because drought is a recurrent problem. The agricultural sector has the greatest water demand and accounts for 75-85% of the water consumed in the country. These trends suggest an inherent vulnerability in this sector.

Jamaica has been found to be vulnerable to climate change as both observed and modelled climate variables indicate some impact on water resource availability. Over the last forty years, temperatures in Jamaica have shown an overall increase and this trend is expected to continue according to both GCM and RCM projections. While there are no observable trends in precipitation in the period between 1961 and 2006 in Jamaica, rainfall extremes (1- and 5- day annual maxima) for the period 1973 – 2008 were found to have decreased. Additionally, there is an overall trend for further decreases in future according to GCM and HadCM3-driven RCM projections. Conditions such as these reflect the experiences that Jamaica has had with droughts, particularly in recent years and will likely increase the occurrence of further dry spells and drought events in the future.

The main stakeholders in the water cycle of Jamaica are the forest managers (government agencies, NGO's and private foresters), upland farmers (legal and illegal), upland settlements, water abstractors (public and private), irrigated farmers, industry and commerce, urban households and tourism. Jamaica will need to enhance the strengths that currently exist within its water sector structure. The institutional networks are quite extensive and have been developed to cope with an already complex water sector that seeks to supply water to 2.6 million people and comprises numerous stakeholders and institutions.

Some individual user groups are already employing methods to address drought problems in particular by increasing water storage in the wet season and using grey-water systems. However, this critical resource necessitates a more coordinated approach to its management and existing institutional frameworks could be revised to address climate change issues and the requirements of specific policies if adequate resources are allocated. Recent adaptation projects have been challenged by the need for co-financing because of the Water Resources Authority's inability to meet their budget contribution requirements. Practical actions such as exploring waste water recycling options and extracting greater volumes of water from areas with more abundant resources can help alleviate pressures on demand.

COMPREHENSIVE NATURAL DISASTER MANAGEMENT

Vulnerability to natural hazards is a cross-cutting problem facing many sectors. In recent years, especially since Hurricane Gilbert impacted Jamaica in 1988, natural hazard events have highlighted the physical, social and economic vulnerabilities on the island; and climate change projections pose a concern about the occurrence of natural disasters. Experiences with Hurricane Dean in 2007 (Category 4) and Tropical Storm Nicole in 2010 confirm that infrastructure and property in the housing, agriculture and public utilities sectors of Jamaica are highly vulnerable. Although the tourism industry was not severely impacted in these storms, the sector will become increasingly at risk as climate change causes sea levels to rise, creating the possibility for greater storm surge heights in coastal areas around the island.



Figure 9: Hurricane Dean Impacts on public utilities in Jamaica

(Source: PAHO, 2007)

As the primary agency working on disaster management in Jamaica, the Office of Disaster Preparedness and Emergency Management (ODPEM) has many programmes and activities that aim to build adaptive capacity at the institutional and local levels. ODPEM has embarked on an assessment of vulnerability in 300 communities across the island in order to rank communities on a variety of vulnerability indicators. Regional programmes led by the Caribbean Disaster Emergency Management Agency (CDEMA) have also been conducted in Jamaica and provide important data about vulnerability. Yet more work must be done to improve awareness and capacity at the community level and provide data, information and tools relevant to decision making and sustainable livelihood strategies.

Some pragmatic strategies recommended to enhance the current system include:

- a) The expansion of early warning systems to incorporate new and more technologies (cell phones, media tools etc.) thus making sure that information is widely and equally dispersed;
- b) The enhancement of hazard, weather and geographical data collection and management strategies that will generate hazard maps and improve the baseline data available for the whole of Jamaica. Improvements in data collection must be shared across institutions to ensure risks are considered in all phases of development, from land use zoning and planning to construction; and
- c) Build capacity in the ODPEM in the linkages between disaster management and climate change.

HUMAN HEALTH

Health is an important issue in the tourism industry because tourists are susceptible to acquiring diseases as well as potential carriers of vector-borne diseases. The impacts from indirect diseases, such as dengue fever, malaria and leptospirosis, are most extensive and also complex due to the external factors that affect transmission such as mosquito habitat conditions. Other diseases with a climate change signal include communicable (emerging and re-emerging) diseases such as meningococcal infections, acute hemorrhagic conjunctivitis as well as a number of food borne illnesses, namely cholera, salmonellosis, shigellosis, listeriosis and eshericida coli (better known as e-coli). While attention must be paid to diseases themselves, the overall conditions and access to basic amenities such as food, water and sanitation will determine transmission and recovery from all of these health conditions. Following disasters, poor health and sanitation responses generate further vulnerability to vector- and water-borne diseases, especially if there is standing water and high temperatures. Also, droughts affect the food supply and sanitary conditions which weakens people's immunity and exposes them to diseases not normally present. This in turn has consequences for food security, which raises the possibility of an increasing proportion of the population of Jamaica likely to be undernourished. On the contrary, water supplies could also be interrupted by episodes of flooding. Excess flooding can also lead to contamination of potable water supply and impact sanitation, causing an increase in cases of morbidity and possibly mortality from gastroenteritis or Cholera. Remote communities are the most affected as they may be without basic services for an extended period.

Considerable efforts have been made to develop the health care system of Jamaica and the policy context regarding climate change is emerging to address the vulnerabilities that exist. There is extensive institutional capacity to cope and some progress has been made in vector and disease management. However, access to basic amenities such as food, water and sanitation is not clearly linked to policy and practice. Measures proposed by the Government of Jamaica, such as increasing resilience to endemic diseases, adaptation and improvement of the emergency response of the country, show their commitment to increasing the health of the island's natural environment and its people. Awareness amongst tourists and tourism facilities is also important as many conditions are entirely preventable with the proper practices.

MARINE AND TERRESTRIAL BIODIVERSITY AND FISHERIES



Figure 10: Blue Lagoon, Jamaica

Source: Jamaica Tourist Board, (2010)

Jamaica has been rated 5th among the islands of the world with regard to endemic plants, with 923 species found nowhere elseⁱⁱⁱ. It is also rich in animal species diversity, with the highest number of bird species (290 recorded – 25 endemic) of any Caribbean island. The environment provides the basis for the tourism industry, which is the most important economic sector in Jamaica and many impoverished rural and coastal communities rely on artisanal fishing and small-scale farming for their livelihoods and nourishment. These two sectors are therefore highly dependent on the natural productivity and integrity of Jamaica's eco-systems.

Unfortunately, human settlements, commercial developments (particularly related to coastal tourism) and road networks are encroaching on natural habitats, often creating discontinuities in the environment and often contribute to its degradation. Many coastal roads cut

off mangrove swamps from the sea, preventing them from functioning effectively as nurseries for marine fish and shellfish. Coral reefs and seagrass beds have suffered from the impacts of overfishing, sedimentation and agricultural runoff. Furthermore, there is increasing recognition that small changes in climate can trigger major, abrupt responses in eco-systems.

The Government and people of Jamaica are aware of these challenges and there are adequate institutions, laws, policies, regulatory bodies and human/technical expertise for addressing them through natural resources management. However, enforcement has been described as difficult and time-consuming due mainly to insufficient human and financial resources to provide comprehensive protection of biodiversity; a lack of knowledge on the part of the persons given the task of enforcing the relevant legislation; and inadequate penalties provided by Acts and Regulations.

Planning for the management of specific critical eco-systems must consider the linkages between eco-systems such as coral reefs, sea grass beds and terrestrial and mangrove forests and their relationships to the stakeholders who use them. An important tool in environmental management is the Environmental Impact Assessment (EIA), which enables environmental factors to be given due weight, along with economic or social factors, when planning applications are being considered.

Such a process involves wide stakeholder involvement which includes the private sector and non-governmental organisations which have already demonstrated their awareness and stewardship for Jamaica's biodiversity by playing a vital role in research, financing, management and public awareness and education. Participatory governance (Co-management) arrangements are also beneficial and the newly designated fish sanctuaries (in Bluefield's Bay, Treasure Beach, Portland Bight, Oracabessa, Boscobel, Discovery Bay) are to be managed in conjunction with local non-governmental organisations (NGOs) and private sector stakeholders, insofar as possible. A co-management strategy for fish sanctuaries across Jamaica will:

- establish a more effective fish sanctuary 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 management.

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

CONCLUSION

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

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

It is clear that the Government of Jamaica is committed to adapting to climate change, as evidenced by some policy responses, current practices and planned actions; as well as the recognition of the importance of Jamaica's natural resources to livelihoods and economies. However, serious financial resource constraints along with limited technical capacities hinder enforcement of laws to protect natural resources, as well as successful adaptation efforts across most government ministries and other stakeholder groups. One result is that some resource users with little or no awareness of alternative courses of action continue to degrade or over-extract from marine and terrestrial eco-systems in an effort to sustain themselves or even for recreation, thereby exacerbating vulnerability to climate change.

It will therefore become increasingly important that individuals have the capacity and evidence-based tools to make decisions and adapt to the changing climate. As such, many of the sectors have recommended education and awareness-building campaigns that would provide the necessary information about vulnerability and risks in specific regions of Jamaica so as to empower communities to build their own resilience. Considerations for gender, economic security and livelihood activities must be considered in any adaptation intervention as not all persons are affected equally and would therefore need to respond differently. Implementing the specific recommendations proposed for each sector can ensure a balanced approach to Jamaica achieving its vision for 2030 to attain 'developed-country' status.

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- The Ministry of Health
- The Ministry of Housing, Transport, Water and Works
- The Ministry of Water and Housing
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This document provides a synopsis of critical *sectoral* vulnerabilities and capacities and highlights challenges, opportunities and strategies for action. The complete, 250+ page, Climate Change Risk Profile for Jamaica 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 Jamaica.

NOTES

ⁱ MEM (Ministry of Energy and Mining), (2009): Jamaica's National Energy Policy 2009-2030. The Ministry of Energy and Mining, Kingston, Jamaica.

ⁱⁱ MEM (Ministry of Energy and Mining), (2010): National Energy Conservation and Efficiency Policy 2010 – 2030 ... Securing Jamaica's Energy Future. The Ministry of Energy and Mining, Kingston, Jamaica.

ⁱⁱⁱ NEPA (National Environmental Protection Agency), (2003a): *National Strategy and Action Plan on Biological Diversity in Jamaica*. National Environmental Protection Agency, Kingston, Jamaica.

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