

Below are tables showing the potential impacts that may arise in various sectors due to commonly known climate variables and extremes. The tables have been extracted from the State of the Jamaican Climate 2012, published by the Planning Institute of Jamaica, and make use of information compiled from a number of sources.

Table 8.2.1: Impacts of Climate Change on Freshwater Resources.

CLIMATE CHANGE ON FRESHWATER RESOURCES	Climate Change Variables and Extreme events	Impacts
	Sea Level Rise	<p>Groundwater quality continues to be and will be further affected by the proximity of some basins to the coast (4,p.74)</p> <p>Sea water intrusion has resulted in the loss of 100 million cubic meters of groundwater (10% of local supply) annually (4,p.74)</p>
	Heavy Rainfall /Storms	<p>Some water catchment areas are prone to flooding and exposed to the risk of debris and sediment flows (4,p.67)</p> <p>Heavy rains contaminate watersheds by transporting human and animal faecal products and other wastes into groundwater. (1,p.25) Heavy rainfall also affects the health and sanitation of some communities without proper toilet facilities (water closets). Flooded pit latrines release waste directly into the rivers. This solid waste then threatens the health of people in the communities and especially the health of children who use the river for bathing purposes. This has led to an increase in diseases associated with water sanitation and poor hygiene practices (6,p.15)</p>
	Droughts	<p>Drought affects sanitation due to lack of water for hygienic purposes, thereby affecting the transmission of disease (3,p.30)</p> <p>Scarcity of freshwater sources could limit Jamaica’s social and economic development. It would affect local sectors which include agriculture and domestic usage which account for 75% and 17% respectively of local water demand (3,p.29)</p> <p>Irrigated agriculture depends on 85% of local water supply. (4,p.83)</p> <p>Water shortages: Loss of food production would create food shortage and a necessity for food importation. Hunger and malnutrition may increase(2,p.12)</p>
	Increasing Temperature	<p>Rising temperature and more evaporation.(4,p.30)</p> <p>Evaporation leads to a greater pathogen density in the water and this could result in a lack of potable water (2,p.12)</p>
Additional Information: 84% of Jamaica’s exploitable water comes from groundwater sources and its availability is subject to climatic conditions(3,p.29)		

Table 8.3.1: Impacts of Climate Change on Energy

	Climate Change Variables/Extreme events	Impacts
ENERGY	Increasing Temperature	Heat stress in buildings and in cars would increase pressure on electricity and fuel demand for cooling aids like fans and air conditioning units (12) Less favourable for the harnessing of solar energy. With photovoltaic solar voltage and power decrease with increased temperature (12) On the other hand increased sea surface temperatures will increase the efficiency of Ocean Thermal Energy conversions (OTEC) systems (16)
	Sea level Rise	A 1-2m sea level rise is expected within the Caribbean region by 2100(12).Sea level rise could greatly impact critical infrastructure which is located near the coastline,(2,p.391). Many power plants are located near the coastline to discharge waste heat.
	Hurricanes, Storms	Damage to on and off shore wind turbines .Damage to power lines, substations and other infrastructure.etc.(12)
	Inadequate rainfall	Inadequate rainfall and drought conditions place more electricity demand for desalination and pumping. Inadequate rainfall will negatively affect river flows and decrease hydropower (12)
	Wind Speed	Wind power increases or decreases as the third power (cube) of the wind speed.(17)

Table 8.4.1: Impacts of Climate Change on Tourism Sector.

	Climate Change Variables/ Extreme Events	Impacts
TOURISM	Sea Level Rise	Beaches respond to sea level rise by retreating inland at approximately 100 times the rate of sea level rise. (7, p.13)
	Increasing Temperature	<p>Temperature extremes can lead to increased incidence of heat stress and other heat related illnesses. In extreme cases it can become fatal. Heat stress remains a concern with higher temperatures for tourists and outdoor workers (1,p.18) Heat storage of built structures, leads to ‘heat island effect’ (1, p.18)</p> <p>This leads to additional operating costs for cooling aids. (5, p.87)</p> <p>Sea surface temperature increases of at least 1.0 degree Celsius will lead to coral reef bleaching (7, p.14)(NB: No base temperature was given for the 1 degree rise)</p> <p>These reefs contribute to Jamaica’s tourism product through diving and fishing tours .They are also critical sources of beach sand (9,p.6)</p>
	Heavy Rainfall	Adverse rainfall /weather conditions could lead to cancellation of reservations or displacement of visitors which would incur massive losses in revenue (3, p.29)
	Hurricanes/Storms	<p>Increased infrastructural damage, additional emergency preparedness requirements and business interruptions, including in the tourist industry, due to floods, coastal inundation and extreme events (5, p.87)</p> <p>Tropical storms and hurricanes appear to be the dominant factor influencing beach erosion (7, p.14)</p>
	<p>Additional information: Aviation emissions are now included in global GHG pollution. This means that the aviation industry (like the EU) cap and trade emissions reductions programs now make long distance travelling environmentally unfriendly and expensive. As a result, tourists will have to spend more on tickets to visit island destinations (3, p. 52). Visitor numbers may decrease because of increased travel costs. Arrivals in Jamaica are reported to decline from 1.3% -3.7% (3,p.53).This reduces discretionary income of tourists which would affect tourism negatively (5, p.88)</p>	

Table 8.5.1: Impacts of Climate Change on Agriculture and Food Security.

AGRICULTURE & FOOD SECURITY	Climate Change Variables /Extreme Events	Impacts
	Increased Temperature	Citrus and root crops are affected by changes in temperature and precipitation (7,p.18) Rising temperatures are expected to result in reduced yield and growth of weeds, pests, bacteria and diseases.(5,p.26)
	Decreased precipitation	Drought conditions affect agro biodiversity. Droughts also lead to large scale losses of cattle and lower reproduction rates among livestock. (5,p.26) Threatens local agriculture, which demands 75% of local water supply .(3,p. 29) Soil degradation and loss of fertility due to droughts (3,p.34) With projected decreases in precipitation up to 40% and up to 2.8 degree Celsius rise in temperature expected by 2080s, many domestic crops will be under stress and food security will be threatened (2,p.262) Higher water and production costs for local food production.(6,p.19) Malnutrition resulting from disturbances in food distribution and production could also occur (3,p.34)
	Sea level Rise	Sea level intrusion in coastal agricultural areas and salinisation of water supply(5,p.27) In Jamaica, some wells have been abandoned due to increased salinity and others produce water unsuitable for agricultural use (4,p.74)
	Storms, Hurricanes and Floods	Passage of extreme events incurs losses of agricultural assets, livestock, crops and agricultural infrastructure (2, p.264). Especially severe for standing export crops (like banana, sugar cane, coffee) (2,p.265) Increased flooding will lead to inundation of production fields.(5,p.27)Increased precipitation and flooding also leads to more favourable conditions for crop disease (3,p.34) Increased food costs, increased costs of insurance and higher rates for capital cost loans (10, p.6.) Threatens livelihoods as agriculture employs 25% of Jamaica’s population (3,p.34)
	Rainfall patterns	Unreliable/Unpredictable rainfall patterns would affect product distribution ,quantity and quality (3,p.34)
	Additional information: Agriculture is one of the Jamaica’s key economic sectors, in 2000 it contributed approximately 7.3% of the island’s gross domestic product (GDP), and represented approximately 12% of foreign earnings (3,p.34)	

Table 8.6.1: Impacts of Climate Change on Human Health.

	Climate Change Variables & Extreme Events	Impacts
HUMAN HEALTH	Increasing Temperature and Humidity, Changes in Circulation Patterns giving rise to transport of Sahara dust to the Caribbean	Increased incidence of acute asthma, bronchitis and respiratory allergies are to be expected as a result of increasing temperature, dust, humidity and wetter conditions respectively (1,p.80) Air pollution which results in the inhalation of suspended particulate matter from fossil fuel emissions, waste incineration etc. will lead to respiratory diseases (1, p.19)
	Increasing Temperature and Humidity	High temperatures and humidity stresses the body's ability to cool itself. This heat stress can lead to increased incidence of heat related illnesses like heat strokes, cramps (1,p.18). Incidences of diarrhoeal diseases and cerebrovascular (strokes)are also linked to heat stress, with the latter being among the leading causes of deaths in Jamaica (2,p.12) The heat island effect exacerbates the impact of increased temperatures (1,p.18)
	Storms, Floods,Tropical Cyclones and Hurricanes	Public Health Consequences: Lack of potable water, loss of food production, population displacement, loss of livelihood security (1,p.19) ;Fatal injuries: Deaths by drowning (5,p.62) Possible increase in incidence of mental cases, malnutrition, increases in infectious diseases(water, rodent and vector borne) (1, p.19)
	Droughts	Storage of water in drums during droughts provides favourable conditions for the breeding of vectors and transmission of infectious diseases(2,p.12) Malnutrition could occur due to declines in food availability and production (3,p.34)
	Heavy Rainfall	Incidence of leptospirosis may increase with heavier rainfall. Humans are infected through exposure to water /soil contaminated by infected animals usually during heavy rainfall and has been associated with wading and swimming in untreated open water (1,p.79) Lack of potable water and poor sanitation also increases the likelihood of infection(2,p.12)
	Increased Temperature	Higher temperatures also speed the life cycle of the Aedes aegypti mosquito and the disease organisms they harbor and make adult mosquitoes bite more often (1, p.79) A 2-3 degree Celsius rise in temperature results in shorter incubation period for the virus and can lead to a three-fold increase in dengue fever transmission. The chances of dengue haemorrhagic fever could also be increased (2,p.12) Warmer temperatures provide favourable conditions for RED TIDE (blooms of toxic algae) which can increase incidence of human shellfish poisoning (1, p.25)
	Additional information: Human population densities and the immunization of the exposed population determines the pattern of mosquito borne disease (Dengue fever) (1,p.79) Jamaica has had all four serotypes of the dengue virus (2,p.12)	

Table 8.7.1: Impacts of Climate Change on Coastal, Marine and Terrestrial (Ecosystems) Resources.

COASTAL, MARINE AND TERRESTRIAL (ECOSYSTEM) RESOURCES	Climate Change Variables and Extreme Events	Impacts
	Increasing Temperature	<p>Rising temperatures are projected to affect reproduction of sea turtles since sex is determined by temperature (7, p.15)</p> <p>Sea surface temperature increases of at least 1.0 degree Celsius will lead to coral reef bleaching (7, p.14)(NB: No base temperature was given for the 1 degree rise)</p> <p>Bleaching reduces the ability of corals to withstand impacts of extreme events and also leads to habitat loss for reef fish and their eventual decline (3,p.36)</p> <p>Sea grasses are also sensitive to thermal discharges and can only accept temperatures up to 2 - 3 degrees Celsius above summer temperatures(3,p.36)</p>
	Increasing Temperature & Decreasing Precipitation	<p>The frequency and extent of forest fires will be affected by changes in temperature and precipitation (7,p.18)</p> <p>Affects agro biodiversity: Citrus and root crops highly sensitive to changes in temperature and precipitation (7, p. 18)</p>
	Sea level rise	<p>Beach erosion as a result of 0.5 m sea level rise in the Caribbean is projected to cause a decrease in sea turtle nesting habitats by up to 35% (3, p.35)</p> <p>Storm surges and sea level rise could increase the salinity of estuaries and fresh water aquifers (3,p. 36)</p> <p>Degraded wetlands have a reduced capability to act as natural filters & buffering systems for shorelines and coral reefs against severe events such as flooding (3, p.36)</p> <p>Mangrove vegetation will migrate landward in response to changing ecological conditions brought on by inland movement of the sea and salt water intrusion into coastal waterways(5,p.46)</p>
	Heavy Rainfall	<p>Sea grasses currently face threats from sedimentation, direct dredge and fill activities and wastewater discharge.</p> <p>Increased storm events, flooding or high intensity rainfall, attributed to climate change, could magnify this effect by increasing the volume of polluted runoff from upstream sources (3,p.36)</p>

Table 8.8.1: Sea Level Rise and Storm Surge Impacts on Coastal Infrastructure and Settlements.

SEA LEVEL RISE AND STORM SURGE IMPACTS ON COASTAL INFRASTRUCTURE AND SETTLEMENTS	Impacts
	<p>Storm surges associated with hurricanes and tropical storms can lead to the inundation of low lying coastal areas by high tides with coastal swells (4, p.67)Permanent inundation could occur in some areas (2,p.391)</p> <p>A large percentage of Jamaica’s population (25%) is concentrated near to the coastline, thus a rise in sea level will cause a displacement of coastal settlements (2,p. 391)</p>
	<p>Critical infrastructures like port facilities, tourism centres and dense population centres are located within Jamaica’s coastal zone. The coastal zone of Jamaica is thus very susceptible to sea level rise, which would cause increased beach erosion rates and higher incidences of coastal flooding (2,p.391)</p> <p>Sea level rise and storm surges will impact these critical infrastructures economically since it is reported that 90% of GDP is produced within the coastal zone (2,p.391)</p>
	<p>Sea level rise is also expected to exacerbate coastal erosion, resulting in damage or increased loss of coastal ecosystems, threatening property and infrastructure located in coastal areas and resulting in salt water intrusion of underground coastal aquifers.(5,p.43)</p> <p>Damages to road networks and bridges, during the passage of Hurricane Nicole resulted in losses totalling JD\$14 billion dollars(16)</p> <p>Coastal erosion along the Palisadoes Spit has caused flooding and deposited sand and debris on the road access to the Norman Manley International Airport rendering it impassable (3,p.36)</p>
	<p>Additional information: The First National Communication indicated that the IPCC in 1990 estimated that the cost to protect Jamaica from one metre of sea level rise would be \$USD462 million(2,p.391)</p> <p>Continued coastal development is very likely to exacerbate risk of loss of life and property due to storms and sea level rise.(9,p.2)</p>

Impacts of Climate Change on Society

Table 8.9.1: Impacts of Climate Change on Community Livelihoods.

	Climate Change Variables/Extreme Events	Impacts
COMMUNITY LIVELIHOODS	Increasing Temperature	<p>The majority of Jamaica’s coastal communities depend on coastal resources for their livelihood. In particular reef fisheries are of major importance in the Jamaican food chain as the island’s fringing reefs provide a livelihood for artisanal fisheries. Coral reefs are already facing impacts from climate change, which are thereby affecting reef fisheries (3,p.34)</p> <p>Temperature increases could lead to the spread of dengue fever and other vector borne diseases(2,p.12) Households consisting of disabled or ill members are considered more vulnerable since this affects the number of people available for productive labour and puts a strain on household resources.(8,p.43)</p>
	Droughts, Storms and Hurricanes	<p>Crop loss and flooding which are some of the effects of extreme weather conditions also affect farming communities, which are largely vulnerable to climatic variability (5,p.61)</p> <p>Increased flooding will lead to inundation of production fields.(5,p.27)</p> <p>Rainfall extremes (droughts; floods) are associated with the spread of waterborne diseases, due to a lack of potable water and sanitation issues (6, p.15) possibly leading to lack of productivity.</p>
	<p>Additional information: Pollution from sewage and agricultural runoff as well as unsustainable activity like (over harvesting of fish) also damage Jamaica’s reef systems, negatively affecting marine life and contributing to declining fish stocks (3,p.36)</p> <p>Flooding is also caused by poor land use practices in watershed areas (4, p.67).Some farmers reduce forest cover which aggravate the impact of extreme events like droughts (6, p.19). Hunger and malnutrition could affect local population due to a reduction in food production as a result of drought conditions (1,p. 18)</p> <p>Increasing sea surface temperature will heighten storm surges which will create more damaging flood conditions to coastal zones and low lying areas. These changes are likely to affect goods and services produced within the coastal zone (5,p.45)</p>	

Table 8.9.2: Climate Change Impacts related to Gender.

GENDER	Climate Change Variables/Extreme Events	Impacts
	<p>Droughts/Decreasing Precipitation</p>	<p>Crop loss and economic woes creates more economic pressure on female farmers (poorer than male counterparts and have less access to land) to find more resources-water and fertilizer for their crops (6,p.19) Women in some communities have less access to credit because they lack the collateral required (6,p.11)</p> <p>During droughts there are increased costs for water ,which places a special burden especially on female headed households (6,p.14)</p> <p>In some communities without running water, water use by men and women are prioritized based on their gender determined roles. Men carry water for agricultural purposes. While women and children have the main responsibility of carrying water for hygiene ,sanitation, potable water , cooking and other duties.(6,p.13)Therefore during water shortages , there are increased economic demands on households, it creates more pressure on women and children in these local communities, to find dwindling water supply to carry out these duties ; more time used by women to purify water for drinking(6,p.40) Furthermore there is also an increase in workload for women; more time spent use at standpipes, they go to the river less and washing ‘piles up” (6,p.40)</p> <p>The unavailability of potable water restricts economic opportunities for women in some communities, who are unable to pursue income earning activities like the production of fruit jams, other food related activities and hairdressing that are heavily dependent on potable water. Women involved in chicken farming, also face the same challenges which are worsened by their heightened exposure to natural hazards (6,p.11)</p> <p>Health and sanitation issues associated with water shortages affecting both women and men, increase during these periods (6,p.15)</p>
<p>Storms, Hurricanes</p>	<p>Women may be more vulnerable in disaster situations, less mobile for evacuation and have the responsibility of taking care of the children in emergency situations(3,p.74)</p> <p>During heavy rains, when there are landslides and pit latrines are flooded, releasing waste directly into rivers it creates hygienic issues. These conditions increase the likelihood of illness among children and the elderly which brings burden on women as primary caregivers(6,p.40)</p>	

GEN DEP	Climate Change Variables/Extreme Events	Impacts
		Women belonging to low income groups more often than men have a limited capacity to adapt to extreme events. Also, they are more exposed to health issues (including worse case risk of survival or death) (3,p. 49)
	Storms ,Hurricanes	<p>Diet of population compromised due to these extreme events has harsh implication for children and the elderly, pregnant and lactating mothers.(6,p.40)</p> <p>There are concerns about the safety of women in shelters. Women more vulnerable to sexual abuse (3,p.50).Women also have specific needs-i.e. may be pregnant or nursing in shelters (11)</p>
	<p>Additional information: Women are more vulnerable to climate change impacts as their livelihoods, which includes subsistence farming and service sectors are largely climate sensitive (3,p.50) Women more at risk of unemployment than male counterparts (3,p.50)</p> <p>Women's roles as key actors in climate change adaptation decision making at the household level could arguably be as a result of their status as heads of the household(40% in Jamaica) (3,p.48)</p>	

Table 8.9.3: Climate Change Impacts related to Poverty

All of these impacts below lead to increasing poverty due to a positive feedback process.

POVERTY	Climate Change Variables/Extreme events	Impacts
	Increasing Temperature	It is anticipated that an increased frequency or severity of heat waves in the Caribbean would cause an increase in human mortality especially among (urban) poor communities without access to cooling aids like air conditioners or refridgerators (3,p.35)
	Droughts	<p>Households in low income communities with no running water are more at risk of dengue fever and other infectious diseases, than those with piped water supply since water storage becomes necessary (8,p.43)</p> <p>Health issues :During water shortages in some communities, diseases spread because of poor infrastructure, waste disposal issues and lack of access to clean water sources (6, p.15)</p> <p>Malnutrition resulting from disturbances in food distribution and production could also occur (3,p.34)</p>
	Storms, Tropical cyclones, Hurricanes	<p>Flooding and landslides lead to population displacement because of vulnerabilities of settlements in floodplains (4, p.67)</p> <p>Heavy rainfall affects the health and sanitation of some communities without proper toilet facilities. Flooded pit latrines, during storms release waste directly into the rivers which some residents use. This has led to an increase in diseases associated with water sanitation and poor hygiene practices (6,p.15)</p>
<p>Additional Information: Lack of access to physical/financial resources; infrastructure and competition restrict alternative opportunities for the most vulnerable (3,p.51)</p> <p>There exists a culture of dependence nurtured by the patronage in the political system which is more evident in our low- income communities, where some residents do not appreciate the importance of their role in disease prevention and feel that, for example, dengue prevention ,is the responsibility of the state. This increases their vulnerability to disease infection (8,p.44)</p> <p>The most vulnerable groups are those generally with no financial resources, who are also working or dependent in ‘high risk’ sectors (agriculture, fisheries, tourism) and in particular when employed in low-paid staff positions (3,p.72)</p>		

Table 8.9.1: Climate Change Impacts related to Development.

	Climate Change Variable/Extreme events	Impacts
DEVELOPMENTAL ISSUES	Storm Surges Sea Level Rise	<p>Increased incidence of sea level rise and storm surges would lead to displacement of 25% of Jamaicans who inhabit coastal areas (2,p.391)Areas like Portmore, which is a drained low lying coastal area (170,000pop) would be at risk from flooding (4,p.67)</p> <p>Inundation of coastal areas, settlements, loss of life and property are also features of continual coastal development which exacerbate risks from these events(9,p.2)</p> <p>Coastal erosion could destroy economically critical infrastructure (ports, tourism centres, airports, road networks, since 90% of Jamaica’s GDP is earned along the coastal zone.(2p.390).This could result in massive economic losses for the country (3, p.29)</p>
	Increasing Temperature	<p>Increasing temperatures has the potential to threaten social and economic development in the country. This is due to the correlation with body temperature, work performance and alertness (14, p.1). This has implications for outdoor workers, indoor workers and students in classrooms without cooling aids. Higher temperatures can lead to low productivity. This is due to the fact that heat exposure can affect physical and mental capacity and lead to heat exhaustion or heat stroke in extreme cases .Particularly there is the potential threat of increasing atmospheric temperature, on youth and their educational development. Reading speed, reading comprehension and multiplication performance of schoolchildren could be affected by temperatures of 27 to 30 degrees Celsius (15, p.1) (NB. Such temperatures are achieved in Jamaica regardless of climate change).</p>
	Storms, Hurricanes, Droughts Tropical Cyclones, Floods	<p>With a rise in the occurrence of extreme events, freshwater may be less available or it may be contaminated which will increase the susceptibility, especially of some remote and rural communities, to infectious diseases that have minimal public health care infrastructure(3,p.35)</p> <p>Improper land use/development in watershed/flood-prone areas increase vulnerabilities to landslides and floods (4, p.67)</p> <p>A deterioration in social and economic circumstances might arise from adverse impacts of climate change on patterns of employment, population mobility ,wealth distribution and limited resettlement prospects (3,p.35)</p>

LEVEL	Climate Change Variable/Extreme events	Impacts
	<p>Storms, Hurricanes, Tropical Cyclones</p>	<p>Insurance sector: Weather and climate are “core business” for the insurance industry. Insurers underwrite weather-related catastrophes by calculating and pricing risks and then meeting claims when they arise. Therefore an unpredictable climate has the potential to reduce the sector’s capacity to calculate and price this weather related risk.(18,p.1)</p> <p>The role of insurance in underwriting weather-related risk is an important component of the national economy. Any reduction in the industry’s ability to underwrite weather-related risk will have serious ramifications for vulnerable countries (like Jamaica) where climate and weather risk is greatest. (18,p.1)</p> <p>The unpredictability of climate change is forcing insurers to develop adaptation strategies which includes putting a price on current and future risks(19)</p> <p>Banking sector: Banks will be affected by climate change mostly indirectly to the extent that general economic activity is affected.(20,p.11)</p> <p>It is estimated that up to 5% of market capitalization could be at risk from the consequences of climate change.(20,p.11)</p> <p>The effects of climate change on banking companies would be direct (eg. Through extreme events that put facilities at risk or indirect (through imposed regulations or shifts in social preferences) (20,p.11)</p>
	<p>Additional Information: Population growth in coastal areas increase demand for land. This involves the removal of coastal vegetation and many natural barriers which increase risks to these events (i.e. storm surges and sea level rise) (9,p.9)</p> <p>Poor land use practices also exacerbate the impact of flooding (3,p.29)</p> <p>Impact by Mid Level Scenario of Sea Level Rise would cost the CARICOM countries(including Jamaica) in 2050, \$USD60.7 billion US dollars (12)</p> <p>During a hurricane or a storm, rainfall exceeds aquifer capacity, causing damage to infrastructure like bridges and roads (3,p.30)</p>	

Table 8.9.2: Impacts of Climate Change related to Natural Disaster Management.

NATURAL DISASTER MANAGEMENT	Extreme Events	Impacts
	Droughts, Storms, Hurricanes, Floods	All of these impacts have already been mentioned in previous tables.
	<p>Additional Information:</p> <p>Displacement of population resulting from hurricanes and floods have been accompanied by outbreaks in shelters managed by the ODPEM (8,p.40)</p>	