

“THE IMPACT OF GEOGRAPHICAL PHENOMENA & NATURAL DISASTERS ON
THE CARIBBEAN SOCIETY & CULTURE”

“Travelers think of them as paradise -- the beautiful Caribbean Islands -- but permanent residents live with the constant threat of hurricanes and earthquakes, floods and droughts, and volcanic eruptions -- a condition that helps shape not only their daily lives, but political and economic decisions at home and abroad.”[<http://www.research.vt.edu>]

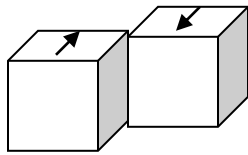
INTRODUCTION

Culture can be defined as learned behaviour that contributes to the way of life of a people. Geographical phenomena [*i.e. plate tectonics (earthquakes & volcanoes), hurricanes, soils, coral reefs and droughts*] affect the non-material component of culture via learnt values and norms centred on our need to protect the physical environment. The material part of culture is also impacted as it can cause changes in **economic organisation** i.e. **tourism, total wealth and welfare (national income)** as well as forms of architecture and settlement patterns (**issues of relocation**). When these cultural changes occur in a defined geographical space, such as a specific Caribbean territory, then the entire **society** is affected.

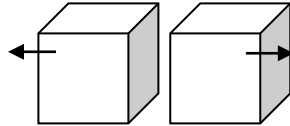
PLATE TECTONICS

The theory of plate tectonics is an explanation of Earth's structure and how crustal plates move in relation to each other, thereby, creating certain tectonic activities at their margin. Plates meet each other at three kinds of margin (see Map 1- The Caribbean plate and its neighbours)

- ❖ Transform (fault) – plates slide past each other. Generates earthquakes (e.g. in Trinidad, Jamaica, Haiti, Puerto Rico)



- ❖ . Divergent (constructive margin) – the plates move away from each other. Generates volcanoes. (e.g. in Cayman Islands)



- ❖ Convergent (destructive margin) – the plate collides and one is forced downwards. Generates Volcanoes & Earthquakes. (e.g. in the Arc of volcanic islands, such as St. Vincent, St. Lucia and Martinique)

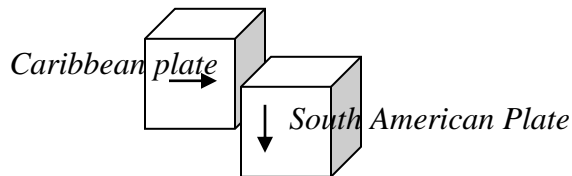
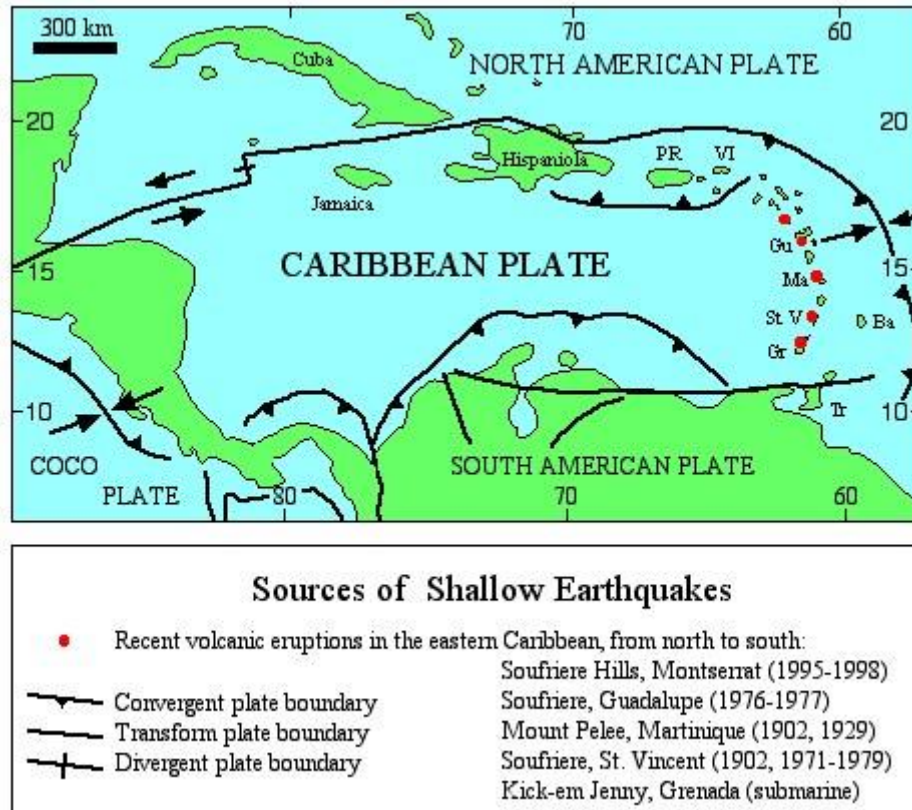


PLATE TECTONICS & THE CARIBBEAN

An Introduction to the Geophysical Process: Earthquakes & Volcanoes



The Caribbean territories are prone to **natural disasters** since two major transformation plate margins demarcate the northern and southern boundaries of the Caribbean plate (see Map 1), and as a result **earthquakes** occur at these margins. The Lesser Antilles being situated on the eastern convergent plate margin experiences **volcanic activity**.

Earthquakes are sudden and rapid vibrations of individual tremors along the earth's crust, both on land and sea. The earthquake zone extends from Grenada to St. Kitts and up to Jamaica and west of Trinidad.



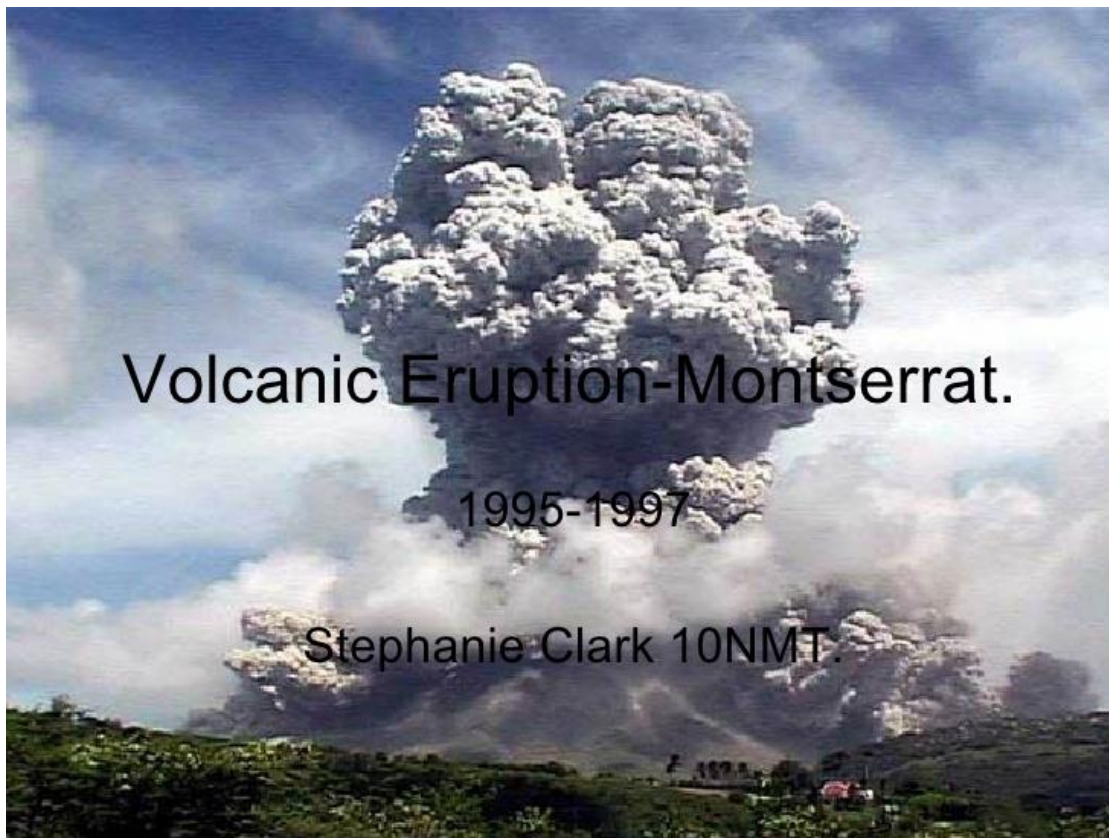
IMPACT (*see also Appendix 3 & 5*):

- Earthquakes are destructive to life and property causing many to be physically displaced and psychologically traumatised. They cause river beds to be displaced and bursts dams. Additionally, they may cause landslides which block water channel and this results in **flooding**, destroying both property and lives.
- Earthquake tremors can cause **landslides** and catastrophic rock fall. This results in the destruction of bridges and railway lines disrupting communication lines. Landslides may also result in the removal of top soil essential for providing nutrients to plant and the stability of the soil will also be lost.

- **Tsunamis** or gigantic waves also result from earthquakes and these results from displacement of large areas of the ocean floor. Tsunamis are very disastrous and the most damage occurs along the coastal regions. An example of this occurred in 1962 when Tsunamis damaged Annotto Bay, Buff bay and Port Antonio on the North Coast of Jamaica.

VOLCANOES: *Social displacement*

Volcanoes are natural vents or fissures linking the earth's interior to the surface through which an assortment of pyroclastic materials of hot ash, lava, debris and poisonous gases are ejected.



IMPACT: Negative (*see also Appendix 3 & 6*):

- Volcanic activity results in havoc and devastation to property, crops and lives due to turbulent avalanches of hot volcanic debris and gases. Expanding hot gases and debris travel at great speed and over long distances and cause pollution to the environment.
- Volcanic activity play a major role in the Caribbean islands to which it occurs. Most are negative effects but some are positive. When volcanoes are active in the Caribbean islands there is a **displacement of population** since individuals either migrate to another country or migrate internally within the island. This results in certain parts/areas of the island becoming overpopulated while others are underpopulated.
- Volcanoes also **destroy crops and the economy** as ash, debris and **molten lava** from the vent covers the ground and restricts growth of crops.
- Volcanic activity also disrupts **tourism** and the airline industry. It can change the weather patterns as clouds of ash ejected from the vent of the volcano decreases the sunlight's intensity and may even cause acid rain. From a human health perspective, it is the source of vision and breathing problems.
- **Landslides and lahars** are also common with volcanic activity and this destroys houses, vegetation and crops. Serious flooding also occurs when drainage channels are blocked and this leads to destruction of lives, crops, property and environmental pollution.
- Volcanic activities can also lead to a threat to the environment. After the volcano is erupted the pyroclastic material **contaminates the water supply** resulting in diseases and other respiratory ailments causing death in some cases.

IMPACT: Positive

Natural disasters are a threat to the environment but not all natural disasters have a negative effect on the environment, some have positive effects.

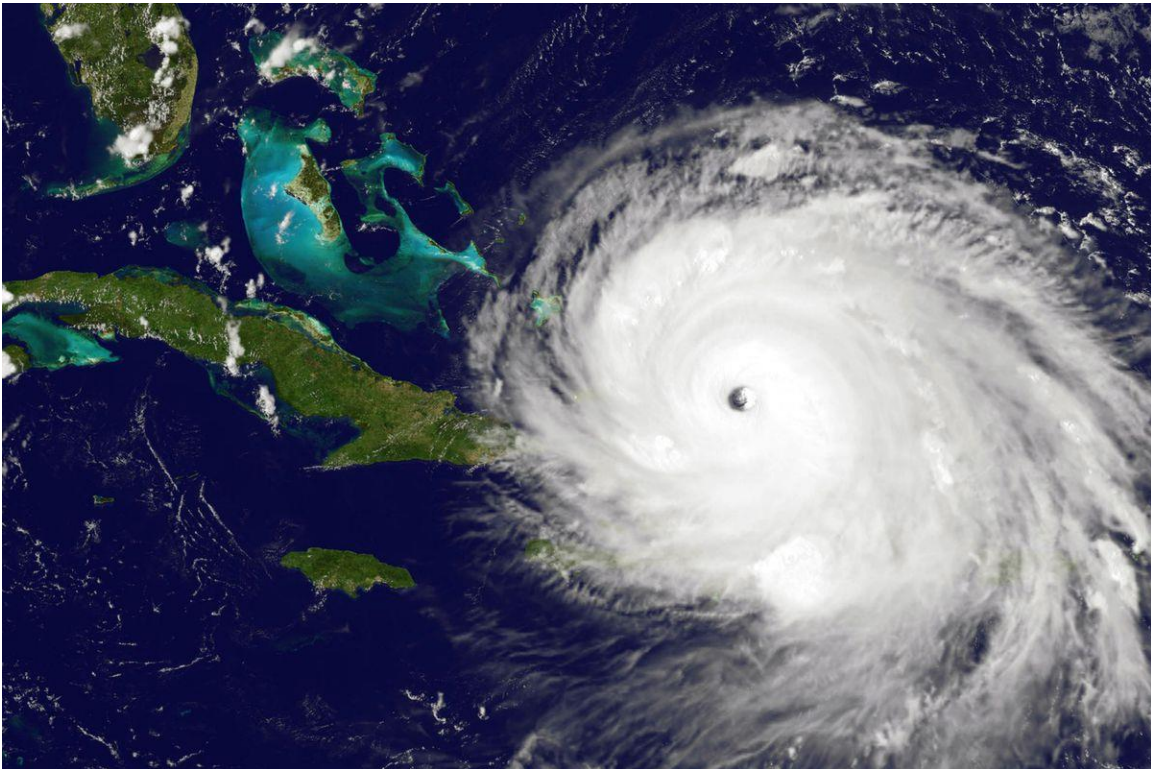
- The volcanic features derived from the volcano after the lava has hardened are major tourist attractions. The results of seismic activity have also provided an abundant supply of ash in the soil and this increases the fertility of the soil, hence yields from agriculture are greater.
- Also derived from volcanoes are hot springs and spas which serve as a source of energy, the hot springs are also high in mineral content and useful for medicinal values. Spas are useful for health purposes, for example Bath in St. Thomas, Jamaica.

Volcanoes are a threat to life, property and crops but it can also be utilized for positive purposes that could enhance life and generate income.

HURRICANES – *Social & Economic Consequences*

(N.B. refer to Appendices 1, 2, 3 & 4)

A hurricane is a violent cyclonic storm with torrential rain and thunderstorm and wind velocity over 119 km/hr (see Appendix 3). Originating in latitudes 5° and 10° N over the west Atlantic, moving west-northwest over the Caribbean Sea and the Gulf of Mexico towards Florida.



WAVE DAMAGE

Waves may reach eight metres high. There may be severe beach erosion, negatively affecting social activities such as beach recreation. Marine life can be damaged, **corals broken** and killed, thus negatively affecting the economy as the production of fishermen are reduced and tourism may fall because of the reduction of coral reefs. In Belize, lobster and conch fisheries took at least a year to recover after hurricane Ibis.

Coastal structures can be torn down. Hurricane Lenny in 1999 came from the west, battering the sheltered coast of the eastern Caribbean islands, and damaging ports, boats, coastal roads and hotels. In St. Kitts, a new cruise ships facility, Port Zante, had to be rebuilt. Hurricane Irma devastated Barbuda making it uninhabitable and in the same year 2017, Maria devastated Dominica and Puerto Rico. In 2019, Hurricane Dorian was regarded as the worst natural disaster in history of The Bahamas.



THE STORM SURGE

Near the eye of a major hurricane, sea levels are several metres above normal. Low atmospheric pressure allows the water to rise. This storm surge is strengthened as it approaches the shore, and low lying coastal areas are flooded. Combined with strong winds and heavy rains, the effect is devastating.

FLOODING

In flash floods, a torrent rushes down a river valley or a narrow gully. The power of the flood may knock down buildings, wash away cars, or drown those in its path.

On flat land, wide areas can be flooded by slowly rising waters. Furniture may be ruined, vehicles damaged, and crops destroyed. Floodwater also threatens disease, by spreading sewage and animal waste into the drinking water.

SOIL: erosion & conservation



SOIL EROSION

Soil erosion is the actual removal of soil by running water, wind or other agents of erosion and transportation (denudation). When the ground is covered with some kind of vegetation, only normal erosion takes place which is unavoidable and is going on everywhere around the globe. When humans interfere with the course of nature by cultivating the land, the rate of soil erosion is often greatly **accelerated**. According to Leong & Morgan (Human & Economic Geography, 1983) “it may take 500 to 1000 years for 25mm of soil to be formed by natural process... but when humans misuse the soil in careless cultivation or indiscriminate removal of forest, 25mm of soil or even more may be permanently lost within a generation.”

Soil erosion can be caused or aggravated by bad farming practices. These are as follows:

- ✚ **Shifting cultivation:** Whereby, the forest is cleared by fire. This harmful act means that the soil is no longer protected from the full force of heavy tropical

rain, nor is it consolidated and held together by plant roots. It is therefore quickly washed away.

✚ **Overgrazing:** The number of animals that can be grazed depends on the carrying capacity of the pasturage, that is the number of animals which can graze on the pasture without completely killing out the grasses or other plants. If this number is exceeded the vegetative cover becomes too thin to protect the soil and rain and wind are able to erode the soil.

✚ **Deforestation:** When land is cleared for cultivation or timber, soil is eroded quickly. Areas where soil erosion and landslides have followed deforestation include the Northern Range in Trinidad, and the Yallahs river in Jamaica, where steep slopes have been cleared for cultivation and housing in a high rainfall area.

✚ **Slope cultivation:** Soil erosion is always enhanced when the cleared area of the land is on a steep slope, because this allows **gully erosion** to take place.

Additionally, the soil on slope is easily moved by gravity when it is loosened.

SOIL CONSERVATION



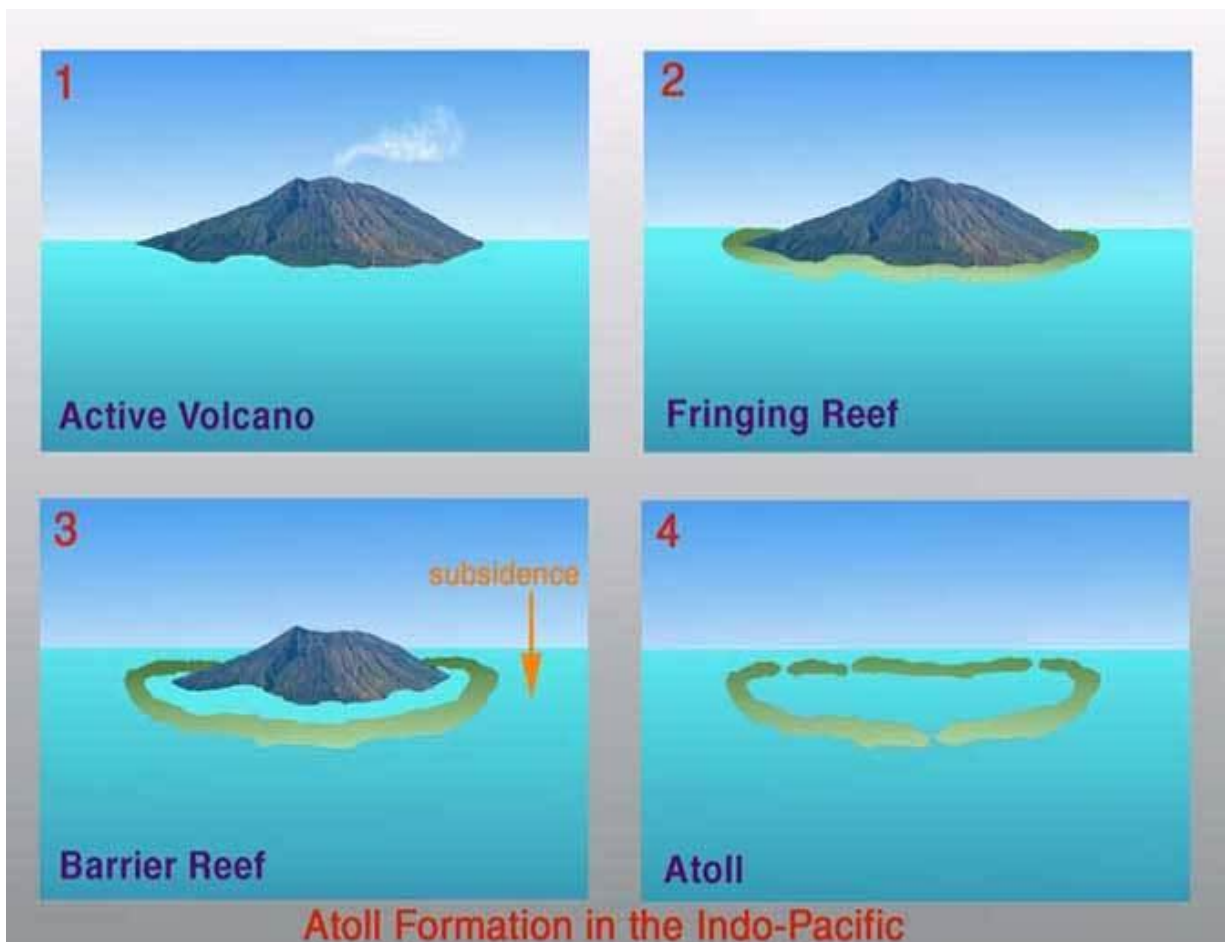
Sound farming practices such as those described below, are most important for conserving/preserving the soil and for improved crop yields and money returns for farmers.

- **Contour ploughing:** If ploughing is done at right angles to the hill slope, following the natural contour of the hill, the ridges and furrows breaks the flow of the water down hill. This prevents excessive soil loss and reduce run-off.
- **Terracing:** Slope may be cut into a series of terrace or steps with sufficient level ground on each terrace to allow cultivation, and an outer wall (retaining wall) at the edge to retain the soil and to slow down the flow of rain water down the slope.
- **Strip cropping:** Whereby, crops are cultivated in alternate strips, parallel to one another. The crops should have differing rotation periods to ensure that at no time will the entire area be left bare or exposed. Thus tall crops may act as wind breaks and strips of other crops, parallel to the contours, slow down soil run-off.

- **Cover cropping:** In some cases, as in plantations, cover crops may be interplanted between the young trees. These crops protect the top soil from the full force of the tropical downpours

CORAL REEFS: *coastal protection & sustainability of fishing industry*

Coral Reefs are large strips of wave resistant coral rocks (calcium carbonate) built by carbonate organism (coral polyps) lying close to the surface of the sea.



In the Caribbean there are generally three types of reefs:

- **Barrier reefs:** are found parallel to the coast and are usually separated by shallow but wide area of water called lagoon. The second largest barrier reef in the world is located off the coast of Belize
- **Fringing reef:** are low platforms of corals, 0.5km to 2.5km. wide, lying close to the shore of an island or continental shelf, but separated by narrow lagoons; its outer edge descends sharply into the sea. In the Caribbean located off the coast of Jamaica, Barbados, Tobago & Antigua
- **Atoll reef:** tend to form a Horse shoe. They are usually linked to a sunken volcanic cone.

COASTAL PROTECTION & THREATS

Coral reefs **protect** the shoreline from **high energy waves**, allowing a **beach to form** (e.g. the south-eastern coast of St. Lucia). Thus, coral reefs are important for the development of other coastal landforms by supplying material for beach sand and provide a **barrier to destructive waves**.

Coral reefs also protects **sea beds and natural habitats** in the under sea world from destruction by creating a buffer effect, thus **preventing backlash and surface erosion**.

The following are various threats to coral reefs:

- **Chemical Pollution:** Herbicides, and other chemical pollutants may poison coral and marine life when they run-off into the sea

- **Organic pollution:** from sewage or fertilizers damages coral. It promotes the growth of other organisms. Corals may be starved of oxygen, or smothered with algae and eventually die
- **Too much fresh water:** coral grows where the water has the right amount of salt (SALINE). Thus, the destruction of parts of the Lagoon barrier at Buccoo Reef in Tobago by man has resulted in **fresh river water from rivers entering the reefs** and reducing the salt content causing a decline in the coral population.
- **Fishing:** damaged may be caused by anchors, by over fishing or by badly placed fish traps and nets. Causing serious and lasting damage to reefs
- **Recreation:** visitors may damage the reef by walking on it or breaking off pieces to take home with them. Dive boats may cause anchor damage. Buccoo Reef in Tobago has been seriously damaged in these ways.

PROTECTING REEFS & COASTLINE

- **Careful environment management** is needed in coastal zones. Such as monitoring water quality, and the state of offshore coral reefs. Also, **educating the public** and advising on shoreline protection and management. These activities are extensively done in Barbados.
- The development of a **proper sewage system** can help protect the marine environment as most organic material and some chemical are removed at the treatment plants.
- **Engineering measures** can protect corals or restore eroded beaches. Well designed **artificial structures** can reduce wave energy and protect beaches from erosion. E.g. earthen embankment, sea walls...

ECONOMIC, CULTURAL & SOCIAL CONTRIBUTIONS: Tourism & Fishing

Coral reefs are important for the Caribbean and other tropical marine environment in many ways:

- ❖ **Fishing industry:** Coral reefs provide a habitat for marine life, including fish and shellfish. Species such as conch and lobster are an important resource for the fishing industry. However, in many Caribbean countries, damage to coral reefs has reduced the number of fish. With small populations, the danger of over-fishing is greater, because there is a smaller breeding population.
- ❖ **Recreation:** Reefs are a recreational resource for local people and for tourism. Scuba diving and snorkelling are an attraction for visitors.
- ❖ **Beautiful beaches:** Much of the sand in many Caribbean beaches, e.g. on the west coast of Barbados, is derived from coral which have been broken up by waves. Further, the reef protects the coastline and beaches from erosion.

Therefore, in closing, coral reefs are very much part of the Caribbean culture and we have learned to use them to enhance our economic wellbeing through fishing and tourism, conscious of their value in sustaining the physical environment

THE IMPACT OF DROUGHTS ON CARIBBEAN CULTURE & SOCIETY

"Drought is a condition of moisture deficit sufficient to have an adverse effect on vegetation, animals, and man over a sizeable area."(Warwick, R.A., 1975)

The equatorial location of the Caribbean islands supports the fallacy that this region of the world with its lush vegetation and “laid back” life style is exempted from the scourges of drought and desertification.

Unfortunately, semi-arid conditions in many parts of the region results in serious land degradation – biological, chemical and physical. The following are major causes and impacts of drought on the region:

CAUSES & IMPACT: Human factors

- **The history of the Caribbean:** written with the blood, sweat and tears of the indigenous Indians and the enslaved Africans, speaks of the rape of cultures and landmasses. For example, ninety percent (90%) of the vegetation of Barbados was destroyed by the colonists in an effort to expose lands for sugarcane cultivation. The denudation of Barbados is largely responsible for the ‘gullying’ and erosion experienced today. A similar situation occurred in Antigua with the same consequences. **Both Antigua and Barbados now experience serious water shortage.** The calciferous nature of the soil in these islands supports excessive leaching and loss of fertility creating **semi-arid conditions that support erosion and loss of productivity.** In the more mountainous islands like St. Vincent and Grenada, the land was devoid of vegetation in all but the most precipitous and inaccessible areas that were unsuitable to agriculture. The loss of stabilizing vegetation in the lower elevations **caused movement of the unstable volcanic soils in the upper elevations leading to landslides** and the exposure of subsurface water sources. With time, much of this water has dried up completely leaving the soil dry and exposed except for patches of scrub vegetation and constructed contour barriers. In the larger islands like Haiti, Jamaica and Cuba much of the land was also cleared for sugar cultivation but the impacts were less

severe than in the smaller islands. In Jamaica for example, there was so much forest remaining that the Maroons were able to develop a subculture totally independent of their former colonial masters who continued to occupy the island and exploit its wood and water resources. Haiti was not so fortunate. The deforestation continued into the nineteenth century resulting in the creation of a virtual desert on large portions of that country.

- **Population pressures:** Many islands are facing the stresses of rapid human population growth increases the region vulnerability to droughts by putting pressure on an already geologically young insular landmasses.
- **The high levels of pesticide:** e.g. use in bananas in the Windward Islands have rendered the lands unproductive without further chemical inputs.
- **Governments' lack of a clear policy on soil conservation:** has not been enough to avoid leaching, erosion and land degradation in general. The problem is exacerbated by the paucity of scientific data on soil loss and the unfamiliarity with droughts in the region despite the temporary dry spells that nature inflicts from time to time.



CAUSES & IMPACT: Physical factors

- **Climatic changes (ENSO effect):** and their associated impacts have conspired to create semi-arid conditions and droughts. The canals and seawalls of Guyana, though very effective in draining the coastal lowlands, could do nothing to stave off the drought of 2001. In recent times, the El Nino Southern Oscillation (ENSO) has emerged as a key indicator of severe changes in weather patterns. The fact that it can be measured from *in situ conditions* makes it appropriate and acceptable as an indicator. El Nino is spawned from increases in surface temperatures of the central tropical Pacific Ocean. These increases in temperature are the forerunners of abnormal air pressure patterns that result in abnormal rainfall patterns or complete shut down of the normal easterly winds resulting in droughts and bush fires. **Under normal conditions, however, the Caribbean has a very active wind system which in addition to drying out the land speeds up the rate of soil erosion/land degradation (a worsen effect).**
- **Rainfall.** One of the best indicators of drought for small island states in the Caribbean is the rainfall pattern. Many of these islands have no real underground store of water due to their size and geology hence they depend exclusively on rain-fed surface streams. Where some underground water exists, it is prone to saline intrusion hence rapid and frequent replenishment is a necessity. The islands of Barbados, the Bahamas, Antigua and Barbuda and the Grenadines of St. Vincent are good examples. Given the islands' limited capacity to retain surface and sub-surface fresh water and the increasing demands for this commodity, it is imperative that there be a regular and reliable replenishment mechanism. The only such source is rainfall. **When the rainfall is delayed, reduced or “inappropriately” distributed, the result is drought and land degradation.**

Therefore, many Caribbean islands are facing the stresses of rapid human population growth, increasing vulnerability to natural disasters, and degradation of natural resources. Droughts and floods are among the climate extremes of most concern as they affect the amount and quality of water supplies in island communities and thus can have significant health consequences. Due to their small size and isolation, many islands face chronic water shortages and problems with waste disposal.

A note on human ecology

What is human ecology?

Human ecology refers to human-land relationships and these differ from one culture to another. Early settlers of the region including the Amerindians and the maroons used geography to their advantage in order to survive. The indigenous peoples had a religion and culture that was **pantheistic** and therefore they treated the environment as sacred. Western/Eurocentric ideology view the natural environment as capital and the domain of humans. This may be linked to the Biblical instruction to Adam to ‘subdue’ the Earth. Our modern civilisation has been built on such principles. However, in the face of post modernistic thinking and the undeniable environmental backlash from poor industrial practices, we are compelled to reimagine our identity as Caribbean and global citizens and inhabitants of Earth. As **Small Island Developing States (SIDS)**, the effects of unsustainable environmental practices hinder not only our physical well-being but also our socioeconomic one.

In light of the above realization, many governments have sought to review policies in the face of growing international pressures and re-educate their population to combat expectations of more material gain at the expense of the environment. For some countries like Trinidad and Tobago this is even more challenging given our economy is fossil –fuel based. Others such as Barbados and Dominica have moved to green energy and built an economy around sustainable industries. The image of a pristine Caribbean is

still a selling point for tourism and ecotourism has had a positive impact on getting buy-in from locals to preserve their natural environment.

Hazards and Responses

However, in the midst of these success stories we are still faced with many challenges - some 'natural' such as climate change - droughts, intense hurricanes etc. Others are human induced such as flooding from deforestation and soil erosion from overgrazing. On an individual and community level, the awareness and response to certain geographic phenomena still leave much to be desired. Cultural norms are formed partly from experience which become our reality. On the island of Trinidad where there is little experience of hurricanes, people take a nonchalant attitude towards precautionary measures when warnings are issued. Some people insist that 'God is a Trini' and assume that their prayers keep away the storms. The reality of our Caribbean neighbours such as Barbados, Montserrat and Haiti are quite different due to their experience with various disasters and thus their attitudes would reflect a less laid-back approach. People's level of education and economic status also influence their behaviour. The poor will always be more severely impacted by a hazard event for obvious reasons. The **Caribbean Disaster Emergency Management Agency (CDEMA)** helps to educate Caribbean citizens and coordinate disaster relief efforts in the wake of disasters. Many individual governments also have plans of action that follow the **disaster management cycle** as promoted by international agencies

Impacts on Culture

Cultural renewal and post modernism has overseen the formation of several interest groups who advocate for protection of the environment. The 'Buccoo Reef Trust' and 'Fishermen and Friends of the Sea' in T&T have challenged authorities in the interest

of protecting the natural environment. It is an indication of a renewed understanding of our inescapable link to our environment and its all-encompassing influence on our society and culture.

GLOSSARY

Agricultural drought: A climatic excursion involving a shortage of precipitation sufficient to adversely affect crop production or range production.

Coral polyps: These are small, soft-bodied creatures which use the calcium carbonate in sea water to build a hard limestone protective casing.

Crop rotation: This is the constant use of the land by alternating crops yearly or longer. As a result of this diversification method the danger of depending on a single crop (monoculture) is reduced especially when world commodity price are falling.

Ground fissures: In a powerful earthquake the ground splits and cracks.

Hydrologic drought: A period of below average water content in streams, reservoirs, ground-water aquifers, lakes and soils.

Lava flows: A hot, molten rock which may flow to the surface from a volcano

Liquefaction: When reclaimed land or loose sediments which are saturated with water may behave like a liquid during an earthquake. Buildings may sink to the ground.

Meteorological drought: A period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area.

Monoculture:	This is the growing of a single crop, year after year, such as sugar cane or bananas. The crop is constantly using up mineral from the soil causing soil exhaustion.
Natural Disaster:	When a hazard causes deaths, injuries, or major damage to property.
Natural Hazard:	Unpredictable threats arising within the physical, climatic or biotic environment.
Pyroclastic flows:	Viscous lava in the form of gas, ash and fragments, which rushes forward at up to 700 km/hr, with a temperature of 300-800 °C, Killing everything in its path.
Soil conservation:	To protect the bare soil from wind and rain – by covering it with vegetation (afforestation).
Soil erosion:	The removal of topsoil by natural agents (running water, wave action, wind...) Assisted in many cases by human activities, especially in the removal of vegetation acting as a soil protection.
Storm surge:	An unusual rapid rise in tide level, above normal heights, usually caused by a storm of hurricane.
Tremors:	The vibration of the ground due to earthquakes.

Tsunamis: A powerful submarine thrust –fault earthquake of magnitude 7.0 or more producing a giant wave or tsunami, devastating low-lying coastal regions.

APPENDICES₁ *HURRICANE: IVAN (7th September, 2004): A Case Study –*

Economic & Social Consequences:

- ✚ Housing: On some estimates, 80-90% of houses were damaged or destroyed.
- ✚ Electricity & water: Power lines were brought down in most communities. The water supply intakes at reservoirs were clogged with debris. There was also a water contamination risk.
- ✚ Other structures: The recently built national stadium was wrecked. Most schools were damaged or destroyed.
- ✚ Agriculture: Tree crops – the main focus of Grenadian agriculture – were hit hard. Nutmegs are the main farm export and 90% of the trees were felled or badly damaged
- ✚ Environment: Trees were blown down over wide areas. This incident increased runoff after heavy rains, with a risk of flooding and soil erosion.
- ✚ Transport: Roads were blocked, and the airport was closed.
- ✚ Communications: Most land line telephones were out of action. Radio transmitters were blown away.
- ✚ Tourism: Of the 1,700 hotel rooms, only 300 were still in service after Ivan.
- ✚ Law & Order: Looting created further disruptions after the hurricane. The prison roofs were blown off and most prisoners left the compound.
- ✚ Economic damage: Agriculture and tourism, the main sources of foreign exchange, were badly damaged many farmers and hotel staff lost their livelihood. N.B. there was generous international help for relief and reconstruction.
- ✚ Trauma: The power of the storm, lost homes and possessions, and a devastated island were powerful emotional shock. Time was needed to recover.
- ✚ **Total cost:** Total of 39 killed, hundreds injured. Estimated damage US\$815 million, 200% of GDP, or eight times the government's normal tax revenue.

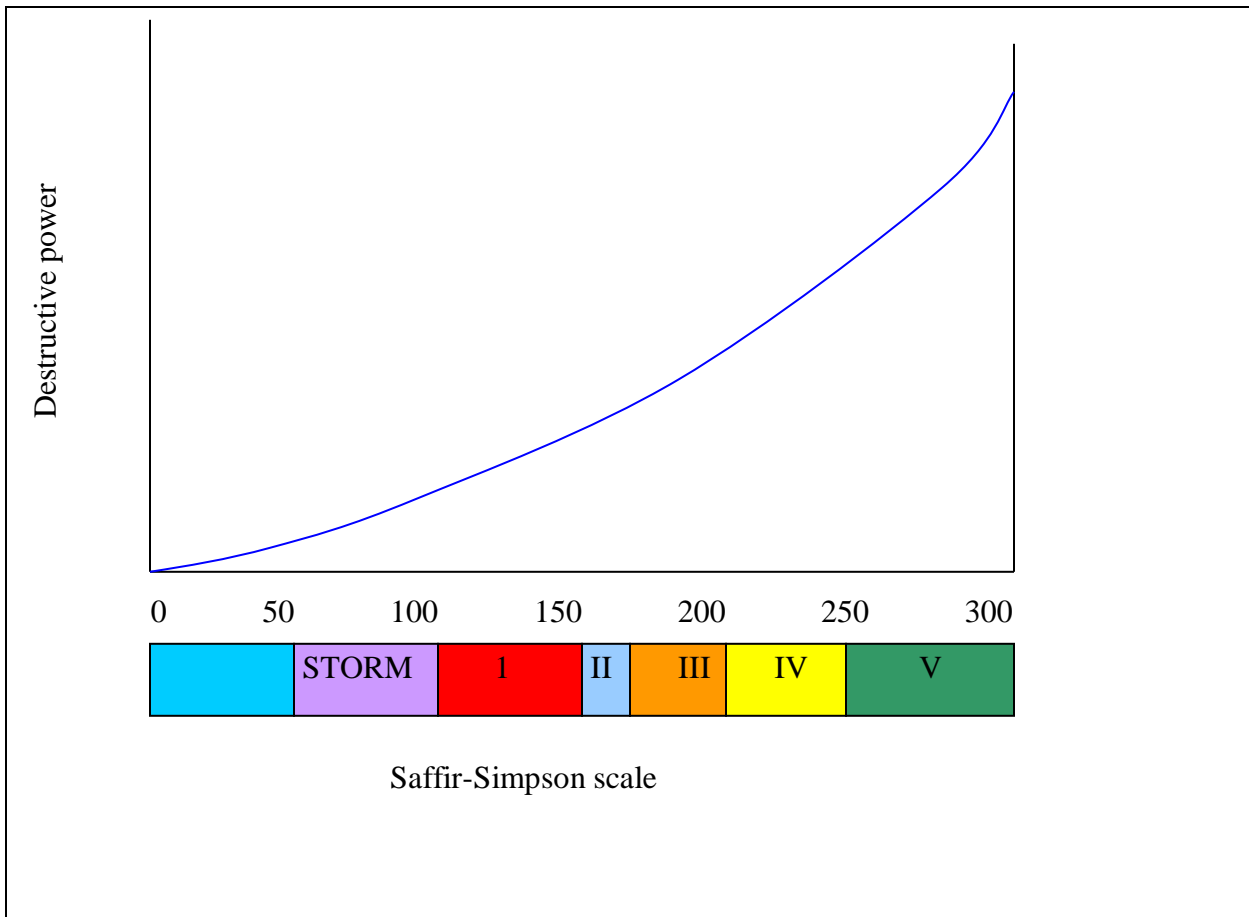
2) WHICH COUNTRIES ARE TREATENED?

HARZARD	CARIBBEAN COUNTRIES TREATENED	NO DIRECT TREAT
Hurricanes	Most Caribbean countries	Guyana Suriname
Volcanoes	Eastern Caribbean	Trinidad, Jamaica, Guyana, Suriname, Bahamas, Belize
Earthquakes	Most Caribbean countries	Guyana, Suriname, Bahamas

3) SOME CARIBBEAN HURRICANES

Hurricane	Islands most affected	Date	Category (wind: km/hr.)	Deaths	Damage (US\$m)
Gilbert	Jamaica	1988	5 (250 + km/hr)	49	1400
Luis	Leewards	1995	4 (210-249 km/hr.)	16	2 500
Marilyn	Leewards	1995	2 (154-177 km/hr.)	8	1 500
Mitch	Belize (Nicaragua & Honduras)	1998	5	9 100	3 500
Ivan	Grenada, Jamaica, Caymans	2004	5	94	17 000
Jeanne	Haiti, Dom. Rep. Bahamas	2004	3	3000	6500

4) WIND SPEED & DESTRUCTIVE POWER (Saffir-Simpson Scale)



5) SOME CARIBBEAN EARTHQUAKES

Date	Magnitude (Mercalli scale)	Deaths	Countries affected
1953	7.7	Nil	St. Lucia (buildings damaged)
1954	6.5	1	Trinidad (buildings damaged)
1997	5.9	80	Venezuela (where deaths occurred) also Tobago, Trinidad
2004	6.3	1	Dominica, Guadeloupe
2006	5.8	Nil	Trinidad

6) SOME CARIBBEAN VOLCANOES

Date	Volcanoes	Countries affected	Deaths & Damage
1902-1903 & 1929	Mount Pelee	Martinique	30 000
1902 & 1917 & 1979	Soufriere	St Vincent	1 600
1976-77	Soufriere	Guadeloupe	
1939-2001 (12 times)	Submarine volcano of 'Kick 'em Jenny'	8 km north of Grenada (190m beneath the sea)	
1995-2005 (18 times)	Soufriere	Montserrat	

BIBLIOGRAPHY

BOOKS

Cheng Leong, L., Morgan, G. *Human and Economic Geography*, Oxford: Oxford University Press, 1983

Reid, R. *Caribbean Studies*, Kingston: Ruel B. Reid, 2002

Wilson, M. *The Caribbean Environment*, Oxford: Oxford University Press, 2005

INTERNET

<http://www.research.vt.edu>

<http://md.water.usgs.gov/drought/define.html>

DICTIONARY

Oxford Dictionary of Geography