

Integrated Coastal Zone Management in response to Climate Change – Adaptation Issues for Barbados

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Coastal areas of Barbados

The coastline approx. 92 km comprising:

32 km coral sand (West and south coasts);

32 km limestone cliffs (north coast, south east coast and some of the west coast);

11 km silica sand (east coast);

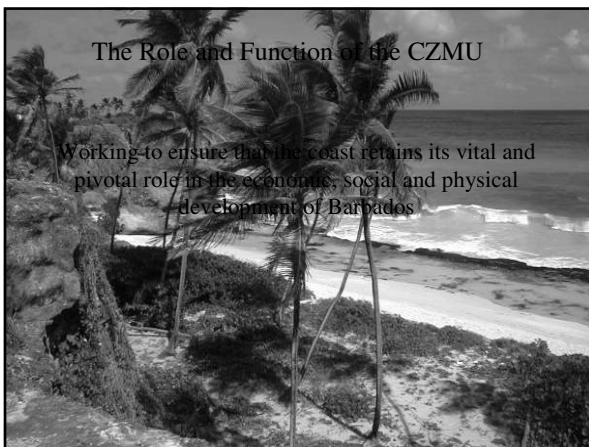
11 km sedimentary slopes (east southeast coast);

6 – 7 km manmade structures (mainly on the west and south coasts).



Role of Coastal Zone Management Unit

- It is concerned primarily with:
 - coastal erosion and management strategies for dealing with this threat.
 - marine resources and island system management issues, coastal planning assessment, public education, coastal engineering design and assessment, and community participation.
 - implementation of the island's integrated coastal zone management plan



The Role and Function of the CZMU

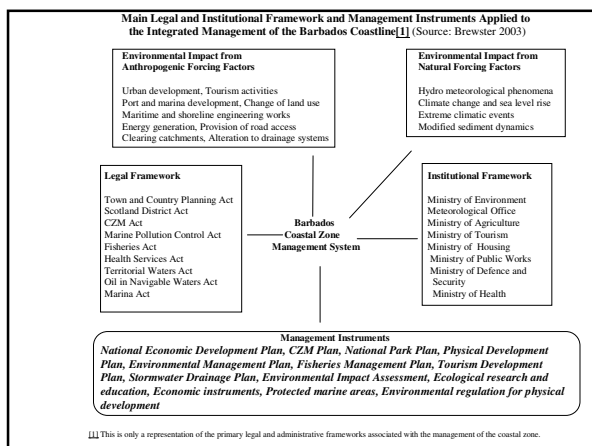
Working to ensure that the coast retains its vital and pivotal role in the economic, social and physical development of Barbados

Functions of the Coastal Zone Management Unit

- **Oceanographic assessment**
 - Beach profiling
 - Coral reef surveys
 - Wave data collection and analysis
- **Coastal research**
 - Beach access identification
 - Dune revegetation and management
 - Coral transplantation
 - Coral disease and bleaching monitoring
 - Coastal legislation identification
- **Project execution**
 - West and South Coast Pre Feasibility & Diagnostic study; Institutional strengthening; West and South Coast Feasibility study; East Coast Study; Coastal Infrastructure Project
- **Education outreach**
 - Public lectures
 - School visits
 - Media programmes
- **Community participation**
 - Community projects that demonstrate good CZM practice and initiatives
- **Development control**
 - Providing assessments on coastal development applications for TCPO; Cliff top vulnerability assessment
- **Coastal engineering**
 - Providing advice on shoreline protection methods, design criteria and structure inspection & evaluation

Organizations involved in Integrated Coastal Management			
Ministry	Organization	Main CZM Function	Contact Person
Energy and Environment	Coastal Zone Management Unit	Oceanographic assessment, coastal research, coastal engineering, coastal development control, education.	Director
	National Conservation Commission	Operation of beach and park facilities, provide advice on coastal rehabilitation, provide life guard service.	General Manager
	Environment Unit	Provide advice on policy and research, environmental education, provide advice on environmental impact assessment.	Senior Environmental Officer
	Environmental Engineering Division	Development approval, pollution monitoring and enforcement.	Chief Environmental Engineer
Housing & Lands	Property Management Unit	Management of Crown lands in the coastal zone	Chief Property Manager
	Lands and Surveys	Definition and determination of land boundaries.	Chief Surveyor
Health	Sewerage and Solid Waste Project Unit	Study design and construction of sewerage collection treatment and outfall works.	Waste Management Coordinator
	Sanitation Services Authority	Solid waste collection and disposal.	General Manager
Public Works	Drainage Unit	Design and construction of coastal drainage structures, maintenance of coastal culverts, wells, and drains.	Chief Technical Officer

Ministry	Organization	Main CZM Function	Contact Person
Tourism and International Transport	Barbados Port Authority	Operation of harbours, terminals marinas, safety and pollution in territorial waters.	General Manager
		Marine affairs, regulation of shipping.	Harbour Master
	Tourism	Promotion of coastal environment as a tourism asset.	Sen. Tourism Dev. Officer, Project Manager, BTH
Finance and Economic Affairs	Town and Country Planning Office	Development approvals control and compliance in the coastal area.	Chief Town Planner
Agriculture and Rural Development	Fisheries Department	Sport and commercial fisheries.	Chief Fisheries Officer
	Soil Conservation Unit	Soil conservation and agricultural pollution, revegetation and reforestation in the Scotland District.	Soil Conservation Unit Manager
	Analytical Services	Environmental laboratory analyses	Director
Defence and Security	Police department and Barbados Defence Force	Policing and enforcing regulations set out for use of the sea.	Commissioner of Police, Brigadier Barbados Defence Force



- ### Some of Barbados' ICZM goals and strategies
- The ICZM plan comprises 3 volumes and has associated legislation for its implementation
 - The goals and strategies as outlined in the plan focus on the following:
 - Maintain a high quality coastal environment
 - Protect valuable species
 - Conserve critical coastal habitats

- Conserve critical ecological processes
- Control pollution
- Provide development guidance
- Provide planning guidance
- Identify critical lands
- Restore damaged ecosystems
- Public awareness

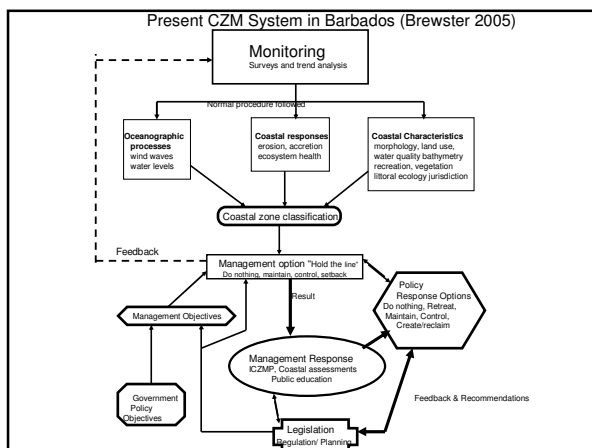
- ### What is Climate Change
- o Climate change refers to changes in climate, or "average weather patterns," that occur on timescales of decades to centuries.
 - o The Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report 2001 (ref. IPCC Third Assessment Report - Climate Change 2001) concluded that the consensus view of thousands of scientists around the world is that climate change is occurring and that global warming is the result of increases of the atmospheric concentrations of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and other heat-trapping gases (SO_x & NO_x).
 - o Excessive amounts of these gases in the atmosphere interfere with the globe's natural warming and cooling cycles. The 2007 IPCC Fourth Assessment Summary for Policymakers Report (ref. Climate Change 2007: The Physical Science Basis, Summary for Policymakers, IPCC 2007) builds upon the 2001 report findings and contains the strongest conclusions to date confirming the links between human-related greenhouse gas emissions and climate change.

Economic Perspective on Climate Change

- The Stern Report, the most comprehensive public review ever carried out on the economics of climate change, was published on Oct. 30, 2006 (ref. Stern Review on the Economics of Climate Change, January 2007). The report makes it clear that climate change is a serious global threat, and that the costs of reducing emissions and proactively adapting to a changing climate are far less than the future risks and damage of global warming.
- The Stern Report estimates that the dangers of unabated climate change could be equivalent to losing at least 5%, and as much as 20%, of global GDP each year. Early action now to reduce greenhouse gas emissions to avoid the worst impacts of climate change could limit the reduction to about 1% of global GDP each year.
- Climate change is not only an environmental issue; it is an economic and social issue as well. Barbados has experienced significant impacts from extreme weather events in recent years which has contributed to economic losses within the tourism sector. Such events are expected to occur more often as the frequency and intensity of storms increases, sea level continues to rise and global temperatures increase.
- Although reducing greenhouse gases entails actions and investments now, for future economic and social benefit, the "do nothing" scenario carries the potential for far greater impacts in the medium and long terms. Government, industry and individuals all have a moral obligation to set priorities and make choices that are environmentally responsible.

Barbados' application of IPCC recommendations

- Barbados has accepted that climate change is a reality that will have significant impact on it as a SIDS.
- It has adopted at the policy level the IPCC committee's recommendations for mitigating accelerated sea level rise. The policy responses focus on practical shoreline management options which have application within a wider context than just disaster mitigation (Brewster 2005).
- Within the small island context, the prime policy has to be on land preservation and protection.
- Given Barbados' small size and the level of development along its leeward coastline, the generic guiding management option has and continues to be to "Hold the Line". As a result some modified interpretation has to be applied to the IPCC guidelines to capture the small island situation (Brewster 2005).



• Do Nothing

- The "do nothing" concept allows nature take its course. This approach is currently used on the undeveloped East Coast locations, which are relatively natural and unspoiled and other coastal locations that may be small open/vacant lots sandwiched in developed areas^[1]. This concept allows for the natural buffer action of the backshore areas to absorb much of the high-energy waves experienced on open coastal sections.

• Maintain (Hard Options)

- In order to maintain the coastline the use of hard engineering options is accepted (e.g. revetments, seawalls, groyne fields, gabions, piles, and breakwaters (surface piercing and submerged). These structures have been used with varying degrees of success.

• Control (Soft Options)

- The soft options currently applied within the existing framework include: 1) the use of vegetation or revegetation of areas; 2) the use of vegetative matting on bluff faces to aid in bluff face stabilization; and 3) the enforcement of coastal related legislation specifically for the use of building setbacks, the protection of some vegetation species and the prevention beach sand mining.

[1] Due to their size these locations are too small for any sort of development, since the setbacks for construction and the road reserve requirements overlap and have to be left vacant.

• Advance the Line

- The area is enhanced either by building protective structures and performing land reclamation and in filling to elevate the threatened area, or increase the size of beach areas by beach nourishment through the elevation of the beach profile to counter the effects of erosion.
- In some instances, structures are required in combination with the nourishment to "anchor" the sand in the nourished area.

• Retreat/Abandon/Relocation

- If the land parcel is large enough some property owners can relocate threatened infrastructure to other locations on the property. Generally, this is not a suitable scenario for the coastline given the level of development.
- The other options of abandonment or relocation are options not normally considered or recognized by property owners as viable alternatives – due to the level of financial investment placed on the coast.

N.B. The main course of action normally taken is property protection, using hard coastal engineering structures. It's only when the site is highly threatened that government will initiate relocation schemes.

How is climate change affecting Barbados now?

In Barbados we have recently had examples of what impacts can be expected from climate change across the island. These include

- extended drought periods reducing accessible groundwater for domestic use;
- increased occurrence of drought – impacting the potential replenishment of the ground water supply;
- increased occurrence of drought and its impacts on the agricultural sector

The climate change impacts on the coast can be expected mainly as a result of increased sea levels around the island resulting in:

- increased episodes of coastal erosion;
- increase swell wave activity with prolonged swell wave seasons;
- elevated water temperatures occurring around the island earlier leading the coral bleaching;
- coral bleaching events impacting the viability of the reefs and hence their capacity to protect the shoreline

Increased sea level rise – implications for Barbados?

- Sea level rise is an inevitable outcome from combined climate change and global warming. Increased sea level will potentially result in:
 - narrower beaches resulting from increased coastal erosion events;
 - coastal flooding and inundation along some low lying coastal areas;
 - salt water intrusion in some coastal aquifers;
 - “drowning” of coral reefs as they are in deeper water than normal, therefore reducing their ability to act as natural breakwaters to protect the coast;
 - Increased water temperature leading to increased coral bleaching events;
 - Increased wave activity during swell events;
 - Increased storm activity especially during the hurricane season.

CZMU approach to lessen climate change impacts along the coast

- The CZMU mandate is focused on retaining the coastline in as near natural a form as possible. To this end the government has pursued a staged approach to the island’s coastal conservation programme focussing on:
 - long term beach change monitoring;
 - evaluation of coastal development applications;
 - the identification of causes for beach and shoreline deterioration and making recommendations for beach rehabilitation, stabilization and enhancement (3 previous projects completed and Coastal Infrastructure Programme (CIP) – ongoing);
 - coral reef monitoring.
- The Unit has always implemented appropriate coastal engineering techniques to stabilize and enhance coastal segments, while ensuring the provision of continuous lateral access to segments where such opportunity formerly did not exist.

- The Unit has ensured that it considers the impacts of potential increases in sea level and increased wave energy due to increased storminess within all of its coastal engineering designs. All CZMU CIP structures are designed to withstand a 1 in 50 year storm wave return event. All structures are physically modelled.
- We monitor coral bleaching events and rate of recovery at the locations once they are reported to us. Increased attention is now being placed on the duration of the elevated water temperatures around the island. We are currently working with UWI Cave Hill on monitoring these thermal episodes and intend to establish a network of temperature stations on several of the location known to be affected by coral bleaching.
- Sea level rise monitoring for Barbados was one of the main components of the CPACC project in the mid 1990s. The Unit has recently reinitiated this project with the installation of a new tide gauge to monitor sea level rise. In addition as part of the MACC project the original tide gauge which also used to measure tectonic uplift will also be replaced and upgraded.

- The nearshore wave climate is also routinely monitored at the coastal infrastructure project sites. It is intended that eventually a network of wave recorders will be deployed along the west and south coasts to actively monitor localized wave climate to help strengthen numerical models for coastal processes occurring along the shore.
- Coastal weather stations have also been installed to start to collect meteorological data for coastal segments. It is envisaged that this will be expanded to include areas of interest for the BWA, Soil Conservation Unit and Natural Heritage Dept to focus on climate change considerations associated with land degradation and drought impacts as well as rainfall and aquifer recharge considerations.
- All submitted coastal town planning applications are reviewed by the Unit with appropriate recommendations for sustainable coastal development being presented.

Conclusion: Identified Best Practices

- Recognizing island as a coastal zone
- Use of coastal setbacks for cliffs and beaches
- Classification of beaches and cliffs based on erosion vulnerability (ongoing)
- Regular monitoring
 - beaches (quarterly), reefs (bleaching – annually; reef health every 5 yrs); post event recovery
- Setting coastal engineering design standards to account for sea level rise and increased “high energy events”
- Achieving “buy in” from developers/property owners regarding the increased need for coastal engineering modeling

Remaining gaps, needs, concerns

- **Oceanographic data collection**
 - Oceanographic data is collected monthly from a series of nearshore wave recorders deployed along the west and south coasts. This assists in the establishment of wave climates at specific locations and provides critical data on wave statistics during periods of unusual wave activity e.g. tropical cyclones and swell events.
- Gaps/Concerns: Not the entire island is covered; need for training in data interpretation and wave and current modeling; .
- **Sea level rise and storm surge impacts**
 - Sea level rise and sea flooding both pose substantial threats to our coastal infrastructure (buildings and roads).
- Gaps/Concerns: Storm surge modeling and sea level rise impacts on the coast need to be identified and mapped. Coastal vulnerability assessments need to be performed to incorporate socio-economic considerations.

● Coastal Hazard Mapping

➢ Coastal and flood hazard mapping is the process whereby information relating to the socioeconomic, environmental and meteorological conditions in an area are brought together to identify locations vulnerable to particular types of impacts. With regard to natural disasters, hazard mapping needs to involve the identification of communities, industries and services at risk of inundation during periods of abnormal sea swells or storm surges (i.e. tropical storm or hurricane conditions).

● Gaps/concerns: Many of the buildings along the west and south coasts designated as storm shelters are surrounded by the zones of potential inundation. This has a high potential for severe disruption to residential (local and tourism), industrial and commercial entities, as well as the potential for loss of life.

- No well defined hazard maps exist for Barbados.
- Capacity building at the institutional level required.
- Coastal vulnerability assessments needed.

Recommendations for improving B'dos' ICZM Climate Change policies

- Compile coastal hazard characterization atlas
- Map and model climate change and sea level rise data related to coastal hazards
- Develop a process to capture and document conditions immediately after major storm events
- Determine coastal community vulnerability assessment to assist in storm damage protection
- Develop update and implement hazard mitigation plans for coastal communities
- Improve climate change monitoring initiatives through continued installation of instrument networks
- Develop a coastal building code for coastal construction

● E.g. Building and land management

- Set back requirements
 - Horizontal set backs: beaches & cliffs – new proposals for cliffs and bluffs based on vulnerability to failure/slumping
- Construction requirements
 - Elevation of lowest floors above projected flood wave crest elevations
 - Implementation of design specifications for shoreline stabilization and enhancement
- Land acquisition
 - Purchase of lands subject to erosion damage and dedicated to public purposes
- Continued public infrastructure investment
 - Encouraging the pattern and density of development to minimize the future losses to coastal hazards
 - Continued implementation of the enhancement and stabilization of coastal segments prioritized for urgent remedial action
- Community education programmes
 - Community education programmes to inform coastal constituencies about coastal hazards and appropriate management practices – developing home owner guides, identification of hazard areas and information dissemination

Thank you

Questions?