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Chapter 3

How do Grenada's Ecosystems Contribute to Climate Resilience?

Climate Change in Grenada

Drying Trend	•Decreasing rainfall and increasing temperatures is expected by 2050 together with increasing frequency and duration of droughts — with moderate to severe events occurring 26% of the time •Increasingly dry trend by 2050, with rainfall decreasing by 20% (May-July) and 20-30% (August-December) •Shift in species range with implications for pest, diseases and invasive species •Species restricted to high elevation moist habitats, such as the Grenada Whistling Frog, would be at risk from a reduction of these areas due to drying conditions
Increased Air and Sea Surface Temperatures	•Mean annual temperatures are projected to increase between 0.9 °C and 1.3 °C by 2050 •Increase in SST is expected to range between 0.43 and 2.15°C per century •Above1.5°C, it is projected there will be further loss of 70–90% of reef-building corals, with 99% of corals being lost under warming of 2°C or more above the pre-industrial period
Changing Rainfall Patterns and Increased Intensity of Hurricanes	•80% increase of category 4 and 5 hurricanes over the next 80 years •Increased flooding •Larger proportion of the most intense tropical cyclones (TCs), storm surges, increased extreme weather events and intensification (i.e. torrential rainfalls, storms, hurricanes)
Sea Level Rise (SLR)	•Projected estimates in SLR for 2050, in a worst case, could be 0.5-0.6m

Chapter Objectives

a) Describe the current status and trends across Grenada's ecosystems and ecosystem services.

b) Given pre-existing and ongoing anthropogenic activity, describe how climate change impacts Grenada's ecosystems & ecosystem services in the present and predict how it might do so in the future.

c) Discuss the current, and predict the future, effect of climate change, in synergy with anthropogenic activities, on the (present) resilience and (future) resilience potential of Grenada's ecosystems.

Ecosystem & Community Resilience

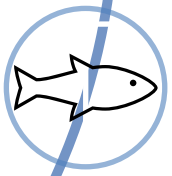
- Ecosystem resilience - the ability of the system to continue its functioning amid and recover from a perturbation
- Community resilience - closely interlinked with ecosystem resilience
- Resilient ecosystems provide multiple benefits, social and economic well-being. For example, among other societal and cultural benefits, coral reefs, mangroves, seagrass, and beaches provide protection against storm surges
- Human actions which drive changes in land use, hydrology, nutrient cycles or increase pollution can reduce ecosystem resilience, especially when synergised with changing climate conditions

Ecosystem Pressures

Land degradation and land use change caused by agricultural, tourism and residential development, and commercial activities leading to habitat loss, fragmentation, degradation (including erosion and sedimentation) and destruction (for example from an increased incidence of wildfires or removal of seagrass beds and other coastal vegetation for development).

Unsustainable land management, with increasing competition for resources, Invasive Alien Species (IAS) and pollution (chemicals, nutrients, sediments, ballast water, waste etc.).

Land tenure - when agricultural land is urbanized and farmers have to move to marginal lands, often near or in forested watershed areas.



Unsustainable natural resource management and consumption rates, such as over abstraction of surface water and overharvesting of species, including seafood for local consumption and tourism demand, result in overexploitation of ecosystems.

Pressures related to climate change include increased storm intensity and frequency, drought, sea level rise and increased sea surface temperature (SST).

Terrestrial Ecosystems - Impacts

- Forest loss already observed in Grenada has led to increased flooding and erosion, particularly after hurricanes and droughts.
- Watershed degradation impacts water supply intakes and coastal water quality.
- Reduction in agricultural productivity through altered soil erosion, nutrient cycling, fire and hydrology, drier conditions could lead to reduced future carbon sequestration.
- Sea level rise is already impacting Grenada and together with high development pressure in coastal areas, this could lead to overall loss of species diversity, abundance and change in habitat composition, including abundance and composition of Non-timber Forest Product (NTFP) species, which could lead to disproportionately negative impacts for vulnerable groups whose livelihoods depend upon these species.

Terrestrial Ecosystems - Impacts

- Dry forest composition suggests the expansion of drought-tolerant non-native and native edge species into intact communities.
- Increased fragmentation, edge effects and reduced connectivity could reduce a species' dispersal ability, creating a gap between species observed and potential ranges.
- The impacts of the resultant changes in species compositions, homogenisation of species diversity and increasing introduced species on ecosystems and their services on Grenada is poorly known.
- Tourism has been greatly impacted by previous hurricanes, with future species and habitat loss potentially impacting the ecotourism sector.

Terrestrial Ecosystems - Impacts

- The high cost of insurance and abatement of damage from hurricanes and other extreme weather events.
- Increases in vector borne diseases due to climatic changes causing more favourable conditions for species such as *Aedes aegypti*.
- Resource conflicts and internal or external migration due to scarce resources.

Agricultural Ecosystems

- Declining diversity and abundance of pollinators have a negative effect on agricultural production.
- Too much abandoned or idle land can also affect productivity of adjacent farmlands leading to food production loss and a consequent reliance on food imports.
- Increased abundance of pest species would also impact agricultural productivity and biodiversity.
- Climate change effects such as saltwater intrusion due to sea level rise could result in agricultural land abandonment.
- Freshwater inundation has either compromised the running of coastal farms or resulted in complete land abandonment.

Coastal and Marine Ecosystems

- Coastal areas may experience physical damage by extreme storms and communities may be unable to respond to sea level rise due to little option for landward retreat.
- Sea level rise is expected to transform fringing mangroves to basin mangroves, diminishing defence against storms and winds.
- Saltwater intrusion from sea level rise is also increasing the salinity in salt ponds, backwaters and estuaries, reducing available oxygen and limiting their ability to support brackish water species and also leading to high algal growth and fish kills in marine ecosystems.
- Impacts of climate change on fishery production or yields could have wide-ranging implications for Grenada's economy.

Coastal and Marine Ecosystems

- Coral bleaching will occur more frequently, and last longer as mean ocean temperatures increase.
- Increased ocean warming also favours conditions for coral disease outbreaks.
- Increased storm intensity and strong storm surge may dislodge and damage corals in coastal lagoons.
- Extreme storms and wave surges are expected to erode seagrass beds, removing seagrasses.
- Sea level rise will also increase the depth of seagrasses in the tidal frame, limiting the amount of light that is available for photosynthesis.
- Sea level rise coupled with storm surges also threaten to transform beaches to open ocean and increase coastal erosion threatening people and property.
- Increased acidification negatively affects corals reducing the amount of sand available for beach formation.

Freshwater Ecosystems

- Impacts to freshwater ecosystems will affect crop yields, in turn threatening food security and economic stability, resulting in vulnerable livelihoods and income.
- Lack of drinking water (e.g., in St. Patrick), changes to precipitation (causing decreased multisectoral resource accessibility and/or availability for tourism).
- Loss of cultural services (e.g., river tubing and baptisms).
- Reduced irrigation for agriculture
- Reduction in freshwater species including biodiversity loss and homogenization of species diversity (e.g., tilapia).

Freshwater Ecosystems

- Changes to water quality from wastewater discharge from livestock and mixed farming.
- Barriers in rivers placed for flood risk management result in poor floodplain habitat (e.g., in River Road).
- Habitat fragmentation and unnatural morphology of the river.
- Reduction in water availability and quality adversely impact tourism and potentially intensify existing gender inequalities.
- Generally, ecosystem health is decreasing, and species diversity and abundance is reducing.

Enhancing Ecosystem and Community Resilience

Responses: Protect, restore and use ecosystems under the broad/overarching framework of 'natural climate solutions' (NCS) or 'nature-based solutions' (NBS). To improve resilience, responses can take place through national governance and policy responses, institutional and sectoral systems, technological responses and socio-economic conditions.

Policy:

- Coordinated national and multisectoral policy, laws and regulations,
- Harmonised policies between sectors that reduce overlaps and gaps to address adaptation, and integration of ecosystem services into national governance
- Land use planning, policies and legal frameworks
- Systemic and institutional interagency coordination requires augmented financial resources for personnel, technical capacity and equipment.

Enhancing Ecosystem and Community Resilience

Policy Response:

Aligned sectoral policies with adaptation planning would include future proofing climate resilient Protected Areas (PAs) including Forest Reserves and Marine PAs. A priority should include maintaining intact PAs, ensuring effective management of existing PAs and sustainable practices in multi-use reserves. These measures would reduce or remove other pressures such as overexploitation and habitat degradation.

Grenada's ICZM Coastal Policy and Legislation, 2016.

- Control of beach sand mining and development of a coastal zone management plan.
- This plan would improve:
  - Understanding of the sediment processes within individual coastal cells which influence the formation of beaches
  - Inform coastal setbacks which consider future sea level rise and better inform both EBA and hard engineering interventions.
  - Develop local capacity for management of the coast.

Enhancing Ecosystem and Community Resilience

Policy Response:

Wetlands

- A wetland management policy with strong legislation could give protection to both mudflat and mangrove areas.
- Grenada has one RAMSAR site (Levera Wetland) but there is no overall management or protection of wetlands.
- The new ICZM legislation makes it a penalty to remove coastal vegetation, but management capacity and enforcement are lacking.
- Larger MPAs such as the proposed southeast corridor in the Protected Area Systems Plan would help conserve a large area of seagrass.
- Grenada has 4 legally established marine protected areas which offer some level of protection to coral and seagrass species.

Enhancing Ecosystem and Community Resilience

Incentives:

- At a local level, incentives (such as payment for ecosystem services (PES)) and access to financial mechanisms which currently limits investment in sustainable agricultural/ land management planning and practices.
- Given the high proportion of private land ownership, small local actions can promote ownership of climate adaptation and have island-wide cumulative benefits.

Enhancing Ecosystem and Community Resilience

Knowledge and awareness:

- Enhanced awareness and understanding is needed among practitioners and decision makers of climate resilient management techniques and practices integrated with biodiversity and conservation.
- Awareness raising and science communication can also be fundamental to providing communities with the knowledge they need to adapt to climate change, such as long-term monitoring of climate, biodiversity, species and ecosystems.
- Improving access to existing data, establishing information systems, as well as sharing data between and within government departments and all stakeholders are crucial.
- Data collection, such as the establishment of baseline date for ecosystems, and climate and water quality monitoring systems, wastewater management – reuse systems and ecosystem-based adaptation are needed.
- Increase knowledge and information on impacts and responses of fish, wildlife, and plants to a changing climate.
- Data analysis and interpretation will lead to policy development to influence behavioural change and, among others, influence legislation and enforcement, education and capacity building (e.g., business skills, or safety at sea), and transparency and accountability tools.

Enhancing Ecosystem and Community Resilience

Knowledge and awareness:

- Recent studies have been conducted in Carriacou focus on invasive seagrass species *Halophila stipulacea*. It will be important to improve island wide monitoring to understand how this species may be outcompeting other native species in Grenada.
- The potential for seagrass to provide carbon sequestration benefits are promising and large amounts of seagrass beds still appear to be intact. Increasing capacity to monitor stocks to account for this will be important as well as investigating carbon trading mechanisms and other financial incentives which can incentivize keeping seagrass beds intact.
- Recent coastal and terrestrial LiDAR conducted in Grenada in 2016/2017 provides an important dataset which can give a more accounting of mangrove spatial cover. This could be augmented by regular surveys with drones.
- A Coral Reef Early Warning System (CREWS) buoy containing instrumentation to record parameters linked to ocean acidification was installed in the Grand Anse area. This instrument is linked to the NOAA Integrated Coral Observing Network. The installation of more stations such as this around the country would be important to gauge these conditions.

Enhancing Ecosystem and Community Resilience

Community Involvement:

- Community co-management of coastal forest afforestation and mangrove restoration is an important initiative.
- Fisheries cooperatives can be used to develop support schemes, to spread risks and provide a financial 'safety net.'
- Building resilient communities by having them play a leading role in the conservation, restoration and management of ecosystems in Grenada is a key response to the impacts of climate change.

Examples:

- Successful mangrove restoration in the south of the country as well as co-management restoration pilot projects in the northeast. In Carriacou mangrove restoration has been ongoing in the Petite Carenage area.
- There have been multiple examples of coral restoration in Grenada. These include the UNEP EBA pilot project in Grand Anse and Carriacou (2015-2016), which focused on staghorn and elkhorn species using trained community members to propagate and maintain the corals using different methods.
- In 2013 in the Grand Anse area, small concrete pyramids were constructed by a local dive shop which has shown accretion of corals and increased fish habitat in the shallow nearshore area.

Thank you

Questions?