

Sustainable tourism, climate change and sea level rise adaptation policies in Barbados

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Abstract

The vulnerability of tourism-dependent communities, coastal tourism facilities, and beaches to climate change demands the use of measures that can urgently minimise vulnerability and in the long term achieve sustainable development. This paper makes policy recommendations to address climate change and sea level rise challenges in small island developing states. Using Barbados as a case study, the paper found that innovations in policies and projects have offset the past ills of mass tourism and fortuitously now serve as pre-emptive measures in adapting to climate change. The array of methods for combating these changes includes physical planning policies, integrated coastal zone management, and infrastructure projects. Among the key areas for policy innovation are the adoption of protection, accommodation, and retreat strategies, which are informed by rigorous cost-benefit analysis and stakeholder consultation. Ecosystem-based adaptation to climate change is also necessary, especially for islands where coral reef protection is urgent. Moreover, policy adjustments are required on building construction, water resources management, sewage treatment, coastal zone management, physical planning, and land management. Institutional constraints, including the lack of capacity to implement, monitor, and enforce measures, must also be addressed if progress is to be made in adapting to climate change. A major conclusion is that the severity of coastal damage, the importance of tourism to sustainable development, and the country's adaptive capacity play a key part in the selection and implementation of climate change adaptation measures.

Keywords: Sustainable tourism; small island developing States; climate change adaptation; climate change policy reform; Barbados.

1. Introduction

The degraded natural environment of the small island developing States (SIDS) of the Caribbean is due to multiple drivers of change and is now further vulnerable to climate change and its associated sea level rise (SLR). SIDS' vulnerability to these phenomena is of concern to the region's policymakers because the livelihood of communities and tourism investors that are located in the coastal zone are endangered by them. Hall (2011) predicts that Caribbean SIDS will be among the most at-risk tourism destinations between 2025 and the mid-21st century. More than ever before there is a need to ensure that the "possible effects of climate change are effectively factored into relevant tourism policies and development and management plans" (Scott and Becken, 2010:287). In the post-Rio+20 period, greater attention needs to be paid to the links between climate change and impacts on sustainable

development, especially in SIDS that are dependent on natural resource-based tourism.

Two geographic peculiarities make SIDS highly susceptible to SLR: they have long coastlines relative to land area and large proportions of their land area are low-lying (Belle and Bramwell, 2005). Many islands are therefore susceptible to inundation of low-lying coastal land, beach and shoreline erosion, and saltwater intrusion in coastal aquifers (Cambers *et al.*, 2008). Researchers such as Nicholls (2004) and Nicholls and Tol (2006) have noted that while the absolute impacts in small islands are quite small at a global scale, in relative terms the impacts are the highest. They have argued that with a SLR of 0.5 metres to 1 metre, many small islands could lose a significant part of their land that is oriented towards coastal activities. Based on these projections, even the less-vulnerable small islands would suffer significant economic effects from the loss of beach tourism and recreation areas. Belle and Bramwell (2005) have cautioned that the failure of SIDS to invest in climate change adaptation policies may leave them poorly prepared to cope with adverse changes and may increase the probability of severe consequences for sustainable tourism.

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Their caveat is supported by recent studies conducted by UNECLAC (2010) that revealed that unless there is meaningful adaptation to and mitigation of climate change, the potential economic loss to the Caribbean region would be 2% to 3% of its gross domestic product (GDP) annually. Furthermore, the total loss due to inaction will amount to 22% of GDP for the Caribbean as a whole by 2100 (Bueno *et al.*, 2008).

The issue of becoming climate ready is not a new one for Caribbean SIDS. Almost two decades ago, the region became proactive in dealing with climate change because of threats posed to the rich biodiversity and fragility of their island ecosystems. Following the SIDS Plan of Action Meeting convened in Barbados in 1994, the Caribbean embarked upon a course of action to prepare for the adverse effects of climate change through adaptation planning. The region demonstrated its commitment to such planning by undertaking a series of initiatives designed to build capacity, assess vulnerability and mainstream adaptation planning into the decision-making and planning processes at the national and regional levels (UNECLAC, 2010). This process is still taking place, but policy formulation and implementation in respect of climate change adaptation and implications for sustainable tourism has only occurred in the latter half of the 2000s. Internationally, there was a paucity of research in this area. It was not until 2007 that the United Nations Environmental Programme and World Meteorological Organisation commissioned a tourism-focused climate change assessment report (Scott and Becken, 2010). For Caribbean SIDS, the emphasis is now on operationalising climate change adaptation policies, and this will require significant effort on the part of Caribbean Governments. Table 1 provides a summary of milestones within the Caribbean region.

Table 1. Milestones in climate change adaptation initiatives

1994	The 1994 United Nations SIDS Conference on Sustainable Development and the identification of climate change as one of the 14 priority areas in the Barbados Programmed of Action to be addressed in order to ensure the sustainable development of SIDS
1994-1997	The decision to design and seek funding for a climate change adaptation project, and the eventual approval of funding for the project
1997-2001	The implementation of the Caribbean Planning for Adaptation to Climate Change (CPACC) Project
2001	The decision by the Caribbean Community (CARICOM) Heads of Government to establish the Caribbean Community Climate Change Centre (CCCCC). It was established in 2005.
2001-2004	The Adapting to Climate Change in the Caribbean (ACCC) Project
2004-2008	The Mainstreaming Adaptation to Climate Change (MACC) Project
2006-2010	The Special Pilot Adaptation to Climate Change (SPACC) Project (Implementation of adaptation measures)

Source: UNECLAC (2010).

Limited research exists on climate change and SLR adaptation policies in Caribbean SIDS. For this reason, a study using Barbados as a case study was conducted to analyse existing policy measures and projects implemented to address problems associated with earlier unsustainable tourism practices, as well as adaptation to new challenges placed on coastal tourism by climate change. Ultimately, the paper seeks to provide policy recommendations on ways of advancing sustainable tourism that are consistent with adapting to climate change and the associated SLR.

2. Research methods

Data was collected from face-to-face semi-structured in-depth interviews, site visits, government policy documents and scientific studies conducted by academicians. In-depth interviews were conducted between 2010 and 2013 with Barbados' policymakers and tourism investors to determine measures used in addressing coastal resource degradation, climate variability, and climate change adaptation challenges. Government agencies specifically responsible for regulating physical development, coastal zone management, and project implementation aimed at adapting to climate change and the promotion of sustainable tourism were targeted. These agencies were the Town and Country Planning Department (TCPD) and Coastal Zone Management Unit (CZMU) of the Ministry of Physical Development and Environment.

The interview conducted with a senior town planner of the TCPD attempted to determine whether there were any major policy reforms and a revision of the National Physical Development Plan (NPDP) of 2003 (GOB, 2003), that would climate proof coastal tourism. Among the specific questions asked were whether there were revisions to: the land use zoning regulations of the NPDP, the setback policy for coastal development, the erosion and sediment control policies of the 1990s, and on-site water storage requirements. Questions were also asked about the extent of coordination between the TCPD and CZMU.

The head of the Integrated Coastal Zone Management (ICZM) Unit was also asked questions regarding adaptation to climate change. These included: What were the climate change adaptation strategies being implemented to minimise threats to coastal tourism? What were the types of protective measures that were implemented and were they financed by the government or international lending agencies? Why were protective measures a priority of the government? What types of "soft measures" were used along the coast to support coastal tourism? Which ecosystem-based adaptation measures were used in response to climate change risks? Was planned retreat considered an adaptation strategy, and if not why? Questions were also raised about infrastructure policies and projects that were implemented to adapt to climate change. Additionally, questions were asked about the continuation

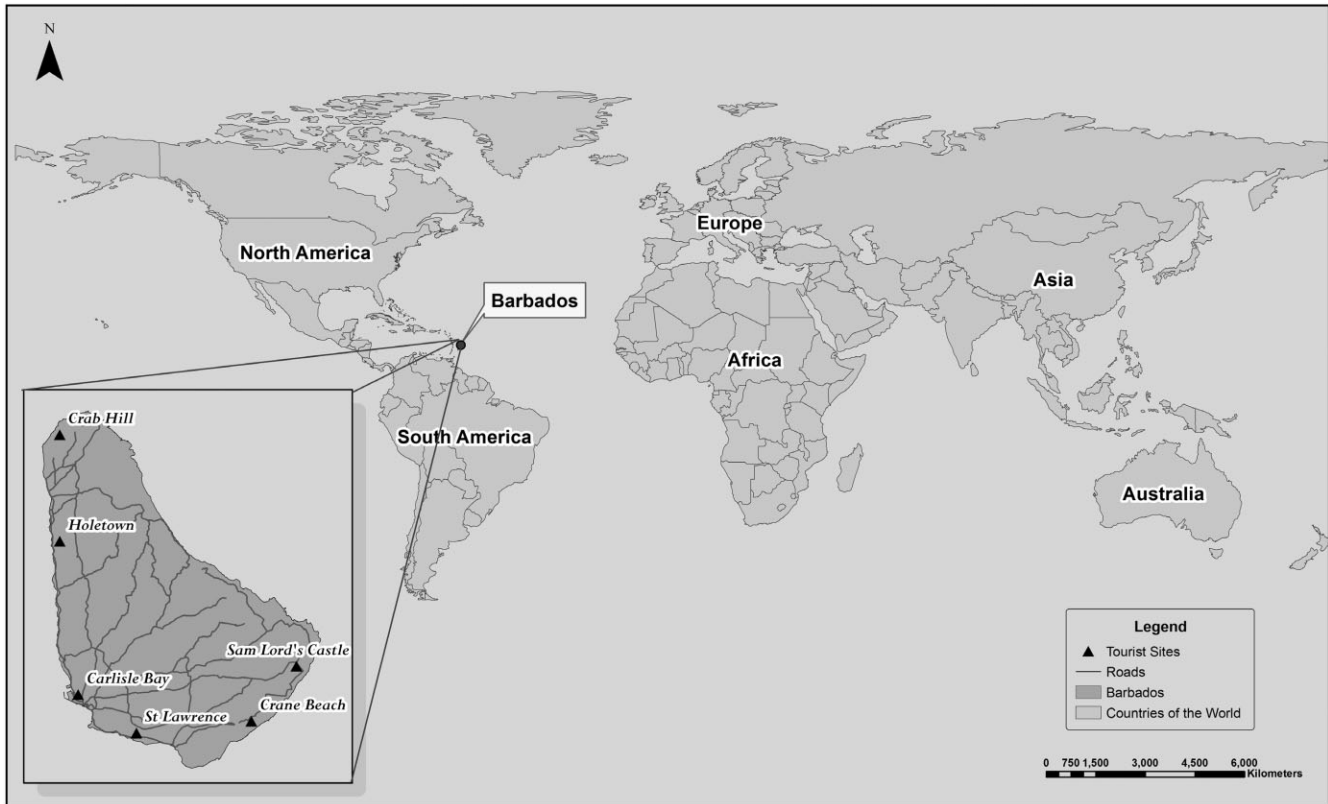


Figure 1. Map of Barbados in relation to major geographical regions of the world.

Source: Gabrielle Thongs (2013).

of tax incentives to hotel operators on the west coast to improve on-site wastewater treatment.

The private sector views of climate change adaptation were obtained from a face-to-face semi-structured in-depth interview conducted in mid-2013 with the director of the Barbados Hotel and Tourism Association (BHTA).¹ The questions pertained to the use of water and energy conservation policies, views on coastal setbacks given climate change, perspectives on whether the private investor should bear some of the costs of coastal infrastructure provision to protect beachfront property, and the effects of the newly imposed air passenger tax on visitor arrivals to the island.

A site visit was conducted on the southwest and west coasts in 2010 and a follow-up visit was concluded in 2013 to examine the effects of coastal erosion and obtain a first-hand view of the effectiveness of projects undertaken in defending critical coastal resources. Information elicited from interviews conducted with the TCPD and ICZM was verified through site visits to these coastlines. Field investigations confirmed the use of coastal setbacks, ecosystem-based adaptation measures, and the use of “hard” coastal protective measures.

¹ Susan Springer, Personal Communication, 19 July 2013.

3. Background on Barbados tourism sector

As illustrated in Figure 1, Barbados is one of the SIDS located in the Caribbean Sea, and many of its hotels are concentrated along beaches on the southwest and west coasts. Climate change and rising sea levels will significantly influence Barbados’ tourism industry, which is vital to its economic survival. The CZMU, using a flood model with a probability of a return period of one flood in every 100 years, projects that 70% of the hotels located on the west coast of Barbados will suffer from flooding and related damage by such an event (Government of Barbados (GOB), 2010; Fish *et al.*, 2008). Research points to mounting evidence of a relationship between climate change and beach erosion (Cambers *et al.*, 2008). In 1999, the project on Caribbean Planning for the Adaptation to Climate Change (CPACC) projected that elevated sea levels were likely to increase beach erosion in Barbados because most beaches were very narrow averaging 12 to 15 metres. Since then new studies have revealed shoreline erosion rates of 15 metres per 100 years for the entire coastline (GOB, 2010). These changes may have deleterious consequences for Barbados according to Uyarra *et al.* (2005) who found that approximately 80% of the tourists they interviewed had indicated an

unwillingness to return to Barbados for the same price if SLR and erosion caused the loss of beach area.

While climate change poses threats to the island, earlier unsustainable land management practices with a bias towards mass tourism, high-density beach accommodation, and past failures of plans and policies to protect its key tourism assets, were major factors in the destruction of the island's fragile ecosystems (Weaver, 2001). Only one hectare of coastal mangrove remained giving way to hotel development (GOB, 2001). Coral reef degradation was reported in two studies spanning twenty years. According to Wilson (1996), the primary causes of reef degradation in Barbados were thought to be inadequately treated sewage and contamination from fertilisers and pesticides. Later on, the GOB (2001) reported that the main causes of coral reef destruction were careless diving near the shore, disposal of solid waste, and indiscriminate alterations to the coastal topography mainly from tourism development, destructive fishing practices, and anchoring boats over reefs. A study of trends from 1982 to 1992 on reefs along the west coast revealed a mean percentage loss of species (Parker and Oxenford, 1998). Subsequent studies showed that coral reefs deteriorated from 1997 to 2007 (University of the West Indies, 2008) in some popular tourism locations. Approximately 80% of Barbados' fringing reefs were seriously degraded, and bank reefs decreased from 37% to 23% over a decade (GOB, 2010). Furthermore, severe coral beaching associated with climate change in late August 2005 affected all reef habitats and nearly all coral taxa and an average of 71% of all colonies experienced bleaching (Oxenford *et al.*, 2008).

Given the negative externalities of traditional coastal mass tourism, Barbados has taken measures to mitigate these impacts over the last two decades thereby ensuring that tourism remains a significant economic sector. In 2008, tourism accounted directly and indirectly for nearly 40% to 47% of the island's GDP (Dulal *et al.*, 2009; Inter-American Development Bank, 2010), 50% of total export earnings and employed 44% of the labour force (GOB, 2010). Beaches constitute a major part of Barbados' tourism product, which is supported by the empirical evidence that a decade ago they contributed US\$ 13 million to the local economy (Dharmaratne and Braithwaite, 1998).

In recent times, a major concern of the island's policymakers is that losses to coastal ecosystem services, infrastructure damage and threats to livelihoods due to climate change can undermine economic resiliency (GOB, 2010). For example, new research has found that the livelihoods of small communities that are dependent on coastal resources, such as fisheries and tourism, are vulnerable to climate change. One key finding of a survey of 50 residents and workers of Oistins (See Figure 1) conducted by Caribsave (2012) was that the socio-economic vulnerability of fishermen was high because their boats were uninsured against hurricanes and storms and they had insufficient savings to absorb the cost of boat repair or

replacement. Another major finding was that many of the women vendors at the fish fry stalls would lose income or be unemployed if the fisheries resources declined or if the market stalls where they sold crafts to tourists suffered hurricane, storm or flood damage. The study also concluded that fishermen would be economically disadvantaged if the fish fry stalls were damaged and they incurred costs to transport their catch to another location or were obliged to use cold storage facilities.

So far the contextualisation of tourism in Barbados points to a clear juxtaposition and paradox emerging between tourism's many undesirable impacts on the coastal zone and climate changes threatening to adversely affect coastal tourism infrastructure, ultimately threatening the very nature, character and socio-economic well-being of this coastal tourist destination. Coastal ecosystem degradation and the challenges of climate change require policy shifts and innovative practices in sustainable tourism and climate change adaptation. The following sections of this paper analyse policy reform and practices used in Barbados' tourism industry to confront these challenges.

4. Sustainable tourism, physical planning policy and practice, and climate change adaptation

Sustainable tourism in Barbados is unattainable if coral reefs, one of its most important coastal assets, are vulnerable. In the context of SLR and coastal erosion, reefs play a key role in ecosystem-based adaptation to climate change because they serve as natural breakwaters. Barbados' existing physical planning policy minimises soil erosion and sedimentation given that coral reefs require clear water conditions to survive. An interview in 2010 with a senior town planner of the TCPD revealed that the erosion and sedimentation control policies from the 1990s remain unchanged.² In practice, built development is disallowed on erosion-prone lands and sediment control and management plans are mandatory for all building and engineering operations, including hotels and other related facilities located in coastal areas.

Over the past 30 years, coastal setbacks have been used to regulate development in Barbados. A coastal setback distance is a prescribed distance to a coastal feature within which all or certain types of development are prohibited. The TCPD applies a coastal setback policy because it eliminates the need for seawalls and other engineering structures that reduce beach erosion and flooding but which may also affect coastal property. In islands such as Barbados, setbacks also provide buffer zones between the ocean and coastal infrastructure, where the beach zone may expand or contract naturally, as observed by French (2006). Additionally, setbacks enhance the probability that artificial

² George Brown, Personal Communication, 5 May 2010.

light will not shine directly on the beach to disturb turtle nesting.

Coastal setback regulations serve as a pre-emptive retreat strategy in Barbados. Barbados' Revised National Physical Development Plan (2003) and Coastal Zone Management Plan recommend a setback of 10 metres from the toe of a cliff undercut for cliff top developments and a setback of 30 metres from the high water mark for beachfront developments. In an interview conducted in 2010, the deputy director of the CZMU indicated that recommended setbacks vary depending on the section of coast targeted for development and the presence of any important ecological or geological features.³

Despite the flexible application of policy guidelines, setback distances remain short, given the storm surges and coastal erosion that Barbados has experienced in the past. This argument dates as far back as the 1990s, when Wason and Nurse (1994) suggested variations in coastal setbacks for Barbados. They recommended that for slopes less than 1:20, a 30 metre distance should apply; slopes of 1:4 to 1:20 should be setback 15 metres; and for coastal cliffs of 1:1 or greater, an 8 metre distance should be adopted. They also made the case that rigorous scientific research on the highest contour normally reached by high seas should determine setback distances.

New evidence on climate change projections highlights the importance of revisiting the setback policy for Barbados. Fish *et al.* (2008) found that beach area was lost from all of Barbados' beaches under all SLR scenarios with a 10 metre and 30 metre setback. They argued that whereas the benefits of long-term beach maintenance accrued from adequate setback regulations are clear, consideration must also be given to issues that can hinder the implementation or effectiveness of setbacks. One difficulty is that the tourism industry has been concentrated in the coastal area since long before the imposition of setback standards. Over 90% of all hotels are within or proximal to the beach (GOB, 2001; Belle and Bramwell, 2005). Approximately 90% of the island's hotels are located within 1 kilometre of the high water mark and less than 20 metres above sea level (Belle and Bramwell, 2005; Dulal *et al.*, 2009). The island's hotels are therefore located almost exclusively within 1 in 500 and 1 in 100 inundation zones, placing them at risk of major structural damage (GOB, 2001). Moreover, although Barbados has not experienced a major hurricane in recent times, it remains vulnerable. Approximately 50% of hotel rooms in Barbados are at risk from a category 3 hurricane because of their proximity to the mean sea level, and Becken and Hay (2007) estimate replacement costs of hotels could be up to US\$ 550 million.

Cambers (1999) has long argued that given the climate change projections, factors such as long-term trends in erosion, short-term storm effects, wave up rush, wind forces and existing development should also help determine

setback distances. More recently, Abuodha and Woodroffe (2010) suggest calculating coastal setback distances using a coastal sensitivity index. The index would consider rock type, coastal slope, geomorphology, barrier type, shoreline exposure, shoreline change, relative SLR, mean wave height and mean tide range. If considered along with social factors, the index can provide a useful framework for establishing setbacks.

5. Integrated coastal zone management policies and projects, sustainable tourism, and climate change adaptation

Integrated coastal zone management (ICZM) can assist in planning for adaptation to climate change because it provides an anticipatory and predictive approach to facilitate a response to medium and long-term concerns such as SLR, as well as responds to short-term needs (Belle and Bramwell, 2005; Tobey *et al.*, 2010). Tobey *et al.* (2010) have argued that the process and best practices of ICZM are not radically changed by applying a climate lens. From their perspective, the best practices of planning and implementation of coastal management measures apply equally to climate change as they do to other coastal issues.

The approach to ICZM taken in Barbados is led by the Coastal Zone Management Unit, and is supported by three legislative acts: the Coastal Zone Management Act of 1998, which establishes the legal framework for coastal zone management; the Marine Pollution Control Act; and the Town and Country Planning Act (GOB, 2001) which deals, *inter alia*, with built development and land use along the coast. These pieces of legislation are effectively enforced by strong coordination among the regulatory agencies.

Among the three generic climate change adaptation strategies that exist, Barbados has focused on protection and accommodation as opposed to retreat. The accommodation or “do nothing” approach has been applied to undeveloped locations on the east coast of the island. Measures for beach protection and enhancement have been implemented on the more highly developed southwest and west coasts (Brewster, 2007; Fish *et al.*, 2008). These include “hard options” such as sea walls, revetments, groyne fields, gabions and breakwaters, which absorb wave energy and stimulate beach nourishment (See Plate 1).

5.1. Protection measures

The CZMU has taken into account that “hold the line” measures intended to reinforce coastal lands should be designed to the highest standards otherwise they would temporarily mitigate erosion and be costly to maintain if poorly designed. But these “hard” structures are also aesthetically unpleasing, as they visually impair the natural ambience of beaches (Mycoo and Chadwick, 2012). However, the CZMU has “softened” the vista of a highly

³ Lorna Inniss, Personal Communication, 3 May 2010.

engineered shoreline by integrating landscaping to help the beaches look more natural in appearance. As part of the promotion of sustainable tourism, the design of visually pleasing boardwalks and landscaping has helped dilute the harsh concrete vistas that would otherwise encircle the coast, as revealed by site visits to Holetown and Rockley Beach in mid-2013.

Barbados' coastal defences are a priority for implementation in the short term because of the severity of beach erosion and the importance of beaches as a tourism product in the wider context of economic revenue generation. Of particular note is the milestone Coastal Infrastructure Programme (CIP) financed by an Inter-American Development Bank loan, which comprises a range of coastal management works and activities designed to achieve shoreline stabilisation and erosion control, restoration of coastal habitats, improved public access to coastal areas and institutional strengthening for coastal management (GOB, 2010). In 2010, the CZMU began conducting a study to identify and prepare a priority list of engineering works for coastal erosion control and flood mitigation. One of the current objectives of the CZMU is to incorporate climate change adaptation into the design of engineering response measures.

Site visits in 2010 and 2013 revealed that three projects were completed: the Welches Beach Improvement Project, the Rockley to Coconut Court Waterfront Improvement Project and one segment of the Holetown Beach Improvement Project. In mid-2013, site investigations into the impact of the “hard” coastal structures revealed positive results. On the southwest and west coasts where these structures have been built there has been success in minimising erosion and achieving beach accretion (See Plate 1).



Plate 1. Protective measures used along the southwest coast of Barbados to minimise beach erosion.
Source: Author's elaboration.

5.2. Planned retreat

Planned retreat is a controversial, untenable option for dealing with climate change and SLR because the coast of Barbados is highly developed. Unlike SIDS that have a coastal reserve of State-owned land that allows some degree of regulation over beachfront development (Mycoo, 2004) the majority of coastal land in Barbados is under private ownership and already highly developed. Brewster (2007) contends that tourism investors in Barbados may resist relocation. This approach ignores substantial investment in property. He further argues that the State would intervene in property relocation only if the site is highly threatened and where property damage has occurred because of an extreme event. The interview held in 2013 with the director of the BHTA revealed that hoteliers were more concerned with economic survival by keeping occupancy levels high rather than the impending dangers of climate change impact, including beach erosion. Cambers *et al.* (2003) have found that planned strategic retreat using setback distances for hotels takes a long time because these buildings have an economic life span of 25 to 30 years before they need to be extensively renovated, converted or demolished. They argue that it is at the end of this life span when there is the opportunity for rebuilding further back from the water. Fish *et al.* (2008) argue that although it is an expensive option, moving buildings back could minimise the likelihood of paying out considerable amounts in the future.

5.3. Beach nourishment

Another popular approach is the use of “soft” measures such as beach nourishment. Restoration occurs by bringing sand to the beach from inland sites or adjoining beach segments, or by hydraulically pumping sand onshore from an offshore site. With climate change, beaches will seek to re-establish their equilibrium by shifting landward in response to rising seas.⁴ Barbados' beach-centred tourism has influenced beach nourishment initiatives in an area of 1.2 kilometres, which include two beach nourishment projects that will cost US\$ 3 m (BD\$ 6 m) and US\$ 2 m (BD\$ 4 m) respectively. These projects are located in areas where there are high investments in tourism facilities and where maintaining a recreational beach supports extensive economic activities. Furthermore, Barbados completed a Beach Management Plan in 2008 which is currently being implemented.

5.4. Ecosystem-based adaptation

Eco-system based measures are used in Barbados to address reef damage and coastal erosion arising from SLR and

⁴ Beach restoration (or renourishment) is expensive in Caribbean islands, in part because the cost of dredged sand ranges from US\$ 5 to US\$ 16 per cubic metre (Cambers, 1999). In addition, mobilisation costs for the dredge may range from US\$ 100,000 to US\$ 300,000, depending on the location of a suitable dredge (Cambers, 1999).

storm surges. Given coral reef damage over the years, the CZMU has embarked on a coral reef transplantation project because corals are an essential constituent of Barbados' beaches and a major asset for sustainable tourism. The coral reef transplantation cost is approximately US\$ 1,000 per 100 square metre of reef restored (personal interview with Deputy Director, CZMU in 2001). The GOB (2010) reported that 400 coral heads were transplanted and numerically tagged for monitoring purposes. Recent assessments have shown that the transplanted corals are in good health.

The CZMU uses several adaptation measures in response to erosion and flooding in coastal areas, but the right balance between “hard” and “soft” options needs to be achieved over the long term, and cost-benefit analysis will be of tremendous help as a decision-making tool. Striking the right balance of adaptation measures is especially important in economic, ecological, social and political terms.

6. Sustainable tourism, infrastructure policy and projects, and climate change adaptation

Infrastructure policies and projects include water conservation and sewage treatment projects, as well as tax incentive policies.

6.1. Sewage treatment

Water pollution is regulated by the TCPD policy that states that outfalls, which discharge wastewater directly into coastal waters, will be prohibited unless they have at least primary level treatment. Coastal water pollution and coral reef damage caused in part by malfunctioning package treatment plants on the south and west coasts, influenced the decision of policymakers to construct a central sewerage system on the south coast where most of the hotels are concentrated, which was later followed by one on the west coast. In 2004, a 44 kilometre central sewer system capturing wastewater flows (11,300 m³ per day) within the 6 metre contour was built on the south coast at Graeme Hall. This system offers an advanced preliminary level of sewage treatment. The West Coast Sewerage Treatment Facility has not commenced operations, but when in operation it will be 119 kilometres long. However, Nurse *et al.* (2008) have reservations about the adequacy of an advanced preliminary level of sewage treatment, particularly since there have been significant changes in the intensity of land use and development on the west coast and the original design specifications remain unmodified. Environmental scientists in Barbados are concerned about the safety of the coral reefs where such a basic level of treated sewage is disposed of in coastal waters (CZMU, 2010).

Apart from the GOB investment in sewerage infrastructure, market incentives encourage wastewater

management as an integral part of the goals of sustainable tourism. A time-bound subsidy is granted for the purchase of equipment or technology that reduces waste. The Tourism Development Act (2002) allows a tax credit of 20 per cent of the capital cost of fittings, pipes and pumps used in the improvement of the wastewater system for operators who incur expenditure in improving the wastewater disposal system. If the credit is not used in one year, it may roll over for a period not exceeding fifteen years.

6.2. Water management policies

For almost fifteen years, policies have promoted the alleviation of water scarcity in Barbados. Barbados is among the top 15 countries in the world that are suffering from water scarcity, and droughts are predicted with climate change if dry seasons become drier. Moreover, saltwater intrusion from SLR may damage freshwater sources such as groundwater aquifers. The GOB is already concerned because in 2010 it reported that the water authority was pumping at near maximum capacity and saltwater intrusion into ground water aquifers may occur as a consequence.

Although desalination plants cause environmental damage, one became operational in 1999 to augment Barbados' potable water supply and mitigate drought. Additionally, since 1997, the Town and Country Planning Department requires all buildings except houses having a gross roof area of 93 square metres or more to install a rainwater storage tank for secondary uses. The storage capacity of the tank is calculated at a rate of 195 litres per square metres of gross floor area at a minimum. It is also mandatory that hotels have on-site water recycling facilities for golf courses and landscaped areas. This is designed not only to ensure water demand management in the context of scarcity but that locals have access to water, in keeping with the issue of equity in sustainable tourism. However, these regulations do not apply to buildings predating the amendment, and a tax rebate incentive is only applicable to new developers who must meet the minimum requirements. Despite policy shifts to carefully manage water demand, there are mixed signals from the GOB in that hoteliers continue to enjoy subsidies that may affect water resources management in the future. Recent findings by Charara *et al.* (2011) found that water bills for hotels in Barbados were less than 5% of their annual expenses; they recommended that they be charged higher water consumption rates, because they were highly subsidised by the government. Table 2 provides a summary of the policies, practices and projects used by Barbados to support sustainable tourism and adaptation to climate change.

7. Policy recommendations for SIDS

SIDS policymakers can learn from sustainable tourism policies implemented in Barbados that are doubling as

Table 2. Barbados' policies, practices and projects to support sustainable tourism, green economy and climate change adaptation

Policy measures	Sustainable tourism	Adaptation to climate change
TCPD policy		
Sediment control plan mandatory for all building and engineering operations	Coral reef protection	Natural breakwater against SLR and coastal erosion
Coastal setbacks applied over 30 years	Protection of tourism facilities	Protects property and population from SLR and storm surges that may cause coastal flooding and erosion Can eliminate use of engineering structures to reduce beach erosion and flooding
ICZMU policies and practices		
“Hard” options implemented (sea walls, revetments, groyne fields, gabions and breakwaters) to protect developed southwest and west coasts	Absorb wave energy and stimulate beach nourishment. Important in protecting beach-based tourism product	CZMU is focusing on incorporation of climate change adaptation in engineering designs
“Soft” options used e.g. beach nourishment	Projects located in areas of high investments in tourism facilities and beach supports economic activities	An adaptation response to climate change e.g. erosion and SLR
Coral reef transplant	Supports beach & diving tourism	Reduces coastal erosion from SLR and storm surges
Infrastructure policy & projects		
Water conservation	Desalination plant (1999) Water recycling and water storage mandatory for hotels	Adaptation to drought and water scarcity Tax rebate for new hotels
Central sewerage system	On tourism intensive southwest and west coasts.	Reef health maintained and coastal protection promoted

Source: Author's elaboration.

pre-emptive measures for adaptation to climate change and SLR.

7.1. Physical planning policies, risk assessment and hazard mapping

In SIDS where coastal erosion is severe, physical planning policies should be implemented to control sediment loss and minimise beach erosion. Failure to do so will result in coral reef damage, beach loss, and erosion of beachfront tourism accommodations. Coastal setbacks are recommended to minimise these impacts, but some flexibility in applying setbacks would be needed. A place-based approach to coastal tourism management is essential and therefore these setbacks should be based on the merits of the specific proposed coastal development. Setback design should be informed by scientific research on long-term trends in erosion, short-term storm effects, wave uprush, wind forces and a coastal sensitivity index. The index can provide a useful framework for establishing setbacks if considered along with social factors, and it should also account for geological and geomorphological variables, relative SLR, mean wave height and mean tide range.

Policymakers need to have SLR projections and measurements of changes in elevation captured by LIDAR, which should then be mapped for the entire coastal zone using a geographic information system.⁵ LIDAR provides

⁵ LIDAR is light and radar. It is a remote sensing technology that produces high resolution maps.

high quality elevation data, with its high vertical accuracy and spatial resolution, and thus it provides a more precise delineation of the potential inundation zone given various SLR scenarios. By mapping different SLR scenarios, varying degrees of risk and vulnerability can be spatially displayed. This informs physical planners and can lead to improvements in policymaking and decision-making with regard to the location of tourism investment.

7.2. ICZM, sustainable tourism, and climate change adaptation strategies

SIDS should adopt ICZM because it has proven to be a successful strategy for addressing past failures in the promotion of coastally-oriented mass tourism and has become important in the context of climate change adaptation, as the Barbados case study highlights. Moreover, as the Barbados study has revealed and as noted by Nicholls (2011), SIDS require an integrated coastal management philosophy that incorporates climate change adaptation strategies with wider societal and sustainable development objectives.

In keeping with the “one size does not fit all” principle, SIDS should explore the suitability of adaptation strategies to the uniqueness of coastal tourism patterns and ecosystem challenges in their individual islands. SIDS have three strategies to select from: protection; accommodation; and retreat. However, a stand-alone strategy is ill-advised because it may compromise successful adaptation to

climate change. In practice, many real-world responses are hybrid, combining elements of more than one approach.

Adaptation strategies and measures are driven by the severity of coastal erosion, economic costs, economic survival — especially of the tourism sector — and the socio-political sensitivity of communities that are impacted by coastal hazards and climate change. An important policy recommendation is that SIDS' response strategies should be influenced by these multiple criteria.

One of the lessons for SIDS is that not all three strategies can be easily implemented and will need to be considered over the short, medium and long term. SIDS policymakers should be aware that protection and accommodation strategies are short to medium term measures and less contentious to implement. In contrast, relocating built development is a long-term costly measure, especially if the overwhelming majority of hotels are already located in the coastal zone. Moreover, policymakers should be sensitised to the possibility that stakeholders will resist the abandonment of high value real estate to the sea unless cost benefit analysis is conducted.

SIDS that are economically dependent on erosion-prone beaches should consider the use of coastal structures in the short term if they are affordable. Barbados has successfully used protective coastal infrastructure to arrest severe beach erosion on the southwest and west coasts where most of its hotels and popular beaches are concentrated.

In addition, ecosystem-based measures such as maintaining existing vegetation, re-vegetation where loss has occurred, and coral reef replanting should be incorporated into climate change adaptation strategies and the costs of doing so should be weighed against long-term benefits.

SIDS are concerned about the financial costs of climate change adaptation, especially given their small carbon footprints. The question of who will pay and who will benefit from adaptation measures is controversial and should be the subject of policy debate among Governments, investors, and communities. Barbados has secured loans from international financial institutions to address severe coastal erosion where its hotels are spatially concentrated. In the case of some SIDS where the degree of risk and vulnerability are high, this financing route is needed because access to “fast-start finance” is currently protracted. As to whether cost recovery from the private sector is necessary, it is recommended that, like Barbados, SIDS Governments finance coastal protection infrastructure if tourism investors are contributing to the GDP both in terms of revenue and employment. But Governments should offset these costs by actively exploring access to the new international climate change funds, especially if their economies have been made fragile by climate change and SLR. For SIDS to access these funds, however, they should commission rigorous research to support their applications and show that funds are needed for climate proofing due to threats arising from climate change.

7.3. Infrastructure policies and projects

Infrastructure policies and projects that promote sustainable tourism are useful adaptation measures to climate change. An important policy reform for SIDS is increased investment in central sewage treatment projects with the appropriate level of treatment to minimise coastal ecosystem degradation. As Barbados has found, without effective sewage treatment, coral reefs will be degraded. Coral reefs are essential to beach sand production, snorkelling, diving and fisheries, as well as to minimising the coastal erosion associated with climate change and SLR, as they function as natural breakwaters. In SIDS where no central sewerage system exists and hotels located on the coast use private sewerage treatment plants, these plants should be carefully monitored by certified inspectors trained by academic institutions to ensure compliance with waste disposal regulations. Additionally, tax incentives should be offered to hoteliers for improving their wastewater disposal system.

7.4. Water conservation

Climate change models predict that water scarcity will result from drought or saline intrusion of freshwater resources associated with climate change. The construction of desalination plants can cause severe environmental damage of the sensitive coastal ecosystems found in SIDS. Water conservation policies therefore should be given high priority. Among the policies that should be implemented is the use of volumetric-based charges for hotels, charges which should not be heavily subsidised so as to discourage high water consumption levels. Providing tax incentives for hotels that install water-saving devices should also discourage water wastage. A mandatory policy should be implemented requiring that all new tourism-related buildings with a gross area of 93 metres or more should build cisterns or rainwater storage tanks for secondary use such as the irrigation of golf courses and hotel landscapes.

7.5. Capacity-building and institutional reform

Although there is no national coastal tourism policy to support sustainable development, Barbados has shown that this policy gap can be managed when there is clear responsibility and delegation of powers between government agencies such as the TCPD and CZMU. SIDS need to ensure that there is strong collaboration among their physical planning and environmental management agencies as well as CZMUs where these have been established.

The success of policy implementation depends on strong institutional capacity for monitoring and enforcement, reliable databases for decision-making and sensitisation of policymakers on how critical governance is to sustainable natural resources management in the face of climate change challenges. Capacity-building and institutional

reform should therefore be given high priority on the SIDS climate change adaptation agenda. In some SIDS, institutionalising these reforms requires improved access to international funding that caters to developing an institutional landscape which facilitates the implementation of adaptation measures.

8. Conclusion

Climate change adaptation for most SIDS will require policy reform in the areas of building construction, coastal management, water resources management, waste management, physical planning and sustainable land management, all of which are components of sustainable tourism. Policies should be linked to market mechanisms that offer incentives for adoption, including subsidies and rebates. Furthermore, these policies should be an integral part of SIDS' national sustainable development policy.

Much work still needs to be done among SIDS, including: conducting rigorous research, prioritising and costing measures that will achieve climate change adaptation and sustainable tourism, weighing the benefits to society, building adaptive capacity among all stakeholders, exercising vigilance in systematically monitoring, and evaluating the effectiveness of these measures in adapting to climate change. What remains to be answered is who will pay and who will benefit from the policies and projects implemented. This matter calls for stakeholder input informed by an awareness of the philosophy of equity, economic efficiency, and environmental sustainability.

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References

- Abuodha, P., Woodroffe, C., 2010. Assessing vulnerability to sea-level rise using a coastal sensitivity index: a case study from southeast Australia. *Journal of Coastal Conservation*, 13(3): 189–205.
- Becken, S., Hay, J.E., 2007. Climate change related-risks and adaptation. In: Becken, S., Hay, J.E. (Eds.), *Tourism and Climate Change: Risks and Opportunities*. Channel View Publications, Clevedon, pp. 223–260.
- Belle, N., Bramwell, B., 2005. Climate change and small island tourism: Policy maker and industry perspectives in Barbados. *Journal of Travel Research*, 44(1): 32–41.
- Brewster, L., 2007. Coastal erosion risk mitigation strategies in small island developing states: The Barbados model. Presented at the United Nations Framework for the Convention on Climate Change Expert Meeting on SIDS Adaptation to Climate Change, Kingston.
- Bueno, R., Herzfeld, C., Stanton, E.A., Ackerman, F., 2008. The Caribbean and climate change: The costs of inaction. Stockholm Environment Institute and Global development and Environment Institute, Tufts University.
- Cambers, G., 1999. Coping with shoreline erosion in the Caribbean. *Nature and Resources* 35(4): 43–49.
- Cambers, G., Claro, R., Juman, R., Scott, S., 2008. Climate change impacts on coastal and marine biodiversity in the insular Caribbean. Caribbean Natural Resources Institute, Technical Report 382.
- Cambers, G., Muehlig-Hofmann, A., Troost, D., 2003. Coastal land tenure: a Small islands' perspective. UNESCO, CSI info.15, Paris.
- Caribbean Project on Adaptation to Climate Change, 1999. Component 6: Coastal vulnerability and risk assessment. Regional Workshop Report, Grenada. St. Michael, Barbados.
- Caribsave, 2012. Climate change risk profile for Barbados. Available at www.caribsave.org/assets/files/CCCR (accessed 19 September 2013).
- Charara, N., Cashman, A., Bonnell, R., Gehr, R., 2011. Water efficiency in the hotel sector of Barbados. *Journal of Sustainable Tourism*, 19(2): 231–245.
- Coastal Zone Management Unit (CZMU), 2010. Available at <http://www.coastal.gov.bb/> (accessed 14 October 2011).
- Dharmaratne, G., Braithwaite, A., 1998. Economic valuation of the coastline for tourism in Barbados. *Journal of Travel Research*, 37(2): 138–144.
- Dulal, H., Shah, K., Nilufar, A., 2009. Social equity considerations in the implementation of Caribbean climate change adaptation policies. *Sustainability*, 1(3): 363–383.
- Fish, M.R., Côté, I., Horrocks, M., Mulligan, J.A., Watkinson, B., Jones, A.P., 2008. Construction setback regulations and sea level rise: Mitigating sea turtle nesting beach loss. *Ocean and Coastal Management*, 5(3): 330–334.
- French, P.W., 2006. Managed realignment — the developing story of a comparatively new approach to soft engineering. *Estuarine, Coastal and Shelf Science*, 67(3): 409–423.
- Government of Barbados, 2001. *Barbados' First National Communications to the United Nations*. GOB, Bridgetown.
- Government of Barbados, 2003. *The National Physical Development Plan-amended*. GOB, Bridgetown.
- Government of Barbados, 2010. *National Assessment Report*. GOB, Bridgetown.
- Hall, C.M., 2011. Climate change and its impact on tourism: Regional assessments, knowledge gaps and issues. In: Jones, P., Phillips, M. (Eds.), *Disappearing Destinations: Climate Change and Future Challenges for Coastal Tourism*. CABI, Oxford, pp. 10–29.
- Inter-American Development Bank, 2010. Barbados adapts to climate change. Available at <http://www.iadb.org/features> (accessed 19 September 2013).
- Mycoo, M., 2004. Minimising foreign control of land: a case study of St. Lucia. *Land Use Policy*, 22(4): 345–377.
- Mycoo, M., Chadwick, A., 2012. Adaptation to climate change: The coastal zone of Barbados. *Maritime Engineering*, 165(4): 159–168.
- Nicholls, R., 2004. Coastal flooding and wetland loss in the 21st century: Changes under the SRES climate and socio-economic scenarios. *Global Environmental Change*, 14(1): 69–86.
- Nicholls, R., 2011. Planning for the impacts of sea level rise. *Oceanography*, 24(2): 144–157.
- Nicholls, R., Tol, R.S.J., 2006. Impacts and responses to sea level rise: A global analysis of the SRES scenarios over the twenty first century. *Philosophical Transactions of the Royal Society A*, 364(1841): 1073–1095.
- Nurse, L.A., Cashman, A., Mwansa, J., 2008. Barbados' West Coast Sewerage Master Plan: Accommodating a changing policy and project environment. Presentation at 14th Annual Wider Caribbean Waste Management Conference, 23–27 June, 2008, St. George's University.
- Oxenford, H.A., Roach, R., Braithwaite, A., Nurse, L., Goodridge, R., Hinds, F., Finney, C., 2008. Quantitative observations of a major coral bleaching. *Climatic Change*, 87(3): 435–449.
- Parker C., Oxenford, H., 1998. Coral reef, seagrass and mangrove sites. UNESCO Coastal Region and Small Island Papers 3. UNESCO, Paris.

- Scott, D., Becken, S., 2010. Adapting to climate change and climate policy: Progress, problems and potentials. *Journal of Sustainable Tourism*, 18(3): 283–295.
- Tobey, J.P., Rubinoff, D., Robadue, G., Ricci, R., Volk, R., Furlow, J., Anderson, G., 2010. Practicing coastal adaptation to climate change: Lessons from integrated coastal management. *Coastal Management*, 38(3): 317–335.
- United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), 2010. Review of the Economics of Climate Change in the Caribbean Project: Phase 1 Climate Change Profiles in Select Caribbean Countries. UNECLAC, Port of Spain.
- University of the West Indies, 2008. Changes in coral reef communities on the west and south coasts 1997–2007. Centre for Resources Management and Environmental Studies, Barbados.
- Uyarra, M., Côté, I., Gill, J., Tinch, R., Viner, D., Watkinson, A., 2005. Island-specific preferences of tourists for environmental features: Implications of climate change for tourism-dependent states. *Environmental Conservation*, 32(1): 11–19.
- Wason, A., Nurse, L.A., 1994. Planning and infrastructure standards, UNCHS and UNDP. United Nations Centre for Human Settlement: Nairobi.
- Weaver, D.B., 2001. Mass and alternative tourism in the Caribbean. In: Harrison, D. (Ed.), *Tourism and the Less Developed World: Issues and Case Studies*. CABI Publishing, Oxford, pp. 161–174.
- Wilson, D. 1996. Glimpses of Caribbean tourism and the question of sustainability in Barbados and St. Lucia. In: Briguglio, L., Butler, R.R., Harrison, D., Leal Filho, W. (Eds.), *Sustainable Tourism in Islands and Small States. Case Studies*, London, Pinter, pp. 75–102.