Journal of Sustainable Tourism
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/rsus20

Assessing the vulnerability of beach tourism and non-beach tourism to climate change: a case study from Jamaica

Tracy-Ann Hyman[a]

[a] The Climate Studies Group, The University of the West Indies, Kingston, Jamaica

Published online: 09 Dec 2013.

Journal of Sustainable Tourism, 2013
http://dx.doi.org/10.1080/09669582.2013.855220

Routledge
Taylor & Francis Group

Assessing the vulnerability of beach tourism and non-beach tourism to climate change: a case study from Jamaica

Tracy-Ann Hyman*

The Climate Studies Group, The University of the West Indies, Kingston, Jamaica

(*Received 3 April 2012; accepted 1 September 2013*)

The Jamaican tourism industry is very climate sensitive, and, like most Caribbean islands, Jamaica's main tourism product is coastal, centered on "*sun, sea and sand*". The island is susceptible to many risks posed by climate change, including sea level rise and extreme events, with resultant impacts such as beach erosion, flooding, saline intrusion into aquifers and general coastal degradation. This paper evaluates the relative vulnerability of beach versus non-beach tourism in Jamaica, using 43 pre-determined literature-linked indicators. These comprise bio-geophysical, social, technological, economical, technological and institutional factors. Four case areas are assessed using multi-criteria decision analysis to derive vulnerability scores for each area. The study finds that non-beach tourism operations should not be automatically perceived as less vulnerable than beach-based operations. Sustainable adaptation options are complex and numerous, and overall beach tourism businesses have better insurance, emergency savings, disaster plans and backup power facilities, among others. They also have the advantage of being in business longer than the inland resorts, a firmer business structure and an extensive marketing budget. In the long term, better adaptation and planning by inland businesses could change this balance.

Keywords: community-based; inland; sensitivity; sustainability; indicators; multicriteria analysis

Introduction

Although small island developing states (SIDS) contribute less than 1% of green house gases (GHGs) (United Nations Framework Convention on Climate Change [UNFCCC], 2007a in United Nations Environment Programme [UNEP], 2008), they have peculiar characteristics which make them especially vulnerable to the effects of climate change. These characteristics (both climate and non-climate specific) include high transportation and communication costs, high import costs, a lack of economies of scale, susceptibility to natural disasters and a heavy dependence on a limited natural resource base, e.g. agriculture, forestry, fishing, tourism, mining and light manufacturing (UNEP, 2008). These challenges exacerbate climate change impacts, hindering growth and sustainable development for SIDS, because of fewer resources to adapt socially, technologically and financially.

Jamaica is the third-largest island in the Caribbean with a landmass of c. 11,000 square kilometers and a coastline of 1022 kilometers (UNEP, 2010). It is mountainous, with nearly half the island over 1000 feet above sea level (Gleaner Company Limited, n.d.). The coast is of great importance historically, as Jamaica was colonized by Britain between the seventeenth and the nineteenth centuries. Sugar production in Jamaica

*Email: hymannic@yahoo.com

formed the backbone of a colonial and mercantilist system that required easy access to the coast, for the quick movement of goods from the colony to the "mother land".

These activities were even made easier in Jamaica because of geographic formations such as natural harbors, waterways, cliffs and coral reefs, which would set the backdrop for the island becoming an important future tourist destination. The colonial powers focused, however, only on economic gain and not on sustainable development. After independence from the colonial rule in 1962, this "*coastal development bias*" continues with little infrastructural development inland.

Tourism's direct and indirect contributions to Jamaica's gross domestic product (GDP) in 2011 were 7.6% and 25.6%, respectively. Direct and indirect contributions are expected to rise by 3.6% and 3.4%, respectively, by 2022 (World Travel and Tourism Council, 2012). Tourism generated 84,000 direct jobs in 2011 (7.2% of total employment) and is the country's second largest earner of foreign exchange (Gleaner Company Limited, n.d.). Jamaica offers a wide array of tourist products that include (1) sun, sea and sand, (2) culture and heritage, (3) sports and wellness, (4) nature, (5) meetings/conventions and (6) community-based tourism.

The focus, however, has traditionally been on sun, sea and sand (hereafter referred to as beach tourism) that comprises an "all-inclusive" package, allowing international tourists to access most if not all services for one prepaid price. The industry is driven by mass tourism with somewhat restricted interactions between locals and tourists. Its main source markets include the USA, Canada and the United Kingdom, with little focus on the domestic market (Jamaica Tourist Board, 2001). This tourism model originated in the late 1970s and still forms the backbone of the Jamaican tourism industry.

Climate change adds to these challenges in the tourism industry. The Intergovernmental Panel on Climate Change's (IPCC, 2007) fourth assessment synthesis report states that "*warming of the climate system is unequivocal*", because of increases in air and ocean temperatures, widespread melting of snow and ice and rising global average sea levels. This is the result of rising atmospheric concentrations of GHGs since 1750, the use of aerosols and declining forest cover because of anthropogenic activities, all of which have altered the energy balance of the climate system (IPCC, 2007).

The projected effects of climate change in Jamaica include temperature increases of 1.1–3.5 °C by the end of the century (McSweeney, New, Lizcano, & Lu, 2010), meaning warmer days and nights. Decreases in rainfall are also predicted (McSweeney et al., 2010), with a heavy tendency for drying towards the end of the century. More intense hurricanes by the end of the century are also expected (Knutson, 2012). In addition, projected increases in sea levels within the Caribbean and around the Jamaican coast vary from 0.17 to 0.24 meters by 2050 (IPCC, 2007 in Meteorological Service Jamaica, 2011). Simpson et al. (2010) further state:

> The question is not if the Caribbean will face SLR of 1m or 2m under either a 2.0° C or 2.5° C global warming scenario, but rather when. (p. 21)

All these projections have implications for water availability, biodiversity loss, ecosystem degradation and vector-borne diseases, among others.

The majority (82%) of the population lives within five kilometers of the coast (UNEP, 2010) and 90% of Jamaica's GDP is produced within the coastal zone (NRCA, 1995 in Meteorological Service Jamaica, 2000). Major infrastructure including the two major airports, seaports and an oil refinery is located on the coast, heightening their vulnerability to climate change.

Climate change will, therefore, further exacerbate the problems already faced in the coastal tourism sector as it is very climate sensitive and in many cases climate dependent (Simpson, Gössling, Scott, Hall, & Gladin, 2008). Specifically, these challenges relate to beach erosion, flooding, saline intrusion into aquifers and general coastal degradation, with negative impacts on hotel infrastructure, water resources and socioeconomic livelihood. This paper, therefore, assesses the vulnerability of the existing beach tourism model and an alternative non-beach tourism model, to guide tourism planners, stakeholders and governments in finding suitable adaptation options.

Vulnerability and adaptation

Climate change presents a challenge for beach tourism models in small island states, and for stakeholders and policy-makers as well. Jamaica's national development plan (Planning Institute of Jamaica, 2009) acknowledges the inefficiencies in the present tourism model and attempts to address its shortcomings. It mentions the negative effects of mass tourism and the need for alternative forms of tourism, e.g. eco-tourism, science tourism, etc. The section that addresses tourism and climate change is, however, very vague with climate change mentioned only eight times. There is no clear plan of action of how it will be addressed and by whom.

Burki, Elsasser, and Abegg (2003) suggest four adaptation options for mountain tourism in light of climate change. These options can be adjusted and applied to the Jamaican tourism sector: (1) maintaining the existing model along the coast with adjustments, e.g. changing building codes, set back limits, increasing insurances; (2) finding alternatives to beach tourism, e.g. culture and heritage, community-based tourism; (3) fatalism, closing down the industry completely or operating in a "business-as-usual" manner and (4) subsidies for businesses that may be at risk of closing down.

Closing down the tourism industry is not practical in the short-to-medium term, with tourism being Jamaica's second largest foreign exchange earner. Operating in a business-as-usual manner is also unwise given the climatic events already experienced; Jamaica has already seen an increase in the number of hurricanes hitting the island. The average 10-year trend for cyclones has increased from 1.7 in 1900 to 2.4 in 2009 (Meteorological Service Jamaica, 2010a).The economic costs of cyclones have accounted for up to 10% (Rademacher, 2010) of Jamaica's GDP, a significant proportion, especially when compared to industrialized countries whose storm losses amount to just 1% of GDP (World Bank, 2011). Providing subsidies to tourism businesses that are at risk of closing down may not be possible, given Jamaica's current economic state and limited financial resources.

Inland tourism has already been proposed by several authors as a viable adaptation option for climate-dependent tourism countries. Research by Becken (2005) suggested that there was room in the higher Fijian islands (Viti Levu) to shift tourist activities inland, under a scenario of sea level rise. Inland tourism development zones were recommended as an alternative to coastal land uses (Jackson, 2002 in Simpson et al., 2008). Richardson (2007) states that inland tourism is less vulnerable to climate change than coastal tourism and suggests that more inland attractions be promoted to further diversify tourism portfolios. All these recommendations have been made, but research still has yet to quantify or measure the success of this particular adaptation option.

This paper, therefore, focuses on the first two adaptation options as the most practical options (short-to-medium term), given the limited resource base of tourism-dependent Jamaica.

Vulnerability is defined as the degree to which a system, subsystem or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor (Turner et al., 2003). Vulnerability, however, has various definitions and has transitioned from early stage to contemporary models. The former tends to focus on the hazard and its impacts (Adger, Brooks, Bentham, Agnew, & Eriksen, 2004), whereas contemporary models include not only the impacts, but also the ability of the system to cope with hazards or be resilient (Mimura, 1999; Turner et al., 2003).

In this study, vulnerability assessments will account for the hazard and the inherent ability to "deal with the hazard". Dealing with the hazard means to operate and sustain system workings, so that it is not significantly hindered. Thus if a tourist operation is prone to storm surges, vulnerability will be assessed on the extent of the exposure (e.g. frequency of storm surge events, distance from the shoreline) and mechanisms in place to cope (coastal defenses, access to financial relief, social networks, etc). Usually, tourism is assessed on a qualitative basis or with heavy emphasis on economic costs, e.g. contribution to GDP, tourism expenditure, etc. There is little integration of qualitative and quantitative factors in tourism statistics. However, a sustainability approach that integrates qualitative and quantitative factors into one analysis, will be applied here.

The conceptual framework is thus based on the principle that both economic and non-economic factors should be included in calculations of vulnerability. As such, social, economic and environmental factors are taken into consideration when deriving vulnerability scores. This research seeks to add to the limited body of data that exist on vulnerability assessments and adaptation options for small island states (Scott et al., 2008). The coastal model (beach tourism) will be compared to a community-based inland model (non-beach tourism), quantifying the results to see if beach tourism is more or less vulnerable to climate change than non-beach tourism. This should determine if non-beach tourism is a sustainable adaptation option.

Methodology

A case study approach was used and four tourist operations were selected for vulnerability assessments in January 2010. These represented a mix of coastal and inland tourist operations, where the criteria for selection included: (1) ease of access to the location by motor vehicle, (2) willingness of owners/managers to be interviewed and their properties inspected, (3) access to written information on the company, e.g. history, standard operating procedures, (4) being legally registered companies with requisite tourism licenses, and (5) compliance with the Jamaican Tourism Product Development Company (TPDCO) guidelines for community tourism.

The owners/managers for each tourist operation were interviewed and information was gathered on product offerings, operational procedures, history, the community, economic standing, alliances, business challenges and climate change issues. At the end of the interview, property inspections were conducted using a semi-structured assessment form, accounting for bio-geophysical and technological factors. The information from the interview and semi-structured forms was then compiled into 43 vulnerability indicators and grouped under five main themes: bio-geophysical, technological, economic, social and institutional factors (sub-indicators). These sub-indicators were further placed under group headings for exposure, sensitivity and adaptive capacity (overall indicators), where vulnerability was calculated as follows (Table 1): $\text{VIndex} = [EEw] - [SSw + \text{ACAC}w]$.[1]

Exposure represents the threats to the tourism system and includes the people, processes and physical structures affected by these threats. Sensitivity on the other hand represents practices and plans that *already exist* to protect against threats and can be summed up as the "network of precaution". Adaptive capacity represents the features, characteristics and activities of the system indicating the ability to successfully adjust to potential impacts in the future. Adaptive capacity is that component of the vulnerability equation which is flexible and can be tweaked, when compared to exposure, which is inflexible.

Exposure comprises 14 indicators, sensitivity 19 indicators and adaptive capacity 10 indicators. The selection and structure of these indicators are influenced by 14 main literature sources: (1) Moreno and Becken (2009), (2) Richardson (2007), (3) Meteorological Service Jamaica (2000), (4) UNEP (2008), (5) Mckenzie (2003), (6) Simpson et al. (2008), (7) Sietchiping (2007), (8) Payet (2007), (9) Proctor and Drechsler (2003), (10) Turner et al. (2003), (11) Adger et al. (2004), (12) Mimura (1999), (13) UNEP (2010) and (14) Phillips and House (2009). Multi-criteria decision analysis (MCDA) is then used to assess the four tourist operations.

MCDA is both an approach and a set of techniques, with the goal of providing an overall ordering of options, from the most preferred to the least preferred option. It provides different ways of disaggregating complex problems, measuring the extent to which options achieve objectives, weighting these objectives and reassembling the pieces (Department for Communities and Local Government, 2009). MCDA can address problems characterized by any mixture of monetary and non-monetary objectives, while placing them in the same analysis. It is for this reason why it is said that MCDA allows for comparisons between "*apples and oranges*" (Department for Communities and Local Government, 2009). Overall, it gives a clear picture of complex issues for decision-makers.

MCDA is not restricted to a sector or a specific problem. It can be used in both public and private organizations, and for various resource allocation issues. It can stand alone or be used along with the results from other analyses, e.g. cost benefit analysis. In tourism, MCDA has been used to assist a group of natural resource managers prioritize ecosystem services for recreation and tourism activities in Australia (Proctor & Drechsler, 2003). In that case MCDA was used in addition to deliberations within a citizen's jury to address complexities within the decision-making process. It can take the form of a checklist analysis for evaluating the priorities for beach use in South Wales (Phillips & House, 2009) or as a pairwise method for the comparison of alternatives in the case of world heritage sites in Spain (Mondejar-Jiminez, Garcia-Centeno, Minguez-Salido, Mondejar-Jiminez, & Cordente-Rodríguez, 2010).

In addition, the Compendium on Methods and Tools to Evaluate Impacts of and Vulnerability and Adaptation to Climate Change (UNFCCC, 2008) recommends multi-criteria analysis as a decision tool that can be used for vulnerability assessments. There are different forms of MCDA, and as such a linear additive model is used in this paper. The additive model is widely used, especially because of its robust and effective support to decision-makers, working on a range of problems and in various circumstances (Department for Communities and Local Government, 2009).

For the most part, indicators measured the current vulnerability of tourist operations, drawing on past and present information, e.g. rainfall trends and cyclonic activity (Meteorological Service Jamaica, 2010a; Meteorological Service Jamaica, 2010c). In two instances, however, indicators directly measured future exposure and adaptive capacity to climate change. These were: (1) the potential for sea level rise and (2) future plans for restoration projects, e.g. coral reefs. Indicators were grouped under themes such as biogeophysical, social, institutional, technological and economic factors. These set the

Table 1. A sample of vulnerability indicators.

Theme	Exposure indicators	Value func/yes or no/ scale	Explanation
Bio-geo	Prone to sea level rise (SLR)/ storm surge	Yes/no	This measured whether the tourist spot was prone to SLR or not
Bio-geo	Cyclonic activity	Value func	This was measured by the frequency of hits to the parish that the tourist operation was located in, compared to the island as a whole. The period under review was 1961–2008
Social	% of international tourists	Value func	This figure represented the percentage of business that this group consists of, as explained at the time of the interview. The author was not privy to the actual numbers for tourists.
Theme	**Sensitivity indicators**	**Value func/yes or no/ scale**	**Explanation**
Bio-geo	Presence of natural barriers	Yes/no	Examples include coral reefs, mangroves, swamps, vegetation, dense forestry
Bio-geo	Assigned protected area	Yes/no	This was measured on the basis of whether the area was declared a national site or confirmed as a protected area by the Jamaican Government or local NGO.
Tech	Backup power i.e. generator	Yes/no	This considered power outages and the ability to function during these times.
Tech	Water storage ability, e.g. tanks, catchments	Yes/no	This considered water shortages and the ability to function during these times.
Econ	Insurance coverage against natural disasters e.g. hurricanes, flooding	Yes/no	This considered the ability of the tourist operation to deal with unforeseen contingencies
Econ	Savings set aside for emergencies	Yes/no	This considered the ability of the tourist operation to deal with unforeseen contingencies
Theme	**Adaptive capacity indicators**	**Value func/yes or no/ scale**	**Explanation**
Econ	Type of business ownership	Scale	This supports the tourist operation's ability to deal with uncertainties and risks, the ability to cope with sudden and extreme changes in business operation
Econ	Length of time in business	Value func	STE = since 1997, BLU = since 2005, STM = since 1981 SEA = since 2009, 2010, is the cut-off point.(the shorter the period the higher the score)
Econ	Marketing ability and budget	Scale	This measured the tourist operation's advertising and financial ability to influence people's thoughts and perceptions through print and visual media.
Econ	Access to emergency loans *locally* (in the event of disaster or external threats)	Yes/no	This considered the ability of the tourist operation to deal with unforeseen events.

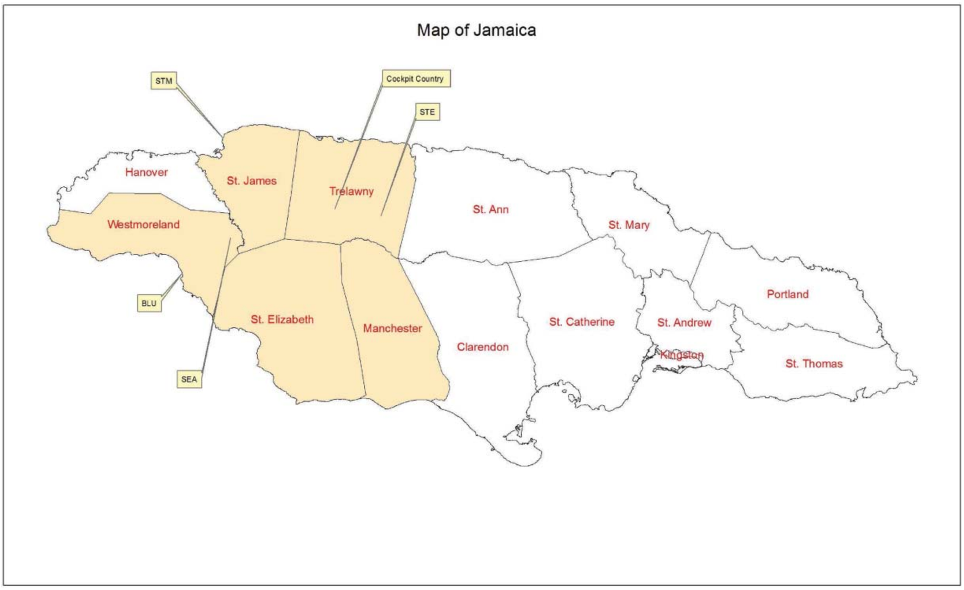

Figure 1. A map showing the case areas in Jamaica.

backdrop for the methodological frame used to derive vulnerability scores. Score values ranged from 0 to 100, where 100 was considered the worst score and 0 the best score; consequently the higher the score, the more vulnerable the tourist operation. Score values were determined by (1) yes/no answers, (2) value functions i.e. minimum and maximum levels and (3) judgment scales.

Case areas

The first tourist operation is within the famous Cockpit Country and is 610 meters above sea level (Falling Rain Genomics Inc., 2010a) (see Figure 1). The Cockpit Country is centered within the parish of Trelawny and extends to the neighboring parishes of Manchester, St. Elizabeth, St. James and St. Ann. This 550 square kilometer wet limestone forest resembles an inverted egg carton and was formed when limestone was eroded by rainfall, leaving a unique shape of conical hillocks and deep depressions called cockpits. The area is well known for its flora, fauna, endemic plants, animal species and accounts for Jamaica's largest wilderness area, as well as 40% of Jamaica's fresh water supply (Brown, 2007).

There are 66 communities in and around the Cockpit Country, with approximately 73,000 people (H. Dixon, personal communication, January, 2010). It is not a declared national heritage site by the Government of Jamaica, neither is it a protected area. Only sections of the Cockpit (forest reserves) are managed by the government and are not open to the public.

STE[2] is a non-governmental organization (NGO) that operates within the Cockpit Country. It specializes in community and eco-tourism and provides visitors with an "authentic" Jamaican experience. This includes educational tours, nature walks, local food, camping and sporting activities. Local guides are trained in the knowhow of the terrain and accompany visitors on each tour. Bed and breakfast services are offered by STE (upon request), where the visitor stays in the homes of private individuals. This is because there is no place assigned for accommodation.

Agriculture is the area's major economic activity, with the cultivation of crops including yam, sugarcane, banana and dasheen. There are direct linkages between the local agriculture industry and the tourism industry, as almost all the food provided by STE is from the area. Visitors can choose to have a "*bush cook*" on their tour, to provide traditional Jamaican meals.

STE's main target market is domestic, consisting of local schools and college groups interested in educational tours. This market represents 80% of the NGO's business; the other 20% represents international visitors from the USA, Japan, Germany, Belgium, the Netherlands and even South Africa. Sections of the Cockpit are faced with soil erosion, because forests are cleared for agricultural purposes. Cultivation takes place on steep slopes and top soil is left exposed and vulnerable to climatic events.

The Cockpit has a high rainfall of 1500–2500 millimeters per annum (Windsor Research Centre, n.d.), and so exposed top soil is leached by rain, making landslides a common feature. Despite the high rainfall, there are serious challenges with extreme and severe droughts (Meteorological Service Jamaica, 2010b).

The second tourist operation is also inland, within the parish of Westmoreland and the community of Seaford Town. Seaford Town, otherwise known as German Town is approximately 232 meters above sea level (Falling Rain Genomics Inc., 2010b). The town is declared a national heritage site by the Government of Jamaica (Jamaica National Heritage Trust, 2011). In 1834, the British plantocracy, realizing that they would be short on labor once emancipation was granted to the African slaves, sought labor sources elsewhere. Over 1000 Germans were brought to the island between 1834 and 1836, with 249 sent to Seaford Town. Many were unaccustomed to farm life and found it difficult living in Jamaica.

The township was also not prepared for their arrival, and so their assigned accommodation was either not built or half-finished (Seaford Town, n.d.). Many died from tropical diseases and overwork, while others migrated to the USA, severely reducing their numbers in the town (Thomas & Vaitlingam, 2003). Today the legacy of German Town remains, as the descendants of Germans are still living in the community. They live alongside and intermingle with ethnic Jamaicans, which is not considered strange in a community of 581 (Seaford Town, n.d.).

SEA[3] is an NGO that operates in Seaford Town. At the time of the interview only day tours were offered and conducted during week days and by appointment only. This was because operations were being upgraded to a more formal and organized system. Bed and breakfast services were also not available at the time of the interview, but there were plans to renovate an onsite guest house to accommodate visitors in the future. Local guides take tourists on a specified path around the community with a major emphasis on historical tourism. The museum, which houses artifacts and pictures of German history and heritage, is a key feature. Most visitors are from Germany and account for approximately 70% of SEA's business. The remaining 30% come from the USA, England and Jamaica.

The main economic activities in Seaford Town are agriculture and livestock production. Crops include pineapple and bananas, and the animals reared are mainly pigs and cows. The area is not prone to soil erosion and has had no major damage from hurricanes in the past. At the time of the interview, however, the manager pointed out that the town had been experiencing irregular weather patterns, which was very unusual. Seaford Town has no major challenges with water supply, but has experienced periods of normal drought (Meteorological Service Jamaica, 2010b).

The third tourist operation is also located in the parish of Westmoreland, in a south-westerly direction from Seaford Town, and lies on the coast. Bluefields is known for its great beaches, eco and adventure tours, flora, fauna, bird species and breathtaking scenery. Its first settlers were the Taino Indians in 650 AD (Bluefields, n.d.), who were eventually decimated by the Spanish. The Spaniards were then overthrown by the British in 1655 (Bennett & Philip, 2004) who developed a port to sail to other Caribbean islands. Bluefields was a rendezvous point for convoys crossing the Atlantic to England, where ships could take on water, food and make repairs. The port became popular with British, Portuguese and Dutch pirates (Bluefields, n.d.; Thomas & Vaitlingam, 2003).

BLU is an NGO operating in Bluefields, interested in creating sustainable livelihoods for its residents. Its motto is "*working together for a better future*", with the aim of preserving the coastline. Fishing is the major economic activity, alongside agriculture and tourism. Some of the large-scale hotels (all-inclusive) in the area are supplied with fish; agricultural products grown for the domestic market include peanuts and sorrel. There are, therefore, strong linkages between the agricultural, tourism and fishing sectors.

BLU specializes in community and eco-tourism and offers mountain hiking, marine tours, bird watching, educational tours, historical tours and nature walks. Most tourists, however, are interested in bird watching. Birding, hiking and walking tours are done in the nearby Bluefield Mountains, 701 meters above sea level (Paradise Park, Jamaica, 2008). BLU's target market is international visitors from England, the USA and Canada which account for 98% of its business. Like STE, BLU has no place for assigned accommodation, so they liaise with local hotels, villas and guest houses to provide these services. BLU has access to 150 rooms.

The Bluefields community of approximately 7000 (Escape Artist, 2010) has challenges with soil erosion, as farming is done on steep slopes. The clearing of vegetation causes problems with flooding and landslides, especially when there is heavy rainfall. In addition, when there are hurricanes, the beach shoreline is severely eroded, causing changes to the bay. Bluefields, however, does not have a challenge with extreme, severe or normal droughts (Meteorological Service Jamaica, 2010b).

The fourth tourist operation is located in the parish of St. James and lies on the north coast of Jamaica. STM represents the traditional all-inclusive hotel which allows visitors to pay one package price for airfare, accommodation, meals, alcoholic beverages, tips, airport transfers and specific watersports activities. STM has 250 rooms and suites and boasts a large white sand beach, accessible only to hotel visitors. This beach forms part of the Montego Bay Marine Park protected area, with special rules and regulations on permissible activities. All rooms include air conditioning, a king-sized bed, telephone, amenity kits, hair dryer, TV, coffee maker, iron, and private baths and showers.

STM caters to couples only and is a favored destination for weddings and honeymoons. Its main target market is the USA, accounting for 80% of its business. The remaining 20% comes from the United Kingdom, Canada and other parts of Europe. STM is an exclusive operational entity compared to the operations of STE, SEA and BLU – where tourism is linked to other sectors in the community. For the traditional beach model, linkages to other sectors are typically low as most supplies are sourced abroad and imported.

STM is constructed in a sensitive ecosystem area, cleared of biodiversity to facilitate its development. Groynes maintain the structure of the beach, as well as mangrove cover at some distance from the shoreline. The hotel is, however, more exposed to damage

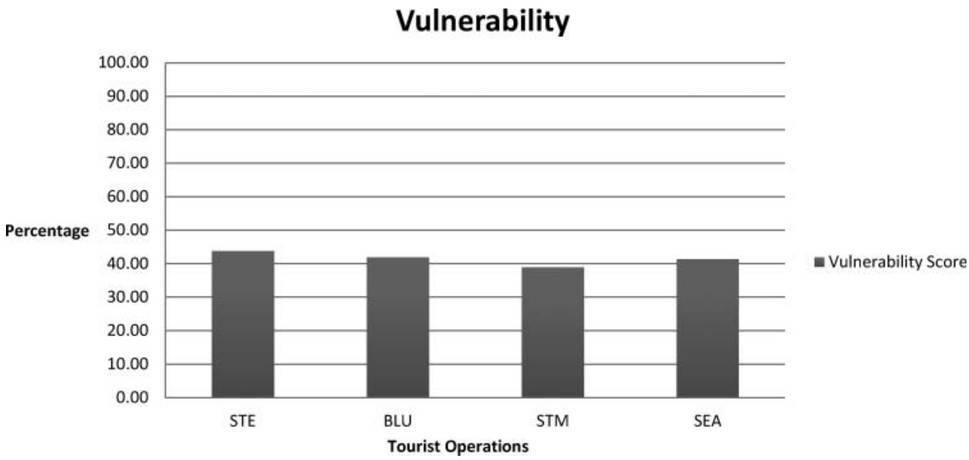

Figure 2. Overall vulnerability scores for tourist operations.

from storm surges and extreme events than BLU, because BLU has better mangrove cover and the Bluefield Mountains is immediately behind the bay. The hotel also faces serious beach erosion, a deteriorating coral reef network and normal drought. These conditions will be exacerbated by sea level rise and hurricane activity, which give rise to storm surges.

Results

In the first phase, *one* overall vulnerability score was derived from pre-determined indicators for each tourist operation. All indicators were weighted equally, and the results showed that STE and BLU scored 43.79 and 41.93 points, respectively. STM and SEA, on the other hand scored 38.88 and 41.35 points, respectively (see Figure 2 and Table 2). The particular MCDA model used in this paper is based on the premise that *the higher the score, the higher the vulnerability*. Consequently, STE and BLU (inland, coastal) were more vulnerable than STM and SEA (coastal, inland) to climate change. STE therefore had the highest vulnerability score, while STM had the lowest vulnerability score among the four operations (by a very small margin).

These vulnerability scores actually represent the percentage of the tourist operation's business at risk and are drawn from Figure 3. Figure 3 shows vulnerability classifications ranging from 0% to 100%, where 0%–50% is considered the safe zone and 51%–100% is considered the danger zone.

Table 2. Overall vulnerability scores for tourist operations.

	STE *inland*	BLU *coast*	STM *coast*	SEA *inland*
Exposure	25.24	40.35	56.95	13.29
Sensitivity	44.21	45.64	15.22	37.418
Adaptive capacity	61.92	39.81	44.49	73.33
Vulnerability	*43.79*	*41.93*	*38.88*	*41.35*

Source: output from MCDA, 2012.

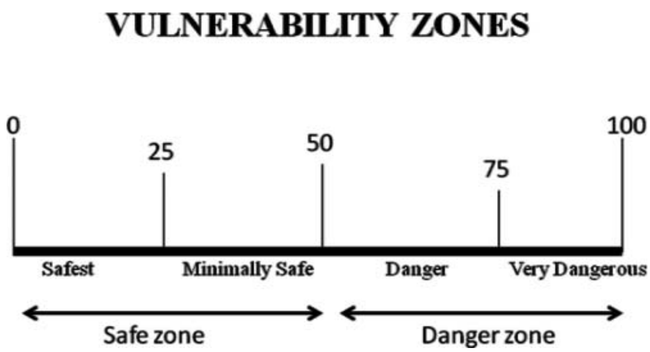

Figure 3. Vulnerability classifications.

Despite the higher vulnerability scores of STE and BLU, they were still considered to be in the minimally safe zone (Figure 2) and were 6.21 and 8.07 points away from the danger zone, respectively. STM and SEA on the other hand were in better positions as they were 11.12 and 8.65 points away from the danger zone, respectively. These scores, however, did not mean that STE, BLU, STM and SEA were fine and should not be concerned. If 43.79% or 38.88 % of a business operation is at risk, there is still major cause for concern.

It should be noted that the inland operations (STE and SEA) had the lowest exposure scores of 25.24 and 13.29 points, respectively (Figure 3 and Table 2), when compared to the coastal operations (BLU and STM). On the other hand, these same inland operations had the highest adaptive capacity scores of 61.92 and 73.33 points, respectively (Table 2). As it relates to sensitivity, STE and BLU's (inland, coastal) scores were near the danger zone, with SEA roughly 8 points behind and STM at a way lower score of 15.22 points.

In the second phase, vulnerability scores for each tourist operation were analyzed based on the themes of *bio-geophysical, technological, economic, social and institutional* factors. The aim of this was to support an integrated assessment that would give detailed explanations of the overall scores shown in Table 2.

From a bio-geophysical and technological perspective STE scored 28.16 and 28.41 points, respectively, which fell into the minimally safe zone. Scores for social, economical and institutional factors, however, were 55, 63.25 and 62.5 points, respectively, all falling within the danger zone (Table 3). STE therefore had three high scores in the danger zone when compared to the other operations. Based on the mathematical calculations in the MCDA model, this would be the reason why STE had the highest vulnerability score compared to BLU, STM and SEA (Table 3).

Table 3. Vulnerability scores by theme.

	STE *inland*	BLU *coast*	STM *coast*	SEA *inland*
BIO-GEO	28.16	33.24	49.22	13.29
SOCIAL	55	52.14	23.64	63.87
TECH	28.41	57.45	38.31	32.5
ECON	63.25	41.45	21.65	48.15
INST	62.5	0	37.5	87.5

Source: output from MCDA, 2012.

The bio-geophysical and economical factors for BLU were in the minimally safe zone and institutional factors in the safest zone (Figure 3 and Table 3). The scores for social and technological factors, however, were 52.14 and 57.45 points (the danger zone), respectively, which in the end resulted in BLU having the second highest vulnerability score. The social, economic, technological and institutional factors for STM ranged from 23.64 to 38.31 points, all of which fall in the minimally safe zone (Figure 3 and Table 3). The only exception to this was the bio-geophysical score of 49.22 points, which can be considered as basically in the danger zone. Once these figures were combined, it allowed STM to have the lowest overall vulnerability score.

The bio-geophysical and technological scores for SEA were in the safest and minimally safe zones (Figure 3 and Table 3), whereas economical factors were 1.85 points away from the danger zone. Social and institutional factors, however, were causes for concern i.e. 63.87 and 87.5 points, respectively (danger, very dangerous zones). Despite the high social and institutional scores, SEA still managed to have the second lowest overall score and thus a better vulnerability than STE and BLU.

Discussion

Both the overall scores and scores by themes point to the fact that being on the coast does not necessarily mean a higher vulnerability score than an inland location. This is contrary to the view expressed by Richardson (2007). It depends on the characteristics and circumstances of each location. In BLU's case, for example, being on the coast leads to a higher vulnerability score, in fact the second highest score. STM's coastal operations, however, did not hamper its ability to have the lowest overall vulnerability score of 38.88 points, despite having the highest exposure score of 56.95 points (danger zone).

The question is therefore: what factors caused STE and BLU to be more vulnerable than STM and SEA (Figure 2 and Table 2)? Upon closer review, the results show that STE and BLU had higher sensitivity scores than STM and SEA, because they have to contend with issues such as the lack of insurance coverage against natural disasters, no backup power, the absence of alternative activities for inclement weather and greater distances from the major airports (Table 1).

More specifically, STE's poor scores are linked to economic, social and institutional challenges that include the absence of savings for emergencies, being far from critical services, lack of disaster preparedness procedures, not having protected area status and not many connections to research institutes or academia (sensitivity and adaptive capacity categories). In BLU's case, social and technological challenges included being far from critical services and airports (mentioned above), the absence of water storage facilities, no hurricane shutters for buildings and very minimal coastal defense structures. All these factors contribute to the high vulnerability scores of STE and BLU.

On the other hand, STM and SEA have better scores because of practices, structures and procedures already in place (sensitivity category), which make a significant contribution to their overall vulnerability score. STM and SEA are closer to the major airports, and they have water storage, backup power and insurance facilities. From an economical perspective, both have access to emergency loans (Table 1). In addition, STM has savings set aside for emergencies and organized activities for inclement weather. STM also has a marketing budget which implies adjustability and flexibility, a stronger business structure and the longest time in business.

SEA's low exposure score is a major contributing factor for having the second lowest vulnerability score. In fact, SEA had the lowest exposure score, because it is not faced with the sea level rise or the need to invest in capital structures, e.g. buildings. There is no reliance on imported supplies or challenges with soil erosion and landslides. SEA's minimally safe sensitivity score is also another significant contributor to its low vulnerability score (Table 2). An adaptive capacity score of 73.33 points, however, placed the operation in the danger zone. This is because of SEA's limited product offerings, its short length of time in business compared to the other operations, the absence of early warning systems or plans for restorations and no marketing budget.

As mentioned before, adaptive capacity is considered to be that flexible component of vulnerability versus exposure, which is not as flexible, because human systems have limited control over climatic events. Adaptive capacity therefore represents the features, characteristics and activities of the system indicating its ability to successfully adjust to potential future climatic impacts. The Assessments of Impacts and Adaptations to Climate Change Report (Socioeconomic Data and Applications Center [SEDAC], 2004) states:

> Adaptive capacity to climate change refers to both the ability inherent in the coping range and the ability to move or expand the coping range with new or modified adaptations. Initiatives to enhance adaptive capacity would expand the coping range.

Adger et al. (2004) define it as

> the ability or capacity of a system to modify or change its characteristics or behaviour so as to cope better with existing or anticipated external stresses

The stress in this paper is more on "anticipated stresses" and supports the idea that modification or change in the system based on a threat represents the potential to mitigate these hazards, rather than actual mitigation/adaptation itself (Adger et al., 2004). A tourist operation could, therefore, be faced with numerous threats, as is STM, but has a low adaptive capacity score and hence an overall low vulnerability score. Adaptive capacity is thus critical to lowering a system's vulnerability.

In this study, adaptive capacity indicators included are: access to emergency loans, length of time in business, marketing budget, interconnectedness with community and research institutes and restoration projects, among others. STM and BLU (coast) scored well in these areas, placing them in the minimally safe zone when compared to the two inland operations (danger zone). This supports the point that adaptive capacity relates to the ability to access resources as well as to act collectively in the face of threats posed (Adger et al., 2004). STE and SEA will therefore need to drastically improve their adaptive capacities. In fact, if both inland operations had lower adaptive capacity scores, their vulnerabilities would be way lower than the two coastal resorts – placing them in better positions.

Sensitivity is also an integral component of vulnerability as adaptive capacity. This is usually not the case, as some researchers view sensitivity as the degree to which a system is affected adversely or beneficially, by climate-related stimuli (SEDAC, 2004). The focus is thus on the impacts (in this case adverse) to the people, processes and structures, e.g. damage to buildings, lives, etc. In this paper, however, sensitivity represents practices and plans that already exist to protect against threats. It therefore views people, processes and structures in an anticipatory manner as opposed to a reactionary one. That said, the subjects that make up the system are viewed as assets instead of liabilities, e.g. a tourist operation may employ 100 employees and view vulnerability in terms of the number of jobs that may be lost as a result of a storm versus the number of employees who may be on hand to help fix and repair facilities in the event of a storm.

Instead of viewing sensitivity as the level of damage expected, strengthening/establishing structures to reduce damage is how sensitivity should be measured. Tourism operations can thus employ basic practices to protect against harm and danger, e.g. evacuation plans, emergency drills, employee training, safety manuals – hence strengthening that "network of precaution". STM had the lowest sensitivity score followed by the two inland operations and then BLU. Again, if the two inland operations were to improve on their sensitivity scores, their vulnerability scores would be way lower than STM's scores. Thus if an operation's network of precaution already exists and is strong, vulnerability scores can be lowered.

It should be noted here that this study did not vary weights for the pre-determined indicators. In both phases all indicators were weighted equally and compared accordingly. MCDA analysis allows you to vary weights, according to the emphasis placed by stakeholders. Stakeholders may give more priorities or preferences to some indicators over others. Therefore, if, for example higher weights were given to exposure factors, then vulnerability scores would probably be more for the coastal operations than the inland operations and vice versa. Also, if higher weights were given to bio-geophysical factors, then there is the possibility that STM may not have the lowest vulnerability score.

Variations in weightings were not done in this paper as they were not validated by tourism stakeholders. Both phases of this analysis, however, lent themselves to ranking by highlighting the strengths and shortcomings for each tourist operation (Table 3). Ranking allows the stakeholder to have a clear overall picture of all factors used to assess vulnerability, and an understanding of why a tourist operation may be succeeding or failing. The linear additive model presented here is a basic example upon which tourist operations can build their models, tweaking it to suit their objectives. In the absence of assigned weights, equal weights were the most objective trajectory.

Conclusion

From the vulnerability assessments conducted, the results showed that beach tourism is not necessarily more vulnerable to climate change than non-beach tourism. This paper highlighted that vulnerability will be dependent on existing structures in place to deal with climatic events, as well as plans for the future. It may also depend on any weights assigned by stakeholders for exposure, sensitivity and adaptive capacity. Beach tourism does, however, have serious challenges that include higher exposure factors (the potential for sea level rise, storm surges and flooding) than the inland operations. Exposure factors are thus inflexible when compared to sensitivity and adaptive capacities.

The value of infrastructural investments and the volume of international tourists exposed to climatic danger are higher for coastal operations as well. In STM's (coast) case, there was a high score for bio-geophysical factors because of large variations in rainfall patterns, normal droughts and heavy soil erosion. STM was also built in a sensitive ecosystem, where natural barriers were cleared, leaving the operation directly exposed to climatic events. Being near the coastline has therefore made STM's operations extremely risky.

The coastal zone is critical to the economy and livelihood of Jamaicans. Seaports and airports lie along the coastline, there are major hotel developments and the majority of the population lives there, and will continue to move there. As such, there is need for specific mitigation measures to address climate change (Calado, Borges, Phillips, Ng, & Alves, 2011), which do not exist at the moment.

Both sensitivity and adaptive capacity are integral in reducing a system's vulnerability. If structures and activities are initiated in the short and long terms, vulnerability can be reduced. SMT had many systems in place to reduce the impacts because of its exposure. This comprised sensitivity indicators such as: insurance, emergency savings, special roof designs, existing disaster plans and evacuation procedures, employee training, water and backup power facilities, among others. From an adaptive capacity perspective, it had the advantage of being in business longer than the other resorts, having a firmer business structure and an extensive marketing budget. BLU (coast) had the lowest adaptive capacity score of all four operations, but still ended up with the second highest vulnerability score, a result of its high sensitivity score. This research therefore emphasizes that sensitivity is just as integral as adaptive capacity in reducing vulnerability.

In addition, if the sensitivity and adaptive capacities of the inland operations were to improve, their vulnerability scores would be far lower than the coastal operations. This is a major drawback for coastal operations because they can only improve sensitivity and adaptive capacity to a point, because exposure will always be high; the coast will always pose a relatively higher risk than the inlands. The advantage that inland operations have is that improvements in vulnerability scores can extend further than the coastal operations, because exposure is not as high.

In that case coastal operations may have to consider plans for retreat, from sections of the coastline in light of sea level rise projections for 2100 (Simpson et al., 2010). If climatic events persist, increase in sea levels will force coastal operations into retreat mode, resulting in heavy losses, especially if their actions are reactionary. Managed retreat, however, was not considered by coastal stakeholders at the time of the interview.

More attention should, therefore, be given to adjusting building codes and setback limits, as well as discouraging further development in low-lying coastal areas. This can be initiated by establishing a coastal zone management plan that specifies the kinds of activities allowed on the coasts and demarcations for build and no-build zones, which will preserve the integrity and operations on the coastline. Governments can adopt this strategy, but critical to this process is input from the stakeholder's concerned, i.e. public participation (Calado et al., 2011).

Coastal stakeholders and governments may even have to consider making investments in inland areas, thus diversifying tourism offerings and reducing coastal risks, respectively. Jamaica is a mountainous country, with nearly half the island over 1000 feet above sea level (Gleaner Company Limited, n.d.). The country has a low population density of 247 persons per square kilometer, compared to 1126.55, 1036.913, 7022.81 and 337.097 in Bangladesh, Maldives, Singapore and Japan, respectively (United Nations, 2006). Most of Jamaica's population resides on the coast, placing extensive pressure on coastal resources and infrastructure. It may not be a simple task to retreat, but there is space for retreat, should climatic events persist.

More investment in inland areas could also improve sensitivity and adaptive capacity scores for community-based operations, making them sustainable adaptation options. The challenge is that there is little attention given to community (inland) tourism in Jamaica, with an overemphasis on beach tourism. Boxill (2004) refers to this as "*lopsidedness*". In Okinawa, Japan, aside from traditional beach tourism, the industry is deeply linked to local cultures, production sectors, information and communication technology, conventions, entertainment and sports (Kakazu, 2009). This interaction gives numerous opportunities for tourists to interact with locals and provide alternatives to the traditional beach tourism model.

One recommendation in addressing the issue of lopsidedness is to adjust marketing strategies and target new source markets. Beach tourism can be accessed in so many tropical destinations today, and it will require more than what is currently offered in Jamaica to increase future tourism arrivals and revenues. In Fiji, where beach tourism is significant, marketing campaigns shift the image away from pure beach to encourage tourists to have a wider experience (Ministry of Tourism, 2003 in Becken, 2005).

The overall vulnerability scores of the tourist operations in this study points to the fact that the Jamaican tourism model is in need of major adjustments in light of climate change. This model may not be sustainable in the long term, especially if the island intends to remain competitive in the international market. Having 43.79% or 38.88 % of a business operation at risk is a major cause for concern. This research, however, realizes that it is not practical to focus on inland tourism as the sole substitute for coastal tourism, because of its current limitations.

There is inadequate room capacity at the community level to accommodate almost two million visitors to the island each year (Jamaica Tourist Board, 2011). At the tourist operation level, STE could offer only 30 rooms, while SEA could not provide any accommodation at the time of the interview. BLU did not have any rooms on its premises, but had to rely on external accommodation. STM, however, was able to provide 250 rooms. If these current limitations are addressed through investments in inland operations with changes to marketing strategies, then the overall vulnerability of the Jamaican tourism sector could be significantly reduced.

Finally, the importance of assessing tourism operations from an economic and non-economic perspective must be stressed here. This paper assigned values to qualitative factors so that a full view of the issues could be examined. This approach is important especially from the perspective of sustainability science, which considers the reconciliation of society's development goals with the planet's environmental limits over the long term (Clark & Dickson, 2003). This involves the dynamic interactions between nature and society at the global and local levels (Kates et al., 2001) and achieving some sense of "*accepted*" balance between economic policies, social welfare and environmental conservation. Sustainability science therefore has an integrated approach where both economic and non-economic factors are accounted for.

Acknowledgements

I would like to take this opportunity to thank the owners and managers of all four case areas, who allowed me to interview them and view their business operations. I thank my thesis supervisor, Professor Yukio Yanagisawa (the University of Tokyo), for encouraging me to develop and write this paper and Dr Leonard Nurse (the University of the West Indies, Barbados) for mentoring and guiding me through the writing process.

Funding

I would like to acknowledge the support received at the writeshop organized by the Stockholm Environment Institute and the University of the West Indies, funded by the United Nations International Strategy for Disaster Reduction, from 27 February to 2 March 2012.

Notes

1. *E* represents exposure, *S* represents sensitivity, AC represents adaptive capacity and *w* represents weighting.
2. The full names of the tourist operations are not disclosed for confidentiality purposes.
3. The full names of the tourist operations are not disclosed for confidentiality purposes.

Notes on contributor

Tracy-Ann Hyman completed her master's degree in sustainability science at the University of Tokyo, Japan, in October 2010. She is a Jamaican and her research interests are in vulnerability and adaptation to climate change in the Caribbean and Asia. In July 2010, she won the "Best Paper Award" at the Asia Pacific Forum Conference in Beppu, Japan. Currently, she is a researcher with the Climate Studies Group at the University of the West Indies, Jamaica.

References

Adger, N., Brooks, N., Bentham, G., Agnew, M., & Eriksen, S. (2004). *New indicators of vulnerability and adaptive capacity* (Tyndall Project IT1.11). Norwich: Tyndall Centre for Climate Change Research.

Becken, S. (2005). Harmonising climate change adaptation and mitigation: The case of tourist resorts in Fiji. *Global Environmental Change, 15*, 381–393.

Bennett, H., & Philip, S. (Eds.). (2004). *The story of the Jamaican people*. Kingston, Jamaica: Ian Randle.

Bluefields. (n.d.). *Bluefields*. A pamphlet received from the Director of BLU during an interview in January 2010.

Boxill, I. (2004). Towards an alternative tourism for Jamaica. *International Journal of Contemporary Hospitality Management, 16*, 269–272.

Brown, K. (2007). *Consultation report of Cockpit Country adventure tours*. Kingston, Jamaica: Tourism Product Development.

Burki, R., Elsasser, H., & Abegg, B. (2003, April). *Climate change – impacts on the tourism industry in mountain areas*. Paper presented at the 1st International Conference on Climate Change and Tourism, Djerba, Tunisia.

Calado, H., Borges, P., Phillips, M., Ng, K., & Alves, F. (2011). The Azores archipelago, Portugal: Improved understanding of small island coastal hazards and mitigation measures. *Natural Hazards, 58*, 427–444.

Clark, W.C., & Dickson, K. (2003). Sustainability science: The emerging research program. *Proceedings of the National Academy of Sciences of the United States of America, 100*, 8059–8061.

Department for Communities and Local Government. (2009). *Multi-criteria analysis: A manual*. London: Communities and Local Government Publications.

Escape Artist. (2010). *Community tourism on Jamaica's southwest coast*. Retrieved from http://www.escapeartist.com/efam/51/Jamaica_Travel.html

Falling Rain Genomics Inc. (2010a). *Albert Town, Jamaica page*. Retrieved from http://www.fallingrain.com/world/JM/15/Albert_Town.html

Falling Rain Genomics Inc. (2010b). *Seaford Town, Jamaica page*. Retrieved from http://www.fallingrain.com/world/JM/16/Seaford_Town.html

Gleaner Company Limited. (n.d.). *Geography and history of Jamaica*. Retrieved from http://www.discoverjamaica.com/overview.htm

Gleaner Company Limited. (n.d.). *Geography and history of Jamaica*. Retrieved from http://www.discoverjamaica.com/gleaner/discover/geography/tourism.htm

Intergovernmental Panel on Climate Change. (2007). *Climate change 2007: Synthesis report*. *Contribution of Working Groups I, II and III to the fourth assessment report of the Intergovernmental Panel on Climate Change*. Retrieved from http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

Jamaica National Heritage Trust. (2011). *Seaford Town*. Retrieved from http://www.jnht.com/site_seaford_town.php

Jamaica Tourist Board. (2001). *Profile of the visitor and their vacation in Jamaica*. [Power-Point slides]. Retrieved from http://www.jtbonline.org/resources/Presentations/Forms/AllItems.aspx

Jamaica Tourist Board. (2011). *Annual travel statistics 2011*. Retrieved from http://www.jtbonline.org/statistics/Annual%20Travel/Annual%20Travel%20Statistics%202011.pdf

Kakazu, H. (2009). *Island sustainability, challenges and opportunities for Okinawa and other Pacific islands in a globalised world*. Victoria, Canada: Trafford.

Kates, R.W., Clark, W.C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I., … Svedin, U. (2001). Sustainability science. *Science, 292*, 641–642.

Knutson, T. (2012). *Global warming and hurricanes: An overview of current research results*. Retrieved from http://www.gfdl.noaa.gov/global-warming-and-hurricanes

Mckenzie, A. (2003). *Issues and challenges in generating and using information for decision-making. The experience in developing environment and sustainable development indicators for Jamaica: Summary paper*. Retrieved from http://www.un.org/esa/sustdev/natlinfo/indicators/idsd/workshops/workshop1pdf/jamaica.pdf

McSweeney, C., New, M., Lizcano, G., & Lu, X. (2010). The UNDP climate change country profiles: Improving the accessibility of observed and projected climate information for studies of climate change in developing countries. *Bulletin of the American Meteorological Society, 91*, 157–166.

Meteorological Service Jamaica. (2000). *Initial National Communication of Jamaica*. Retrieved from http://www.metservice.gov.jm/ClimateChange-2.asp

Meteorological Service Jamaica. (2010a). *Drought indices: January to December 2009* [Data set]. Retrieved March 2010.

Meteorological Service Jamaica. (2010b). *Rainfall: 1971–2000* [Data set]. Retrieved March 2010.

Meteorological Service Jamaica. (2010c). *Tropical cyclone analysis, ten year trend* [Data set]. Retrieved February 2010.

Meteorological Service Jamaica. (2011). *The Second National Communication of Jamaica to the United Nations Framework Convention on Climate Change*. Retrieved from http://www.metservice.gov.jm/ClimateChange-2.asp

Mimura, N. (1999). Vulnerability of island countries in the South Pacific to sea level rise and climate change. *Climate Research, 12*, 137–143.

Mondejar-Jiminez, J.A., Garcia-Centeno, M.C., Minguez-Salido, R., Mondejar-Jiminez, J., & Cordente-Rodríguez, M. (2010). Cultural tourism, using a multicriteria analysis: Spanish world heritage cities. *International Journal of Management and Information Systems, 14*, 35–43.

Moreno, A., & Becken, S. (2009). A climate change vulnerability assessment methodology for coastal tourism. *Journal of Sustainable Tourism, 17*, 473–488.

Paradise Park, Jamaica. (2008). *Description of land*. Retrieved from http://www.paradiseparkjamaica.com/dotl.html

Payet, R. (2007). *Impact of climate change on tourism in Seychelles and Comoros*. A final report submitted to Assessments of Impacts and Adaptations to Climate Change (Project No. SIS90). Washington, DC: The International START Secretariat.

Phillips, M.R., & House, C. (2009). An evaluation of priorities for beach tourism: Case studies from South Wales, UK. *Tourism Management, 30*, 176–183.

Planning Institute of Jamaica. (2009). *Vision 2030 Jamaica national development plan.* Kingston, Jamaica: Pear Tree Press.

Proctor, W., & Drechsler, M. (2003, February). *Deliberative multi-criteria evaluation: A case study of recreation and tourism options in Victoria Australia*. Paper presented at the European Society for Ecological Economics, Frontiers 2 Conference, Tenerife, Spain.

Rademacher, Y. (2010). Jamaica: Disaster mitigation, preparedness and response. A community-participation approach. Retrieved from http://www.preventionweb.net/english/professional/publications/v.php?id=18157

Richardson, R.B. (2007). *Tourism in Belize: Vulnerability and capacity assessment*. Submitted for Belize's Second National Communication to the United Nations Framework Convention on Climate Change. Retrieved from http://cbtadaptation.squarespace.com/storage/TourismVulnerabilityAssessment-Belize.pdf

Scott, D., Amelung, B., Becken, S., Ceron, J.P., Dubois, G., Gossling, S., . . . Simpson, M.C. (2008). *Climate change and tourism: Responding to global challenges*. Summary Report for the Second International Conference on Climate Change and Tourism. Retrieved from http://www.onecaribbean.org/content/files/unwtoclimatechangereport.pdf

Seaford Town. (n.d.) *History of Seaford Town*. A pamphlet received from the Chairman of SEA during an interview in January 2010.

Sietchiping, R. (2007). Applying an index of adaptive capacity to climate change in north-western Victoria, Australia. *Applied GIS, 2*, 16.1–16.28.

Simpson, M.C., Gössling, S., Scott, D., Hall, M., & Gladin, E. (2008). *Climate change adaptation and mitigation in the tourism sector: Frameworks, tools and practices*. Paris: UNEP.

Simpson, M.C., Scott, D., Harrison, M., Sim, R., Silver, N., O'Keeffe, E., . . . McSharry, P. (2010). *Quantification and magnitude of losses and damages resulting from the impacts of climate*

change: Modelling the transformational impacts and costs of sea level rise in the Caribbean (Summary document). Barbados: UNDP.
Socioeconomic Data and Applications Center. (2004). *Assessments of impacts and adaptations to climate change in multiple regions and sectors*. Retrieved from http://sedac.ciesin.columbia.edu/aiacc/methods.html
Thomas, P., & Vaitlingam, A. (Eds.). (2003). *Rough guide to Jamaica 3*. London: Rough Guides.
Turner II, B.L., Kasperson, R.E., Matsone, P.A., McCarthy, J.J., Corell R.W., Christensen, L., . . . Schiller, A. (2003). A framework for vulnerability analysis in sustainability science. *Proceedings of the National Academy of Sciences of the United States of America, 100*, 8074–8079. Retrieved from http://www.pnas.org/content/100/14/8074.full.pdf
United Nations Department of Economic and Social Affairs Population Division. (2006). *World population prospects: The 2004 revision. Volume III. Analytical report* (Sales No. E.05.XIII.7). New York, NY: United Nations.
United Nations Environment Programme. (2008). *Climate change in the Caribbean and the challenge of adaptation*. Panama City: Regional Office for Latin America and the Caribbean.
United Nations Environment Programme. (2010). *Linking ecosystems to risk and vulnerability reduction: The case of Jamaica – RiVAMP*. Geneva: Division of Early Warning and Assessment (DEWA)/GRID-Europe.
United Nations Framework Convention on Climate Change. (2008). *Compendium on methods and tools to evaluate impacts of, and vulnerability and adaptation to climate change*. Retrieved from http://unfccc.int/adaptation/nairobi_work_programme/knowledge_resources_and_publications/items/2674.php
Windsor Research Centre. (n.d.). *Cockpit Country*. Retrieved from http://www.cockpitcountry.com/Formation%20of%20cockpits.html
World Bank. (2011). *Reducing the risk of disaster and climate vulnerability in the Pacific islands*. Retrieved from http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFICEXT/PACIFICISLANDSEXTN/0,,contentMDK:22479543menuPK:441893pagePK:2865066piPK:2865079theSitePK:441883,00.html
World Travel and Tourism Council. (2012). *Travel and tourism economic impact Jamaica*. London: Author.