A Climate Change Vulnerability Assessment of a Tourism Destination Community (A Case-Study of Oistins, Barbados)

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change has documented substantial evidence for human influence as the dominant cause of global climate change. As some degree of further climate change is inevitable, natural and human systems are faced with a range of impacts they must adapt to. Small island developing states (SIDS) are widely considered to be highly vulnerable to climate change, for which appropriate adaptation measures need to be planned and implemented. SIDS are also key tourist attractions with tourism representing significant part of national and community economies. As the sector is highly exposed to climate change, further research is needed regarding its adaptation, particularly in countries where tourism is a major component of future development strategies. Additional research is also needed to understand climatic and non-climatic stressors that influence the vulnerability of tourism dependent communities and their households, including methods that facilitate comparative assessments.

This dissertation seeks to understand climate change vulnerability at the tourism destination community scale in a small island developing state. The research is guided by two goals: 1) To examine the influence of climatic and non-climatic stressors on the pre-existing vulnerability of a destination community, including its local tourism stakeholders; and 2) To employ and compare two methods (an indicator approach and a Community-Based Vulnerability Assessment (CBVA) approach) to assess vulnerability across and within the community and determine whether either or both can advance knowledge gaps in this understanding at the destination community scale.

This research was carried out in the tourism destination community of Oistins, Barbados, in the eastern Caribbean. The Caribbean is considered a '*tourism climate change vulnerability hotspot*' by the United Nations World Tourism Organization, as it has the most tourism intensive economy in the world and because climate change impacts to its sector are predicted to be significant. Oistins is a key tourist attraction in Barbados, due to its beaches, hotels and restaurants, the Bay Garden Vendors Area and the Oistins Fish-Market, which are all at risk from an increase in climate-related events. The research undertook a mixed methods case-study. A national tourism sector vulnerability assessment was completed via a critical review and empirical analysis of the literature, which contextualized the Oistins' community scale vulnerability assessment and informed its potential adaptation choices. Field work for the indicators and CBVA was also carried out in 2010

and 2011. Approximately 150 individuals participated in the research, including tourism stakeholders i) whose livelihoods were most connected to the tourism related activities of the destination community, ii) who lived in two neighbourhoods (households) adjacent to its key attractions and iii) who were decision-makers and/or tourism, government and community representatives (key informants). Five focus groups were held with key informants to develop destination-community and household level indicators. Some of the destination-community indicators were applied through data collection and the household indicators applied through the collection and analysis of neighbourhood surveys. Individuals were also consulted via CBVA interviews representing vendors, fishers, beach activities, accommodation and restaurants and key institutional informants.

The national tourism vulnerability assessment indicates that studies have examined climate change and tourism at the Caribbean or national level, with only a few having addressed adaptation and if so not comprehensively. No studies have examined destination-community level vulnerability. Furthermore, Barbados' tourism sector is and will experience a range of climatic and non-climatic stressors. Mid-century scenario planning predicts a doubling of tourism arrivals to the island, yet does not account for increased water scarcity or the long-term degradation of tourism infrastructure and assets due to sea level rise. The assessment thereby suggests that the island transformatively adapt its tourism sector, by reconsidering the emphasis and location of its infrastructure and attractions, while diversifying its economic activities as a whole. This could involve Barbados emphasizing luxury facilities and catering to fewer tourists along a protected west coast, where communities such as Oistins could maintain cultural attractions on an increasingly degraded south coast.

With regards to goal #1, the CBVA results suggest that Oistins interviewees were exposed to minor and local level impacts of climatic stressors, though recent non-climatic stressors were found to be causing far more adverse impacts. Tourist enjoyment of tourism-related facilities was not being affected by observed climate variability, though their numbers and spending had been affected substantially by non-climatic stressors such as the global economic crisis of 2008. Individuals working within small to mid-scale operations faced the highest exposure-sensitivity and lowest adaptive capacity to both types of stressors and resulting impacts to their livelihoods. The manner in which stakeholders are coping with present multiple stressors and plan to adapt to future changes, provides some insight in how they could adapt to near-term changes in climate. In regards to future climate change exposure sensitivities, vulnerabilities were not well understood in the destination community, as stakeholders were focused on near-term or minor weather changes, not the more significant long-term or severe impacts of climate change, such as sea-level rise, ecosystem changes or mitigation policy and the mobility of international tourists.

In terms of goal #2, this research determined that the indicator and CBVA methods were limited in advancing the understanding of climate change tourism vulnerability of the community level study area. Destination community indicators were most applicable if a defined boundary was determined to collect relevant data, though even then data was lacking for the majority of indicators at that scale. Household level indicators provided useful information on socioeconomic determinants to understand stakeholder dependence on tourism-related livelihoods, though analysis was found to be more worthwhile at the parish and national levels. Of both methods, the CBVA approach provided a more comprehensive assessment and offered some value in community-based adaptation. For the tourism sector, the CBVA also provided novel information by highlighting that most stakeholders identified vulnerabilities and adaptation measures occurred above the destination community scale.

Among the original contributions of this research, two are key. The first is that local stakeholder led adaptation was not found effective to reduce tourism vulnerability, suggesting that sectoral and community-level adaptations are not always consistent. The adaptive strategies suggested by stakeholders differed by scale, with some that could be undertaken locally by destination-community stakeholders and others that would require the support of national or international stakeholders. Second, this research advances methodology at a broader community-scale, by suggesting that both methods work in combination to address certain limitations of each. Certain applicable destination-community indicators could identify vulnerable systems within the destination community and monitor long-term some of the processes and contexts of the baseline vulnerability detailed with the CBVA approach. The CBVA approach could also collect qualitative data for the conceptually relevant indicators that were not found applicable at the destination community or household scale, to provide descriptive and disaggregated information to assist with local adaptation planning efforts.

The results of this research provide several contributions to theory, practice and policy. Theoretically, the research demonstrated the assessment of tourism sector vulnerability of SIDS to multiple stressors at several scales. The empirical results propose enhancing local stakeholders' adaptive capacity to current stressors, including increasing their understanding of climate change and its predicted impacts to the tourism sector and to their destination-community. Barbados' tourism industry also benefits from this research, as it identifies gaps pertaining to the understanding of sector vulnerability at several scales and highlights areas in which it can build adaptive capacity and adapt. Methodologically, the results show how an indicator and CBVA approach could be used in combination if a broader assessment is required at a community level. Stakeholders also concluded that in future, for SIDS the size and density of Barbados, it would be more useful to define and develop indicators for a national tourism destination. In summary, this research has contributed to the further understanding of vulnerability in small island tourism dependent communities, thereby informing more effective sectoral and community-based adaptation initiatives.

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List of Acronyms

Acronym	Organization
ABI	Association of British Insurers
AOSIS	Alliance of Small Island States
APD	Air Passenger Duty Tax
AR5	Fifth Assessment Report IPCC
BAU	Business as usual.
BDS	Barbadian Dollar
BHTA	Barbados Hotel & Tourism Association
BGVA	Bay Garden Vendors Association
BPOA	Barbados Program of Action
BRIC	Brazil, Russia, India and China
BTPA	Barbados Tourism Product Authority
CBVA	Community-Based Vulnerability Assessment
CARICOM	Caribbean Community Secretariat
CCA	Climate Change Adaptation
CCCCC	Caribbean Community Climate Change Centre
CDEMA	Caribbean Disaster Emergency Management Agency
CERMES	Center for Resource Management and Environmental Studies
CTO	Caribbean Tourism Organization
CZMU	Coastal Zone Management Unit
CVM	Climate Vulnerability Monitor
DEM	Department of Emergency Management
DEO	District Emergency Office
DFID	United Kingdom's Department for International Development
DRM	Disaster Risk Management
EDs	Enumeration Districts
EMC/ EMP	Emergency Management Committee/ Plan
FCBI	Futurebrand Country Brand Index' (FCBI)
GCMs	General Circulation Models
GDP	Gross Domestic Product
GHG	Greenhouse Gases
HDI	Human Development Index

HRVA	Hazard Risk and Vulnerability Assessment
ICAO	International Civil Aviation Organization
IPCC	Intergovernmental Panel on Climate Change
MBM	Market Based Measure
ME&R	Monitor, Evaluate and Report, in ref to CDEMA (2013a)
NAB	National Assistance Board
NAR	National Assessment Report
NCC	National Capital Commission
NGO	Non-government Organization
NIS	National Insurance Scheme
NOAA	National Oceanic & Atmospheric Administration
OCVA	Oistins Craft Vendors Association
OSBOA	Oistins Small Boat Owners Association
OUC	Oistins User Committee
RCMs	Regional Climate Models
SAP	Strategy and Action Plan, in reference to CDEMA (2009a)
SCC	South Christ Church
SIDS	Small Island Developing States
SLR	Sea Level Rise
SMEs	Small and Medium Enterprises
SPSS	Statistical Package for the Social Sciences
TCI	Tourism Climate Index
TTCI	Travel and Tourism Competitiveness Index
UK	United Kingdom
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organization
VAT	Value Added Tax
WMO	World Meteorological Organization

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Chapter 1

Introduction

1.1 Background Statement and Research Justification

As noted by the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), global climate change, caused by natural variability and human activity, is one of the most pressing issues currently facing humanity (Alexander et al., 2013). From 1880 to 2012, the average global temperature increased by 0.85°C, for which the IPCC has documented substantial evidence for human influence as the dominant cause of warming due to increasing greenhouse gas (GHG) emissions (Stocker et al., 2013). As Alexander et al. (2013), p. 3 note, "*Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased*". Further evidence is reported by the World Meteorological Organization (WMO), which notes that the 2001-2010 decade was the warmest for both hemispheres and for land and ocean surface temperatures since measurements started in 1850, which has led to unprecedented high-impact climate extremes, including precipitation and floods, tropical cyclones, heat waves and drought (WMO, 2013).

The international community has made some climate change mitigation efforts by reducing greenhouse gases emissions and enhancing their sinks (IPCC, 2014). Such efforts include several parties to the United Nations Framework Convention on Climate Change (UNFCCC) agreeing to the '*Copenhagen Accord'* in 2009, which aimed to keep the global average increase in temperatures below 2°C relative to pre-industrial levels to avoid the worst effects of climate change (UNEP, 2013). This Accord involved parties pledging to reduce GHG emissions by 25 - 40% from 1990 levels by 2020 to stabilize global temperature by 2100 (den Elzen, Mendoza-Beltran, Vliet, Bakker, & Bole, 2009; UNFCCC, 2013a; UNFCCC, 2013b). As of 2010, global GHG emissions were considerably higher than the median estimate of the emissions level in 2020 to meet the 2^{o}C target and continue to grow (Hof, den Elzen, & Roelfsema, 2013; Meinshausen et al., 2009; Roelfsema et al., 2013; UNEP, 2013). Recent studies indicate that society should prepare to address the impacts of 4^{o}C of warming by

2100 over pre-industrial levels, which could lead to extreme heat-waves, life threatening sea-level rise (SLR), decreasing food stocks and biodiversity loss, with adverse impacts to be felt most acutely in developing countries (New, Liverman, Schroeder, & Anderson, 2011; Oppenheimer et al., 2014; World Bank, 2012a).

Even if anthropogenic GHG emissions were to cease, the IPCC AR5 notes that due to the past and present rate of GHG emissions, the earth will undergo a certain level of additional climate change and resultant impacts will continue for many centuries (Alexander et al., 2013). As some degree of change is inevitable, human and natural systems are faced with a range of impacts that they must adapt to***.*** Adaptation can be defined as "*the process of adjustment to actual or expected climate and its effects"*, p. 1, IPCC (2014). In human systems, adaptation aims to minimize harm or exploit beneficial opportunities, while in natural systems, human intervention can assist adjustment to expected climate and its effects (IPCC, 2014). Adaptation types can be reactive or planned, with measures including structural, physical, institutional and/or social responses (Field et al., 2014; Smit et al., 2000; Smithers & Smit, 1997). Adaptation efforts can be focused at the sectoral level and to those sectors that would be most affected by climate change, including agriculture, human health, water supply, coastal management and tourism (Handmer et al., 2012; Klein, Schipper, & Dessai, 2005). Furthermore, as adaptation efforts have not always been planned and implemented efficiently at the national level, local approaches have also been developed for communities and ecosystems (UNFCCC, 2013c). The local level includes individuals, households and communities, with the latter being a distinct collection of households (Coombes, Green, & Owen, 1988; Ford & Pearce, 2012; Hinkel, 2011; Smit & Wandel, 2006).

To adapt to present and future climate change impacts, communities, regions and countries can undertake the following: assess impacts, vulnerabilities, risks and opportunities; plan for adaptation; implement adaptation measures and monitor and evaluate adaptation initiatives (UNFCCC, 2013c). Conducting scenario-based physical impact assessments of sectors, regions and countries can be a first step to consider climate change adaptation options (Burton, Huq, Lim, Pilifosova, & Schipper, 2002; Füssel & Klein, 2006; Kelly & Adger, 2000; O'Brien, Eriksen, Nygaard, & Schjolden, 2007). It can also include evaluating the pre-existing vulnerability of communities, regions or countries to climatic and non-climatic stressors, when the goal is to target adaptation strategies towards the most vulnerable systems (Burton et al., 2002; Füssel & Klein, 2006; O'Brien et al., 2007; Smit &

Wandel, 2006). The focus of this dissertation is on adaptation in a human system, in particular a community in the small island developing state (SIDS) of Barbados, located in the eastern Caribbean, where climate change impacts are predicted to be severe (Nurse et al., 2014). The community is also dependent economically upon the tourism sector, which is considered a climate-sensitive sector, and for which resources will be required to implement sectoral adaptation measures (Scott, Hall, & Gössling, 2012). More specifically, the dissertation examines climate change vulnerability at the tourism destination community scale for the community of Oistins.

1.2 The Tourism Sector and the Vulnerability of the Caribbean

It is imperative to address climate change in fostering sustainable tourism development, as the sector is one of the least prepared for its associated risks (KPMG, 2008; Scott, 2011). Tourism is one the largest and fastest growing economic sectors in the world and is the primary source of foreign exchange for one-third of developing countries and one-half of least developed countries (UNWTO & UNEP, 2011; UNWTO, 2013b). International travel is predicted to double by 2030, from 2010 levels, with arrivals in developing economy destinations projected to increase at double the rate of that in developed economy destinations (UNWTO, 2011; UNWTO, 2013b). In addition, many developing regions include '*tourism climate change vulnerability hotspots'*, where tourism is vital to the region's economy and/or because climate change impacts to its sector are predicted to be significant (Scott et al., 2008). For these reasons, it is necessary to understand the tourism development–climate change nexus for these '*hotspots'*, in order to assess their tourism competitiveness and the sustainability of the sector as a development strategy (Gössling, Hall, & Scott, 2009). Moreover, to reduce climate change impacts upon the sector, tourism stakeholders will need to engage in more adaptation efforts (Scott et al., 2008).

Coastal zones and small island developing states, including those in the Caribbean, are among the most attractive areas for tourists around the world and one of the most vulnerable regions to climate change (Nurse et al., 2014; P. P. Wong et al., 2014). The Caribbean has the most tourism intensive economy among the twelve regions of the World Travel and Tourism Council (WTTC, 2015b). The region has developed various tourism products emphasizing its natural assets of the sea and beaches, with key tourism products being "*sea-sand-sun*" resorts and related attractions (Zappino, 2005). Predicted climate change impacts to the Caribbean's tourism sector include changes in the length and quality of tourism seasons and in the number of weather extremes, effects on assets important for tourists (i.e. beaches) and destination image and altered tourist mobility due to mitigation responses (Gössling et al., 2012; Scott et al., 2012; Scott, Gössling, & Hall, 2012). Such impacts could lead to infrastructure damage, higher seasonal operating costs and business interruptions, thereby affecting tourism demand (Scott et al., 2012). For these reasons, the region needs to take concerted efforts to adapt to the effects of climate change as it could have detrimental impacts on its tourism sector and economic livelihoods (Simpson, Gössling, & Scott, 2008; Simpson et al., 2010). To enable evidence-based adaptation support from the international community, information to assess climate change impacts and vulnerability in the Caribbean needs to be improved (Griffith & Gibbs, 2009; Mycoo, 2013; Simpson et al., 2010). This includes further studies to examine the vulnerability of the region's tourism sector (Becken, 2013; Bishop & Payne, 2012).

It is within this context, of the tourism development-climate change nexus, that this research is situated and for which it is important to understand the types of tourism and climate change studies that have been undertaken to date. A limitation of tourism and climate change research is that the majority of it has been located in Europe, North America, and Oceania, with a few studies from SIDS or the Caribbean (Becken, 2013). In recent years, there have been a few studies in developing countries (i.e. Nepal, Fiji and China), though further research is needed on the impacts of climate change on their tourism sectors (Becken, 2013; C. M. Hall, 2008; Kaján & Saarinen, 2013). Additional research is also needed regarding potential adaptation of the sector to climate change, particularly for tourism-destination communities in developing countries and tourism regions considered most vulnerable (Becken, 2013; Kaján & Saarinen, 2013; Scott et al., 2012).

Tourism stakeholders involved directly in the sector consist of governments, tourists, tourism operators, tourism service suppliers and tourism destination communities (Becken & Hay, 2007; Gössling & Hall, 2006b; Scott, 2006). Of these stakeholders, tourism destination communities and their local operators have been identified to be the most vulnerable and to have the least adaptive capacity to climate change impacts (Scott & Jones, 2006). Tourism destinations can range in size from a small nation to a region (e.g. Napa Valley, California) or to a specific resort or site (eg. a national park) (UNWTO, 2004a). Tourism destination climate change studies to date have also generally centered on a small number of Western world destinations (Becken, 2013; Kaján &

Saarinen, 2013). The scale of destination studies has varied from specific resorts to larger regions such as municipalities or countries, with only a few focusing on communities and their networks (Kaján & Saarinen, 2013).

Another shortcoming in the tourism and climate change literature, of relevance to this research, is that the majority of studies examine a single climatic stressor (e.g. from direct impacts) and do not consider other multiple climatic stressors (i.e. from indirect climate-induced changes or climatic policy) or important non-climatic interactions (i.e. fuel price volatility) (Scott et al., 2012). For these reasons, further research is also needed on the assessment of the multiple impacts of climatic and non-climatic stressors on a single tourism destination and how climatic drivers interact with other non-climatic drivers, especially in small islands (Scott, 2006; Scott et al., 2012; Simpson et al., 2010).

This research examines the climatic and non-climatic stressors influencing adaptation of a tourism destination community, including its households, in the Caribbean. No studies to date have examined household level vulnerability of tourism destination communities in the region, which would be insightful as highly vulnerable individuals to climate change include those who live in areas with high exposure and are dependent upon climate sensitive industries such as tourism (Boruff & Cutter, 2007; Dunn, 2008; Massiah, 2006). In addition, tourism and climate change adaptation studies need to increase their attention on and work with host communities, their networks, perceptions and adaptive capacities, particularly in developing countries (Becken, Lama, & Espiner, 2013; Kaján & Saarinen, 2013; Scott et al., 2012). To address the community dimension in tourism and adaptation research, local knowledge should be considered to understand climate change (Brace & Geoghegan, 2011). In particular, Brace and Geoghegan (2011) suggest "…*exploring lived experiences based on how local people and workers in tourism businesses understand and witness a destination, its climatic conditions, changes and related risks and adaptive strategies"* (in Kaján and Saarinen (2013) p. 184). By examining a tourism destination at the community scale, this research also considers the climate change vulnerabilities of tourism-dependent workers, which no studies have previously examined in the Caribbean and is a broader gap in the tourism and climate change literature. For this reason, in addition to considering local tourism stakeholders involved directly in the sector (i.e. tourism organizations) or who have other relevant expertise (i.e. government organizations), this research considers stakeholders whose livelihoods are most connected to the tourism destination (i.e. workers, vendors, small and medium-sized enterprises). So unlike many studies that focus on understanding the perceptions of tourists, this dissertation focuses on the tourism stakeholders deemed most vulnerable.

1.3 Vulnerability Assessment of a Tourism Destination Community

This research examines the vulnerability of a tourism destination community in Barbados to climatic and non-climatic stressors. Barbados was selected as a case-study site as the island and its tourism sector face high exposure-sensitivity to climate change, though the island also demonstrates a high adaptive capacity at the national level (Bishop & Payne, 2012; Boruff & Cutter, 2007; Climate Investment Funds, 2009; Mycoo & Chadwick, 2012). Studies have examined climate change and tourism at the Caribbean or the national level (CDEMA, 2013c; GOB, 2001a; GOB, 2012), though only a few have addressed adaptation (CCCCC, 2009a; UNECLAC, 2011) and none have engaged in scenario planning to understand key challenges and develop a vision for the sector's future (Scott & Gössling, 2015). Knowledge limitations remain, including an examination of future trends that could significantly impact upon Barbados' tourism sector and an investigation of sector climate change vulnerability at the community level. Moreover, as community tourism is promoted by international and national level stakeholders to reduce poverty and diversify Barbados' tourism product, an understanding of destination-community scale vulnerabilities is important (GOB, 2012; Gössling et al., 2009; UNWTO, 2004b). Furthermore, this research was carried out through a case-study, as it examined the climate change vulnerability of a key economic sector in a specific island and one of its communities (Stake, 1995). A case-study allowed for the examination of micro-level data, which is often not considered in broader-based studies (Evans & Gruba, 2002; Flyvbjerg, 2006).

This dissertation seeks to understand the tourism destination community's vulnerability by applying two common vulnerability assessment methods: an indicator and a community-based approach. Each method presents strengths and weaknesses and can inform adaptation planning. This research elicits insights from both methods to determine whether either or both can advance knowledge gaps in the understanding of vulnerability at the destination community level. Furthermore, both methods can undertake a '*starting-point'* approach to viewing a system's vulnerability as a pre-existing state (context) that renders it susceptible to harm, which involves understanding how vulnerability changes overtime (Burton et al., 2002; Kelly & Adger, 2000; O'Brien et al., 2007).

Quantitative and qualitative indicators can enable the comparison of phenomena between local, regional and/or national levels by summarizing large amounts of information (Birkmann, 2006a; Perch-Nielsen, 2010; UNWTO, 2004a; Vincent, 2007b). They can also facilitate rapid vulnerability assessments, which can be useful to address the pace and magnitude of climate change impacts and adaptation challenges (Rosenzweig & Wilbanks, 2010). Furthermore, indicators can be used to measure progress towards the attainment of an outcome (Bours, McGinn, & Pringle, 2014; Hinkel, 2011; Vincent, 2007b). If developed and applied appropriately, many scholars note that indicators can be a useful comparative tool for decision-makers, including funding agencies, to ascertain where climate change adaptation is most needed and how best to distribute investments (Bours et al., 2014; WEF, 2014). Other scholars argue that vulnerability indicators are the most appropriate for identifying vulnerable systems at the local scale, where they can be narrowly defined, and not for allocating adaptation funds (Hinkel, 2011). When developing vulnerability indicators to climate change, sector, hazard or geographic specific criteria can be more important than generic indices (Cardona et al., 2012; Füssel, 2010; Hinkel, 2011). For the tourism sector and the communities that rely upon it, destination assessments need to incorporate relevant vulnerability, adaptation and impact indicators to assist with impact comparisons amongst destinations and the synthesis of studies (Scott et al., 2008; Scott et al., 2012). Indicators to assess the vulnerability of local tourism destination communities remain to be developed (Perch-Nielsen, 2010; Scott et al., 2012).

Lack of data and over-simplification of information via aggregation are some of the challenges in using indicators (Adger, Brooks, Bentham, Agnew, & Eriksen, 2004; Bours et al., 2014; Füssel, 2009). For these reasons a contextual analysis and a disaggregated accounting of vulnerability, within a given system, also continues to be important (Bours et al., 2014; Parkins & MacKendrick, 2007). Qualitative, place-based studies can collect descriptive information on the determinants of vulnerability and facilitate a more in-depth understanding of unknowns and uncertainties at the household, community or economic level (Birkmann, 2006a; Ford et al., 2010; Rosenzweig & Wilbanks, 2010; Smit & Wandel, 2006). Furthermore, place-based studies, such as Community-Based Vulnerability Assessments (CBVAs), can identify climate change vulnerability determinants directly from a community, with the goal being to ascertain ways of implementing adaptation initiatives or enhancing adaptive capacity (Smit & Wandel, 2006). In the tourism context, place-based research would allow for the consideration of climatic conditions and tourism adaptation needs that are pertinent to community members (Becken, 2013; Kaján & Saarinen, 2013). Nevertheless, place-based studies face limits in their comparisons across and beyond systems (Birkmann, 2006a; Smit & Wandel, 2006). For these reasons, additional place-based methodologies are needed to more comprehensively capture the dynamic nature of vulnerability and facilitate adaptation planning, including those that support longitudinal studies, community-based monitoring and focused adaptation research (Ford & Pearce, 2012; Ford et al., 2012).

Both indicator and place-based methods can enable comparative assessments of vulnerability and provide insights to target adaptation initiatives across communities (indicators) and within communities (place-based) (Smit & Wandel, 2006). It is also important to consider if and how different quantitative and qualitative data sets can complement each other and jointly analyze vulnerability and depict adaptation progress (Birkmann, 2007; Bours et al., 2014; Cardona et al., 2012; Malone & Engle, 2011). Furthermore, to foster the most robust assessments, indicators can be used in combination with place-based studies, which this research aims to do (Malone & Engle, 2011).

1.4 Research Goals and Questions

1.4.1 Research Goals

This dissertation seeks to deepen the understanding of the dynamic processes and contexts influencing climate change vulnerability at the tourism destination community scale in Barbados. The research focuses on two goals: 1) to examine the influence of climatic and non-climatic stressors on the pre-existing vulnerability of a destination community, including its local tourism stakeholders; 2) to employ two methods to assess vulnerability across and within the community, and based on specific criteria**,** determine whether either or both can advance knowledge gaps in this understanding at the destination community scale. More specifically, the first goal involves undertaking a tourism vulnerability assessment at the destination community level, within the context of a national level understanding of vulnerability. The second goal develops and applies a set of indicators for the determinants of climate change vulnerability at the destination community and household level. It also carries out CBVA interviews with stakeholders whose livelihoods are most connected to the tourism related activities of the destination community. By completing a vulnerability assessment utilizing two methods in the same community, the research examines the strengths and limitations of each, including whether one method can offset any limitations posed by the other, to facilitate the targeting of adaptation initiatives in the destination community. In summary, by examining the multiple stressors influencing vulnerability and the application of two methods in a destination community, this research will provide new insights into the tourism and climate change literature on the vulnerability of destination communities in developing countries, thereby fostering more effective sectoral and community-based adaptation.

1.4.2 Research Questions

Based on the above two research goals, this research addresses the following questions:

Goal #1

1. How are climate change vulnerabilities differentially distributed within the destination community and household levels? Furthermore, what are the specific or unique vulnerabilities of tourism workers, vendors and small and medium-sized enterprises (SMEs)?

2. i) How connected are the livelihoods of the neighbouring households to the tourism destination community? What does this imply for the best method to collect data on household-level vulnerability for tourism destination communities?

   ii) How should the household data collected in the destination community best be used? What is the appropriate scale of its analysis: household level, destination community level or both?

Goal #2

3. How viable is the development and application of local level indicators to comparatively assess the vulnerability of tourism destination communities, including its households?

4. What are the strengths and limitations of the indicator and CBVA approaches in assessing vulnerability at the tourism destination community level?

   i) Can the use of indicators overcome the scaling up and out limitations of the CBVA approach? More specifically, can some of the applicable indicators serve to monitor long-term the baseline vulnerability detailed with the CBVA approach?

   ii) For any indicators that are found relevant to develop, but challenging to apply at the tourism destination community-scale, can their determinants still be portrayed through the CBVA approach?

1.5 Dissertation Organization

This dissertation is organized into nine chapters, including this introductory chapter. This chapter has presented the background information to understand climate change and the rationale as to why human systems will need to adapt to its impacts, particularly in developing countries. It then detailed why this research examines the tourism sector and by presenting key gaps in the tourism and climate change literature, reinforced the impetus to further understand adaptation in tourism destination communities, in particular SIDS communities. Furthermore, the chapter introduced the two methods that this research will employ to assess the vulnerability of a tourism destination community in Barbados and ascertain how each can inform adaptation planning. Lastly, the chapter outlined the research's goals and key research questions.

The second chapter reviews the academic literature pertaining to climate change adaptation, adaptive capacity and vulnerability and presents the types of studies that can be undertaken to examine climate change impacts and vulnerabilities. It then details the types of methods that can be used to assess the vulnerability of communities, with a focus on indicator and place-based approaches. The chapter then presents the tourism sector, its relationship with climate change and impacts of climate change on the sector. It then details gaps in the climate change and tourism literature, with a particular focus on adaptation and methods to assess the vulnerability of tourism destination communities. The chapter comes to a close by outlining research gaps that this dissertation aims to address, along with conceptual figures to assess the climate change vulnerability of the tourism sector in a SIDS (Figure 2) and to examine methodological gaps at the destination-community scale (Figure 3).

Chapter three details the methodology undertaken for the research, including key stakeholders involved, its mixed-methods research approach, justification of the study site and its timeline. The chapter then presents the process to develop and apply the destination and household level indicators, followed by the process to collect and analyze data for the Community-Based Vulnerability Assessment. It then outlines how data obtained from the indicator and CBVA approaches were analyzed according to the criteria presented in Figure 3. Research challenges and considerations and ethical issues considered are then highlighted.

The fourth chapter presents the detailed study area for this research, the island of Barbados and the tourism destination community of Oistins. The chapter introduces Barbados, its geography, weather patterns and climate change, national initiatives on climate change and the importance of its tourism sector. The chapter then details the tourism destination community of Oistins, its justification for selection, its key tourist attractions and districts for the household surveys.

Chapter five critically assesses current literature which examines the vulnerability of Barbados' tourism sector to climate change, to provide context and value for the interpretation of results detailed in chapters 6 and 7. This includes an assessment of predicted climatic and non-climatic impacts to the sector. The chapter then empirically analyses national and regional climate change preparedness to date and any research gaps. It also presents different scenarios for the island's tourism arrivals under future climate change and concludes by suggesting measures that Barbados could take to adapt.

The sixth chapter presents the empirical results of the research obtained via the development and application of the destination community and household level indicators. It commences by detailing the conceptually relevant and refined list of implementable and operationally feasible destination level indicators, concluding with the results of any applicable indicators. Similarly, it then outlines the conceptually relevant and refined list of household level indicators, concluding with the results of any applicable indicators. The chapter then reflects on the general strengths and limitations of the indicator approach, as determined through the research results.

Chapter seven details the findings from the Community-Based Vulnerability Assessment. It commences by presenting an overview of the key stakeholder groups consulted in the tourism destination community of Oistins. It then presents stakeholder perceptions as to current climatic and non-climatic stressors impacting the community of Oistins, along with coping strategies, resources and support, and any limits or constraints. The chapter discusses future climatic and non-climatic stressors that stakeholders perceived could affect their community, including future adaptive strategies, required resources and support and any limits or constraints. The chapter then presents the empirical results of the vulnerability assessment based on the CBVA.

The eighth chapter analyses the research results and discusses its theoretical, empirical and methodological contributions. It commences by reflecting upon the research's empirical findings from the national sector vulnerability assessment, the indicator and CBVA approaches, including recommended adaptation strategies, the capacity of local organizations and future adaptation strategies for the island and the destination-community. The chapter then discusses the research's methodological findings, by reflecting on the utility of the indicator and CBVA approaches in examining the destination community's climate change vulnerability and whether they can be used in combination or offset any limitations of the other. It then examines the relationship between household level vulnerability and the destination community. The chapter concludes by discussing the practicality of defining a tourism destination at the community scale.

The final chapter discusses how the research responded to the goals and questions presented in the introductory chapter. It then presents the theoretical, empirical and methodological contributions of the research, including potential use of findings for each. Directions for further research are also recommended, emphasizing where there is need for additional knowledge to continue to contribute to adaptation efforts for tourism destination communities.

Chapter 2

Literature Review

2.1 Introduction

This chapter details the key concepts of adaptation, adaptive capacity and vulnerability that pertain to this research. It then presents the types of climate change impacts, vulnerability and adaptation studies that are commonly undertaken, followed by the importance of scale and participation of local stakeholders in such studies. Methods to assess the vulnerability of communities are then presented, with a focus on indicator and place-based approaches. The chapter then details the significance of the tourism sector and why it is examined in this research. It discusses the relationship between tourism and climate change, with a focus on climate change impacts on the sector. It then presents research gaps pertaining to tourism, climate change and adaptation, including empirical and methodological gaps in understanding vulnerability in destination communities. It concludes by summarizing research gaps that this dissertation will address and presents two conceptual figures. The first assesses the vulnerability of the tourism sector in a small island developing state, including community level, and the second investigates methodological gaps in assessing vulnerability at the tourism destination community scale.

2.2 Key Concepts

The following section presents the concepts of adaptation, adaptive capacity and vulnerability as they pertain to the study of the human dimensions of climate change.

2.2.1 Adaptation

The conceptual roots of adaptation lie in population biology and evolutionary ecology, which pertain to the genetic characteristics that allow organisms to survive and reproduce (Winterhalder, 1980). In human environments, this can be interpreted as the success and/or survival of a culture (Smithers & Smit, 1997). The concept of adaptation, like that of vulnerability, has been applied in the study of natural hazards, political ecology, livelihoods and more recently, in climate change scholarship (Smit & Wandel, 2006; Smithers & Smit, 1997).

In the climate change context, adaptation can be defined as the "*adjustment in ecological, social and economic systems in response to actual or expected climate change stimuli and their effects or impacts*", p. 9 (Smit & Pilifosova, 2003). In human systems, adaptation is based on the climate related stimuli, its time and spatial scales (Smit et al., 2000). Climate related stimuli can include stresses (continuous hazards) and/or perturbations (discrete hazards) (Smit et al., 2000). A hazard can be defined as "*the potential occurrence of a natural or human-induced physical event or trend, or physical impact, that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources*" p. 15, (IPCC, 2014) and which is "…*characterized by its location, intensity, frequency and probability*" p. 160 (Füssel, 2007).

Temporally adaptation can occur to long term climate change, to current and short-term variability in climatic conditions and to isolated extreme weather events, the last two of which can occur independently of climate change but are predicted to increase in magnitude and frequency as a result of climate change in the 21st century (Field et al., 2014; Smit et al., 2000; Smithers & Smit, 1997). Uncertainty regarding the extent of future change should not limit adaptation initiatives, as decision makers should consider the execution of effective adaptation strategies over a range of future scenarios (Birkmann, 2011; Denton et al., 2014; Dessai, Hulme, Lempert, & Pielke, 2009). In addition, the magnitude and areal extent of the climatic disturbance should also be considered, when considering adaptation options (Smithers & Smit, 1997). Spatial scales pertaining to adaptation are further discussed in section 2.3.3.1.

Adaptation to climate change is also determined by '*who adapts'*, which involves defining the system and its characteristics (Birkmann, 2011; Smit et al., 2000). In human systems adaptation can minimize harm or exploit beneficial opportunities, and can include a household, a community (a distinct collection of households), a region or an economic sector (Brooks & Adger, 2004; Coombes et al., 1988; Smit & Wandel, 2006). Its system characteristics include adaptive capacity, vulnerability, sensitivity and resilience, which are detailed in sections 2.2.2 and 2.2.3 (Smit et al., 2000). Adaptive responses to climate and its effects can be also defined by their form, that is whether they are structural (i.e. sea walls), physical (i.e. ecological restoration), institutional (i.e. building standards) or social (i.e. livelihood diversification) (Field et al., 2014; Smithers & Smit, 1997). Successful approaches include a blend of hard infrastructure responses (i.e. climate-proofing of infrastructure) and soft solutions (i.e. early warning systems) (Cutter et al., 2012; Lal et al., 2012). The particular response links to the goal of the adaptation initiative and whether it incrementally buffers the system and upholds its character or transforms it to a new state (Klein et al., 2014).

In unmanaged systems, adaptation activities are autonomous and tend to be reactive*,* often undertaken by private actors after climate change impacts have been felt (Smit et al., 2000; Smit & Pilifosova, 2001; Smit & Pilifosova, 2003). Adaptation activities can also be planned, often by public actors, and be reactive or anticipatory*,* with latter activities undertaken before impacts are observed (Smit et al., 2000; Smit & Pilifosova, 2001; Smit & Pilifosova, 2003). In most circumstances, anticipatory adaptations have lower long-term costs and are more effective (Stern, 2007). The financing of adaptation measures is important to consider, particularly for vulnerable developing countries, where cost estimates are higher than current adaptation funding and investment (Chambwera et al., 2014; UNFCCC, 2013c). Fatality rates and economic losses associated with climate change, expressed as a percentage of gross domestic product (GDP), are predicted to be higher in developing countries, while economic losses as a whole are predicted to be higher in developed countries (Handmer et al., 2012).

The UNFCCC (2013c) notes that to adapt to present and future climate change, communities, regions and countries will need to assess impacts, vulnerabilities and risks; plan for adaptation; implement adaptation measures and monitor and evaluate adaptation initiatives. In light of the limited accuracy of climate predictions, it is important to note that adaptation can be carried out without impact assessment for a range of future climate scenarios (Dessai & Hulme, 2004; Dessai et al., 2009; Eakin & Patt, 2011). Furthermore, as detailed in section 2.2.3.1, adaptation and vulnerability can be linked through the notion of risk[1] and vulnerability analysis can be one of the first steps of any adaptation intervention, as the causal analysis of why a system is at risk (i.e. vulnerable), informs what can be done to reduce it (i.e. adapt) (Ribot, 2011). Recent literature notes that the majority of adaptation studies to date have focused on impacts, vulnerability, and adaptation planning, with only a few assessing the implementation process of adaptation (Mimura et al., 2014; Noble et al., 2014)**.**

[1] Risk = *"The potential for consequences where something of human value is at stake and where the outcome is uncertain. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur*" (IPCC, 2014).

Adaptation measures must be implemented with caution due to the following reasons: the opportunity for adaptation might be lesser than predicted, due to the scale of change and interconnectedness of impacts; adaptive capacity does not always lead to adaptation action; unsustainable actions might already be in place (mal-adaptations); and the metrics to establish the successes and any trade-offs can only be understood in the social context in which adaptation takes places (Adger & Barnett, 2009). Furthermore, mal-adaptation can be defined as "*action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups*" p. 211 (Barnett & O'Neill, 2010). To avoid mal-adaptation, adaptation decisions could be screened for any possible adverse effects by considering whether they exacerbate the climate change problem they are adapting to by increasing GHG emissions, excessively burdening the most vulnerable, creating high opportunity costs relative to alternatives, reducing incentives to adapt, or nurturing path dependency through development patterns that are challenging to change in the future (Barnett & O'Neill, 2010).

Other constraints to adaptation planning and implementation include uncertainty about projected impacts; inadequate resources; limited coordination amongst governance levels; diverse risk perceptions and partial tools to monitor adaptation effectiveness (Klein et al., 2014; Mimura et al., 2014; Noble et al., 2014). To overcome such constraints, adaptation initiatives can be integrated (mainstreamed) with existing development initiatives and provide several co-benefits by addressing other goals, such as livelihood improvements, social and economic well-being and environmental quality (Klein et al., 2014; Mimura et al., 2014; Mohan & Morton, 2009; Smit & Wandel, 2006). This can allow for a focus on '*no-regrets*'[2] or '*low-regrets*'[3] options, which can be useful to address the limited confidence in climate change projections at the local scale, while reducing vulnerability under current and future climate change scenarios (Lal et al., 2012). Adaptation choices and their implementation are also best facilitated when informed by equitable and participatory frameworks that engage communities in a manner that promotes accountability and trust (Dulal, Shah, & Ahmad, 2009; van Aalst, Cannon, & Burton, 2008). Participatory stakeholder involvement can provide important information about the priorities that communities', government and private

[2] No regrets = benefits with or without climate change.
[3] Low-regrets = could increase operating costs marginally.

sector organizations link to the sector for which adaptation is required (Moreno & Becken, 2009; Noble et al., 2014).

Current scholarship notes that worldwide adaptation is occurring and becoming entrenched in some planning processes, with structural and physical measures being the most common (Klein et al., 2014; Mimura et al., 2014; Noble et al., 2014). Furthermore, the selection of measures has focused on incremental adjustments and is commencing to highlight flexibility and learning (Mimura et al., 2014). To further implement effective adaptation measures, the IPCC AR5 recommends sustainable development pathways that unite adaptation and mitigation efforts (Denton et al., 2014). Such pathways can also be seen as iterative risk management, by constantly developing to address change within multifaceted systems (Denton et al., 2014). Moreover, by undertaking a risk-based approach to decision-making, adaptation limits can be considered which are context-specific (Denton et al., 2014; Klein et al., 2014). In instances where adaptation limits have been exceeded, losses and damage may increase and the goal of some stakeholders may no longer be attainable. In such cases, there may be a need for transformative adaptation to alter key traits of the system in reaction to climate change impacts (Klein et al., 2014). This could involve adaptations that occur at a larger scale than in the past, are new to the system, lead to a relocation of activities, launch new behaviours or create new systems of governance (Denton et al., 2014; Klein et al., 2014). This notion of transformation links to resilience and is briefly detailed in section 2.2.3.

2.2.2 Adaptive Capacity

Adaptive capacity is considered a system characteristic of adaptation (Smit et al., 2000). Many systems have limited technical, financial, institutional and, political and social capacity to plan and implement adaptation measures effectively (Birkmann, 2011; Huq & Reid, 2004). As a result, when considering adaptation measures for a particular system, it is also important to assess and enhance its adaptive capacity (Adger et al., 2007; Brooks & Adger, 2004; Smit & Pilifosova, 2003). Adaptive capacity can be highly differentiated within systems, as multiple processes (stressors) of change interact to influence vulnerability (Smit & Wandel, 2006). Furthermore, the capacity to adapt can be analyzed via thresholds and coping ranges. A coping (recovery) range reflects a system's short-term adaptive capacity and change that can be absorbed without incurring significant impacts, within current institutional settings (Birkmann, 2011; Smit & Pilifosova, 2003)[4]. Coping capacity can lead to impacts being less extreme, but it does not guarantee the capacity to adapt (Birkmann, 2011). A threshold is when significant impacts exceed the coping range and result in the system undergoing a change of state (Smit, Burton, Klein, & Street, 1999). Adaptive capacity can be defined as the medium or long-term capability of a system to change to climate stimuli, which can require institutional change (Birkmann, 2011; Smit et al., 2000)[5].

A system's adaptive capacity can represent material resources (attributes) available for adaptation, as to be presented in Table 1. It can also include non-material and intangible attributes, such as sense of place, attachment or identity (Lewicka, 2011; Marshall & Stokes, 2014). In the climate change literature, some scholars argue that the determinants of adaptive capacity and vulnerability are related, as increasing the adaptive capacity of a system can also reduce its vulnerability (Berkes, 2007; Smit & Pilifosova, 2003; Smit & Wandel, 2006). *"…. The vulnerability of a system to climate change will be inversely related to the capacity of that system to respond and adapt to change over time…"* p. 170 (Brooks & Adger, 2004). Other scholars argue that the relationship between vulnerability and adaptive capacity is not always inverse, because communities that are highly vulnerable may also display high adaptive capacity (Gaillard, 2010; Handmer, 2003). Vulnerability can be an inherent characteristic of any system and *"…rather than trying to eliminate vulnerability, the challenges are to identify acceptable levels of vulnerability and to maintain the ability to respond when vulnerable areas are disturbed"* p. 412 (Nelson, Adger, & Brown, 2007). For these reasons, when examining a system's vulnerability, it can be useful to distinguish its various determinants and their relationship to each other (Vincent, 2007a).

2.2.3 Vulnerability

In the climate change context, vulnerability is also one of the system characteristics of adaptation and can be defined as the *"degree to which a system is susceptible to injury, damage or harm",* p. 238, (Smit et al., 2000). Vulnerability research can be undertaken within natural hazards, entitlement and sustainable livelihoods, resilience and integrated research traditions (Adger, 2006;

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[4] Coping capacity: "*The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term*" (IPCC, 2014).

[5] Adaptive capacity - "*The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences*" (IPCC, 2014).

Eakin & Luers, 2006; Patt, Schröter, De La Vega-Leinert, & Klein, 2009). This research undertakes an integrated approach to examine vulnerability to climate change and draws more explicitly upon a modified sustainable livelihoods approach to identify determinants within a single sector. The following section briefly describes the vulnerability research traditions and then provides more details on the sustainable livelihoods and integrated approaches.

2.2.3.1 Overview of Vulnerability Research Traditions

The natural hazards and disaster[6] risk management (DRM) traditions initially focused on the biophysical vulnerability of human systems through external exposure to hazards and current climate variability (Cutter, 2003; Füssel, 2007; Thomalla, Downing, Spanger-Siegfried, Han, & Rockström, 2006). More recent hazards traditions examine the dynamic processes affecting social, economic and biophysical vulnerability to hazards, while identifying its social and economic root causes (Adger, 2006; Cutter, 2003; Eakin & Luers, 2006; Wisner, Blaikie, Cannon, & Davis, 2004). The natural hazards and climate change research traditions have found common ground in recent years, to further understand the underlying causes of vulnerability and become more forward looking with climate change adaptation strategies (Prabhakar, Srinivasan, & Shaw, 2009; Thomalla et al., 2006; van Aalst et al., 2008).

Other vulnerability research traditions view internal system characteristics and social vulnerability as a pre-existing condition due to a lack of entitlements or livelihoods, as detailed in the next section (Adger, 2006; Chambers & Conway, 1992; Sen, 1981). Vulnerability can also be examined through a resilience lens, which is considered a characteristic of adaptive responses (Adger, 2006; Nelson et al., 2007; Smit et al., 2000; Tompkins & Adger, 2004). Current literature focuses on the social-ecological resilience of coupled human-environments, which in addition to the ability to absorb and persist through disturbance, involves adapting, learning, innovating and self-organizing (Folke, 2006). Resilience thinking, and its process of iterative risk and adaptive management, can reconcile the disconnect between the short and long-term perspectives on climate change adaptation and address some of its complexities and uncertainties (Denton et al., 2014; Lavell et al., 2012; O'Brien

[6] Disaster = *"Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery*" (IPCC, 2014)

et al., 2012). Research on climate change vulnerability and adaptation requires an integrated approach and spans prior and successor traditions, as detailed in section 2.2.3.3 (Adger, 2006; Eakin & Luers, 2006; Patt et al., 2009).

2.2.3.2 Entitlements and Sustainable Livelihoods

A system's vulnerability can also be seen as a failure of entitlements or shortage of capacities (Sen, 1981). Such a perspective led to the emergence of the '*sustainable livelihoods*' approach, defined as those livelihoods "... *which can cope and recover from stress and shocks*, *maintain or enhance its capabilities and assets, and provide sustainable livelihoods for the next generation; and which contributes net benefits to other livelihoods…*", p6 (Chambers & Conway, 1992). The approach focused on the well-being of a household based on its capabilities, assets and activities and on five capitals (human, social, physical, financial and natural) (Adger, 2006; Chambers & Conway, 1992). The United Kingdom's (UK) Department for International Development presents the five capitals in their '*Sustainable Livelihoods Framework*' (DFID, 1999). More recently two other capitals, political (institutional) and cultural, have been considered within the approach (Baumann & Sinha, 2001; CARE, 2002; Daskon, 2010; Throsby, 1999). Table 1, at the end of the next section, describes each of the seven capitals.

The sustainable livelihoods approach is useful for detailing the root causes and multiple drivers of social vulnerability, as it offers insights into livelihoods that matter most and how they can combine to affect adaptation measures (Adger, 2006; Eakin & Luers, 2006; Hahn, Riederer, & Foster, 2009). The associated capitals can be useful to assess the socio-economic determinants of vulnerability, in particular the differential exposures, sensitivities and adaptive capacities that exist within a system in response to changing environmental or social conditions (Eakin & Luers, 2006). Furthermore, nurturing a community's entitlement to key resources is crucial to fostering adaptive capacity to climate change, as communities with greater assets often have a larger range of options to switch between several strategies to secure their livelihoods (Cutter et al., 2012; DFID, 1999). Nevertheless, the approach has been critiqued for considering too many issues or sectors at once, meaning that it can be useful to adopt the approach within a single sector (J. Clark & Carney, 2008; Haidar, 2009; Petersen & Pedersen, 2010; Wu & Pearce, 2014). Another limitation of the approach is that it is not dynamic enough, as it focuses on '*cope and recover'* from stresses, versus investigating options for long-term adaptation (Scoones, 2009).

2.2.3.3 Integrated Approach

Climate change is a multi-scale global change problem with diverse actors, stressors and time scales, for which a variety of approaches is needed (Adger, 2006; Eakin & Luers, 2006; Patt et al., 2009). Integrated vulnerability research traditions combine natural hazards, sustainable livelihoods and resilience traditions to examine external exposure to hazards and internal factors of coupled-human environments (Füssel, 2007). Turner et al. (2003) and Smit and Pilifosova (2003) present key frameworks to examine coupled human-environments in the global environmental change context. Further to the definition noted in section 2.2.3, Turner et al. (2003) define vulnerability 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/stressors"*, p. 8074, while Smit and Pilifosova (2003) define it as "…*related both to its exposure to climate change effects and to its capacity to deal with those effects",* p. 21. Both frameworks suggest that in addition to external exposure to hazards, vulnerability is influenced by the internal sensitivity and adaptive capacity (or resilience) of the system. The authors define exposure as the external stress to the system, caused by variability and change in conditions. They then, building on the definition presented by Smit et al. (2000)[7], present sensitivity as an internal system characteristic, which affects a system's susceptibility to external stresses. Furthermore, the Smit and Pilifosova (2003) framework employs the term adaptive capacity and the Turner et al. (2003) framework utilizes the term resilience, both of which are used to describe the internal ability to withstand or recover from the impact of an external stress and address potential opportunities. Both frameworks consider environmental and social stresses originating from the place, region and global scales, though precise impacts are noted at the place (local or community) scale, which the National Research Council (2002) and Clark (1999) define as '... *a spatially continuous distinctive ensemble of human and biophysical conditions…'* in p. 8076 (Turner et al., 2003). The frameworks also differ as the Turner et al. (2003) framework considers social and biophysical vulnerability, while the Smit and Pilifosova (2003) framework examines social vulnerability.

[7] Sensitivity = the "*degree to which a system is affected by or responsive to climate stimuli*", p. 238 (Smit, Burton, Klein, & Wandel, 2000).

Both frameworks suggest that vulnerability is scale and time dependent[8], can have multiple stressors and is dynamic (varying in space in time), as environmental and socio-economic stresses are constantly subject to change (Smit & Pilifosova, 2003; Smit & Wandel, 2006; Turner et al., 2003). Due to this dynamic nature, vulnerability cannot be reduced to a single metric or easily quantified (Adger, 2006; Patt et al., 2009; Smit & Wandel, 2006). For these reasons, it is easier to measure the processes that condition a system's vulnerability (Brooks, Adger, & Kelly, 2005; Eriksen & Kelly, 2007; Patt et al., 2009). This process-based approach views vulnerability as a pre-existing state (context) of a system that renders it susceptible to harm, which involves understanding how vulnerability changes overtime ('*contextual vulnerability*'), as further detailed in section 2.3.2 (Burton et al., 2002; Kelly & Adger, 2000; O'Brien et al., 2007). To capture this dynamic nature of vulnerability, past and current vulnerability are often viewed as a proxy for future vulnerability and for identifying ways to augment adaptive capacity (Adger & Kelly, 1999; Adger, Huq, Brown, Conway, & Hulme, 2003).

Understanding the multiple interacting perturbations and/or stresses which can increase a system's vulnerability, is key to comprehensively assessing exposure-sensitivity and adaptive capacity (Füssel & Klein, 2006; Kelly & Adger, 2000; Schröter, Polsky, & Patt, 2005; Turner et al., 2003). This involves assessing the impacts of climate change on a system along with other non-climatic drivers, such as economic growth, increasing population and increasing global interconnectivity (Burton et al., 2012). Such drivers can be referred to as '*double-exposures*', the assessment of two processes (Leichenko & O'Brien, 2002; O'Brien et al., 2004; Turner et al., 2003) or '*multiple exposures',* the assessment of multiple variables of concern (Belliveau, Smit, & Bradshaw, 2006; Keskitalo, 2008). The IPCC AR5 notes that as a whole, the impacts of changing social and economic conditions have been greater on human systems than climatic-related conditions, but nevertheless, some impacts to human systems have been linked to climate change (Cramer et al., 2014).

Table 1 presents the social, economic and biophysical features that determine a vulnerable system's internal traits of sensitivity and adaptive capacity (exposure is determined through biophysical (external) conditions), based on the seven sustainable livelihood capitals. The

[8] With global processes occurring over longer time periods and local level processes over shorter periods.

determinants shed light on differences in economic resources, human skills, social capital, physical infrastructure, natural resources, political and cultural capital. The determinants are dynamic, place and system-specific and can be assessed through a variety of methods. High sensitivity and low adaptive capacity can be the result of distorted development initiatives, such as environmental mismanagement, demographic changes, rapid urbanization, failed governance and a shortage of livelihood options (Cardona et al., 2012). Individuals and communities can also be differentially vulnerable, based on demographic determinants such as gender, education, wealth, age, ethnicity, religion, class, health status and size of household (Cardona et al., 2012), which can affect their access to control over the types of capital listed in Table 1.

Table 1. Determinants of Sensitivity and Adaptive Capacity Based on the Seven Capitals

FINANCIAL CAPITAL: Financial resources, including economic assets, monetary policies and labour policies, leading to economic opportunities.
HUMAN CAPITAL: Skills, knowledge, capacity and health, including education levels, literacy, and availability and access of technology.
SOCIAL CAPITAL: Quantity and quality of social resources from which people draw upon, including networks, membership in groups, social relations and access to wider institutions. The quality of networks is determined by the level of trust and shared norms that exist between members.
PHYSICAL CAPITAL: Infrastructure and other means that enable people to pursue their livelihoods, including transport, shelter, energy, communications, medical, sanitation and water systems.
NATURAL CAPITAL: Natural resources from which livelihoods are derived, including land, water, wildlife, biodiversity and environmental resources.
POLITICAL CAPITAL: Distribution of rights and power and ability to use them to further political or economic positions, in turn affecting livelihood options. Includes institutions and equity (governance and policy structures).
CULTURAL CAPITAL: Perceptions and practices that are key to the functioning of societies and acquired through history, heritage, values, knowledge, traditions, rituals and religious ideologies.

Sources: (Baumann & Sinha, 2001; Brooks et al., 2005; CARE, 2002; CIER, 2009; Eriksen & Kelly, 2007; King & MacGregor, 2000; Simpson, Gössling, Scott, Hall, & Gladin, 2008; Smit & Pilifosova, 2001; Smit & Wandel, 2006; Throsby, 1999; Vincent, 2007b).

2.3 Approaches to Climate Change Impact and Vulnerability Assessments

This section details two approaches that are commonly undertaken to understand climate change impacts – impact assessment and vulnerability assessment. This dissertation undertakes the former approach to assess the vulnerability of Barbados tourism sector to climate change (chapter 5) and the latter approach to assess the vulnerability of the tourism destination community of Oistins (chapters 6 and 7). As described below, the important difference between both approaches is their starting points (Smit & Pilifosova, 2003). The starting point for impact assessments is the specified climate and for vulnerability assessments is the system, with selected climate attributes being those to which the system is vulnerable (Smit & Pilifosova, 2003). Impact and vulnerability assessments present different, yet complementary framings of climate change, and are often both key to carrying out iterative studies, providing effective adaptation measures and addressing uncertainty (Burton et al., 2002; Jones et al., 2014; Mimura et al., 2014; Noble et al., 2014; O'Brien et al., 2007). This section also discusses the consideration of scale and participation in vulnerability assessments.

2.3.1 Impact Assessments or '*Outcome'* Vulnerability Studies

Impact assessments focus on the impacts of climate on a system, by starting with the stimulus or climate scenario, and can be considered '*first generation'* impact and adaptation studies (Burton et al., 2002; Füssel & Klein, 2006). The studies generally subscribe to a '*top-down'* approach to understand impacts as they are often undertaken at the national, regional and/or sectoral scales (Burton et al., 2002; Füssel & Klein, 2006; Kelly & Adger, 2000; Smit & Pilifosova, 2003). Furthermore, they estimate the future biophysical and economic impacts of climate change and identify potential adaptation measures to address any negative impacts (Füssel & Klein, 2006; Kelly & Adger, 2000; Smit & Pilifosova, 2003; Smit & Wandel, 2006). In addition, impact assessments can undertake a '*scientific framing'*, viewing climate change as a predicament of human influence on the global climate system (O'Brien et al., 2007).

The assessment of vulnerability in impact assessments is at the '*end point'*, where vulnerability is considered an '*outcome'* of a linear set of climatic stresses and seen as a particular pattern at a point in time (Kelly & Adger, 2000; O'Brien, Eriksen, Schjolden, & Nygaard, 2004; O'Brien et al., 2007). In particular, the amount of vulnerability is ascertained by examining the negative residual impacts that remain after the process of adaptation has taken place [Vulnerability = Impact – Adaptation] (Burton et al., 2002; Kelly & Adger, 2000; O'Brien et al., 2007). Outcome vulnerability can be reduced by decreasing exposure through climate change mitigation, or devising adaptations to minimize negative impacts (O'Brien et al., 2007). Earlier studies considered socioeconomic scenarios infrequently (UNFCCC, 2008). These types of studies continue to be useful for mitigation, compensation and technical adaptation policies (Füssel, 2007; Smit & Wandel, 2006).

2.3.2 Vulnerability Assessments or '*Contextual*' Vulnerability Studies

In the late 1990s, attention to social drivers and institutional conditions increased and a distinction occurred between impact-oriented research and vulnerability assessments of human systems to climate (Burton et al., 2002; Kelly & Adger, 2000; Smit & Pilifosova, 2003). As a result, climate change impact and adaptation studies also started to assess the vulnerability of human systems, thus called '*second generation*' studies [Vulnerability = f (Exposure, Sensitivity and Adaptive Capacity)] (Burton et al., 2002; Füssel & Klein, 2006; Smit & Wandel, 2006). Vulnerability assessments can be seen as the inverse of impact assessments as they undertake a '*starting point*' approach and view vulnerability as the present inability to cope with changing climatic conditions and thus as a pre-existing property of a system relative to climatic conditions (O'Brien et al., 2007; Smit & Pilifosova, 2003). Such studies attempt to understand how vulnerability changes over time ('*contextual vulnerability*') and identify pre-existing and current vulnerabilities of the system to climate. They then examine current adaptive strategies and their potential to address future vulnerabilities, including opportunities or constraints for adaptation, and connect existing decision processes to future adaptation responses (O'Brien et al., 2007; Smit & Pilifosova, 2003). The studies also consider social and biophysical systems, with a particular focus on reducing internal socio-economic vulnerability (Burton et al., 2002; Füssel & Klein, 2006). Contextual vulnerability can be reduced by changing the circumstance in which climate change occurs, so that communities can better address altered conditions (O'Brien et al., 2007). In addition, studies can undertake a '*human-security*' framing, viewing climate changes as one of the stressors affecting societies and focusing on the impacts of change for individuals and communities (O'Brien et al., 2007).

As further detailed in section 2.4, vulnerability assessments can comparatively evaluate the vulnerability of communities, regions or countries, based on criteria, indices and variables (Adger et al., 2004; Brooks et al., 2005; Kelly & Adger, 2000; O'Brien et al., 2004; Smit & Wandel, 2006). Such assessments are useful when the goal is to target adaptation strategies towards the most vulnerable groups, sectors and geographic areas and monitor their exposure to current and future climate-related hazards (Downing & Patwardhan, 2004; Smit & Wandel, 2006). Studies can also contribute to practical adaptation initiatives by identifying vulnerability determinants directly from the community, with the goal being to ascertain ways of implementing adaptation initiatives or enhancing adaptive capacity (Smit & Wandel, 2006). These latter type of studies can be considered '*bottom-up'* due to their use of participatory methods and efforts to reduce vulnerability by devising policy options with stakeholders, including those at risk (Burton et al., 2002; Füssel & Klein, 2006; Smit & Pilifosova, 2003; Smit & Wandel, 2006).

Many vulnerability assessments also examine the vulnerability of local and regional institutions (Agrawal, 2008; Keskitalo, 2004; Keskitalo & Kulyasova, 2009; Lebel, Nikitina, Kotov, & Manuta, 2006). A multilevel focus in community adaptation work is important, as decision-making power often rests with government or other organizations (Keskitalo, 2007). Institutions, especially those that govern, can foster adaptive capacity by providing the contexts and processes through which adaptations take place, including how different social groups access and use resources (Agrawal, 2008; Brooks & Adger, 2004). Furthermore, to address climate change, governance systems must have sufficient institutional adaptive capacity to modify institutions and governance processes as required and to decrease vulnerability in an equitable and accountable manner (Adger, Arnell, & Tompkins, 2005; Gupta et al., 2010; Pittman, Armitage, Alexander, Campbell, & Alleyne, 2015).

2.3.3 The Importance of Scale and Participation

2.3.3.1 Scale

Vulnerability and adaptation studies can take place between differing spatial scales, with the particular scale depending on the objectives of the collaborating stakeholders (Mimura et al., 2014; Noble et al., 2014; Schröter et al., 2005; Smit & Wandel, 2006). The local level, which includes households and communities, are where the most severely impacted systems live (Birkmann, 2006a; Hinkel, 2011; Queste & Lauwe, 2006). Households are highly organized units where members look after each other's interests and the livelihood assets of one member usually benefits others (Vincent, 2007b). Furthermore, local government and the private sector can play important roles in scaling up adaptation initiatives of communities and households and in managing financing and risk information (Klein et al., 2014; Mimura et al., 2014; Noble et al., 2014). Moreover, the regional level is often the smallest scale where impacts can be physically modeled (Huq & Reid, 2004). Analyzing vulnerability at the national level enables the consideration of impacts in and across sectors and the formulation and coordination of adaptation efforts at the local and regional scale (Brooks et al., 2005; Lal et al., 2012; Mimura et al., 2014; Noble et al., 2014). Adaptation action is also required at the global level, where nations can act together under the UNFCCC and other international efforts (Huq & Reid, 2004).

The processes and contexts influencing vulnerability are best understood at the local and regional scale (Füssel & Klein, 2006; Smit & Wandel, 2006). Studies at such scales reveal variation that could be lost in national studies and are congruent with the scale at which adaptation planning takes place, though processes operating at broader spatial scales contribute significantly to patterns at this level (Füssel & Klein, 2006; Kelly & Adger, 2000; Smit & Wandel, 2006; Turner et al., 2003). Integration across international to local scales needs to be improved, as stronger adaptation efforts at the international level have not always lead to results at the local level (Burton et al., 2012; UNFCCC, 2013c).

2.3.3.2 Participation

Stakeholder knowledge, personal observations and creative thinking are invaluable for dealing with the complex problems of climate change (Few, Brown, & Tompkins, 2007; Kelman, 2010; Kloprogge & Sluis, 2006). Local stakeholders, in particular, have the current and past experience of coping with and adapting to climate variability and extremes, and can provide a valuable baseline from which to examine and address any changes (Conde & Lonsdale, 2004; Kelman & West, 2009). Furthermore, such stakeholders document their experiences with climate in different ways and can provide an entry point to their communities on their terms (Conde & Lonsdale, 2004; Cutter et al., 2012). As a result, adaptation efforts can be strengthened by integrating local, traditional, scientific and technical knowledge (Burton et al., 2012; Kelman, 2010).

Participatory approaches are most pronounced in vulnerability assessments (Carter et al., 2007; Füssel & Klein, 2006; Smit & Wandel, 2006). A vulnerability assessment is the most useful when it is participatory, provides pertinent policy information to decision makers and is verifiable (Eakin & Luers, 2006; Patt et al., 2009). Stakeholder involvement can *"promote equity in decision-making, a thorough and transparent exchange of information and viewpoints, agreement on key objectives and a general consensus on recommended measures and policies",* p. 35 (Ebi, Lim, & Aguilar, 2004). Participatory assessments can also foster learning about the perceptions of those affected by climate change, explore benefits and costs and examine the pros and cons of different adaptation strategies (Toth & Hizsnyik, 2008).

Challenges to meaningfully involving stakeholders include commitments of time, energy and resources (Conde & Lonsdale, 2004). As a result, stakeholder involvement **"**… *must be carefully designed and implemented, as stakeholder participation does not in itself guarantee equity, fairness or eventual buy-in",* p. 51 (Conde & Lonsdale, 2004). This can involve more focused participatory approaches, which can include identifying the most vulnerable and/ or the most influential stakeholders and selecting input based on the study's particular objectives and available resources (Few et al., 2007; Kloprogge & Sluis, 2006). In addition, when fostering participation in vulnerability assessments, it is important to recognize that local knowledge might sometimes be inaccurate due to limitations in historical or current observations of the environment and the lack of cohesiveness within communities (Cannon, 2008; Ford & Pearce, 2012; Tibby, Lane, & Gell, 2007). Furthermore, communities may have some universal interests, but they can also compete with each other and not always collaborate (Cannon, 2008). For these reasons, at times, it can take the wider efforts of outsiders to foster local collaboration, as communities do not always enable the best conditions to reduce vulnerability (Cannon, 2008).

2.4 Methods to Assess Vulnerability

2.4.1 Overview

Vulnerability assessments can include local, national and global quantitative methods and locally based qualitative participatory methods (Cardona et al., 2012). Quantitative and qualitative approaches can complement each other to analyze vulnerability and depict climate change adaptation progress and performance (Arakida, 2006; Birkmann, 2007; Bours et al., 2014; Cardona et al., 2012). Furthermore, Rosenzweig and Wilbanks (2010) state that there are joint needs for "*Rapid assessments of vulnerability, impacts, and interactive mitigation and adaptation options to meet urgent requirements as decision-makers begin to mainstream climate change into …programs and policies*; *and for in-depth research… focused on key unknowns and uncertainties in vulnerability, impacts, mitigation, and adaptation topics*", p. 104. As detailed below, an indicator approach can facilitate rapid assessments and a place-based approach in-depth research. The particular approach, or combination of, depends on the particular system's need and context (Eakin & Luers, 2006; Füssel & Klein, 2006; Füssel, 2007; Rosenzweig & Wilbanks, 2010).

In addition, as the number of climate change vulnerability assessments increase, methods and frameworks for cross-study comparisons (cross-scale and up-scale) become necessary (Polsky, Neff, & Yarnal, 2007; Rudel, 2008). Comparative evaluation of vulnerability and adaptive capacity across and within communities can identify those that are the most vulnerable, thereby providing insights to target adaptation initiatives (Smit & Wandel, 2006; Smit, Hovelsrud, & Wandel, 2008). Such comparisons can also analyze findings from several local studies and allow key actors or decision makers within a community or a region, who lack the time or resources to conduct their own comprehensive assessments, to make informed decisions about adaptation (Eakin & Luers, 2006; Polsky et al., 2007; van Aalst et al., 2008).

This dissertation employs an indicator and a place-based approach to assess the vulnerability of a tourism destination community to climatic and non-climatic stressors. The following section provides an overview of each method, including their strengths and limitations. Section 2.5.5 discusses the applicability of the two methods for the tourism sector, based on research gaps pertaining to the assessment of tourism destination vulnerability. Section 2.6 outlines how each method will be investigated regarding their potential advancement of knowledge gaps in the understanding of vulnerability at the destination community level, including facilitation of comparative assessments.

2.4.2 Indicator Based Approaches

2.4.2.1 Overview

Indicators can facilitate rapid vulnerability assessments by collecting readily available information on key determinants, which could be of use to communities who do not have the time or resources to undertake comprehensive assessments. In the context of adaptation planning, "*An indicator is a quantitative or qualitative parameter that provides a simple and reliable basis for assessing change…a set of indicators is used to characterize an adaptation phenomenon, to construct a baseline* (current vulnerability) *and to measure and assess changes in the priority system* (monitor future vulnerability)*"*, p. 36 (Ebi et al., 2004). An indicator can be a single variable. It can also be an output value from a set of variables that is transformed[9], weighted and combined

[9] Facilitates comparison amongst indicators of different units and orients their values in the same direction.

(aggregated/averaged) into a final composite index**.** Such an index can enable the comparison or rating of phenomena between local, regional and/or national levels and summarize large amounts of information in a format that is simple and understandable (Birkmann, 2006a; Perch-Nielsen, 2010; UNWTO, 2004a; Vincent, 2007b).

Indicators can assess a system's vulnerability using numerical analyses, empirical quantitative data and/or normative and descriptive qualitative criteria (Birkmann, 2006b; Eakin & Bojórquez-Tapia, 2008; Polsky et al., 2007; Wisner, 2006), as presented in the tourism context in Table 29 in Appendix A. Sometimes proxy measures are used, when a measurement does not provide precise data but approximates the information (UNWTO, 2004a). Indicators can also be used in future scenario development and to determine thresholds, that is when significant impacts exceed the short-term coping range, resulting in the system undergoing a long-term state of adaptation (Smit et al., 1999). Moreover, indicators can be used as benchmarks to evaluate (monitor) whether the particular goal of adaptation planning at a particular scale has been met (Birkmann, 2006b).

Quantitative indicators have often been used to measure specific instantaneous vulnerability (hazard dependent) and physical exposure to particular impacts (i.e. number of homes destroyed by a hazard) (Adger et al., 2004; Brooks et al., 2005; Eriksen & Kelly, 2007; UNWTO, 2004a). They have had a retrospective focus in regards to experienced losses and have often been static as they signify a constant state, such as mortality (Bours et al., 2014; Brooks et al., 2005; Eriksen & Kelly, 2007; Parkins & MacKendrick, 2007). Such indicators can also be categorized as '*outcome'* indicators, as they determine whether a particular objective has been achieved (Bours et al., 2014). As vulnerability and adaptation processes are not always outcomes, other measures are needed to assess adaptation progress, including proxies that measure and capture the dynamic determinants and root causes of vulnerability (Bours et al., 2014; Brooks et al., 2005; Eakin & Luers, 2006; Parkins & MacKendrick, 2007).

For the above reasons, and the fact that vulnerability cannot be measured directly and objectively, generic (hazard independent) quantitative and qualitative indicators, which provide insights on factors, processes and contexts are increasingly being used (i.e. % of trained government workers or existence of flood management plans) (Bours et al., 2014; Eriksen & Kelly, 2007). Process-based, contextual or '*theory-driven'* indicators are deductive and use theories to select variables and to determine the dynamic nature and root causes of vulnerability (Bours et al., 2014; Hinkel, 2011; Vincent, 2007b). They measure progress towards the attainment of an outcome (i.e. resilience to drought), but do not assure or measure the final outcome itself (Bours et al., 2014). In addition, they are often forward looking (predictive) and signify patterns of change, by assessing vulnerability through general development patterns, such as dependency ratios or educational enrolment rates (Adger et al., 2004; Bours et al., 2014; Eriksen & Kelly, 2007; Vincent, 2007b). Bours et al. (2014) note that the distinction between an outcome and a process indicator is not always evident and depends on the particular objective, for example "… *'number of people trained' might be an outcome indicator if the programme objective itself is to conduct trainings. However, if the programme objective is wider in scope (e.g. capacity building), then 'number of people trained' could be a process indicator*", p. 5.

If developed and applied appropriately, indicators can be a useful comparative tool for decision-makers, including funding agencies, to ascertain where climate change adaptation is most needed and how best to distribute adaptation investments (Bours et al., 2014; WEF, 2014). Hinkel (2011) argues that vulnerability indicators are only appropriate for identifying vulnerable people, communities and regions and sectors at local scales and not for identifying mitigation targets, raising awareness, allocating adaptation funds, monitoring general adaptation policy or conducting scientific research. The author has several bases for this claim, including that vulnerability indicators are only appropriate for identifying local systems, where they *"… can be narrowly defined and hence deductive* (theory-driven) *arguments are available for selecting indicating variables and inductive* (data-driven) *ones for aggregating them"*, p. 206. Furthermore, indicators should not be used to allocate funds at the global level, where inductive arguments are not available and any deductive arguments are centered on frameworks, which can select indicating variables, but not aggregate them. Furthermore, at the national level, countries should address climate change by establishing national priorities and creating specific programmes and projects (Hinkel, 2011). In addition, adaptation policy could be monitored if it has clear goals and uses process indicators to monitor the institutional stages of adaptation, but not indicate vulnerability itself (e.g. whether a heat-wave emergency management plan has been put in place or not). This research will examine these arguments.

Indicators need to be used critically with realistic expectations of their abilities and to avoid maladaptation, thereby increasing vulnerability (Bours et al., 2014). Challenges in the development and application of indicators include the availability and quality of data, especially for communities that lack capacity, and over-simplification of information via the aggregation of indicators (Adger et al., 2004; Bours et al., 2014; CIER, 2009; Füssel, 2009). Choosing appropriate normative indicators for the determinants of vulnerability, assessing whether or not a change in an indicator improves their status and the fact that criteria, indices and variables are often chosen by the researcher present other challenges (Brooks et al., 2005; CIER, 2009; Vincent, 2007b). Determining assumptions to weigh indicator variables, the mathematics of their aggregation and the direction in which to interpret indices are other factors to consider (CIER, 2009; Eakin & Bojórquez-Tapia, 2008; Eriksen & Kelly, 2007; WEF, 2014). Furthermore, process-based hazard generic indicators can be harder to collect data for, particularly qualitative data, as their determinants can be less tangible and more difficult to measure than for hazard specific indicators. The dynamic nature of vulnerability also means that any indicators and their scores would need to be periodically updated and refined (Eakin & Luers, 2006; Eriksen & Kelly, 2007; Vincent, 2004). In addition, it is important to note, that indicators for adaptive capacity highlight only the potential for adaptation to occur, *"…whether or not adaptive capacity is drawn upon to bring about adaptation depends on a further set of uncertainties in the decision-making process"*, p. 23 (Vincent, 2007b).

Minimizing limitations associated with the development and subjective nature of indicators, can be facilitated by using transparent methods to devise a clear conceptual framework, identify the assumptions and sources of data, and select indicators, sub-indices and aggregation functions (Eriksen & Kelly, 2007; Perch-Nielsen, 2010; Vincent & Cull, 2014). This involves developing indicators that are specific to the scale of the system, appropriately capture the process-based (contextual)-identified driving forces and devising indicators that are sensitive enough to demonstrate differentiation (Vincent, 2007b). Any indices should be updated regularly, in particular when estimating longer-term processes of adaptation from coping experiences with short-term climate variability (Eriksen & Kelly, 2007; Vincent & Cull, 2014). To enhance the development and application of vulnerability indices, there is also the need to improve the compilation of local level data and to seek local guidance when comparable data is difficult to collect at the local level, which this research aims to do (Bours et al., 2014; WEF, 2014).

Moreover, even though indicators attempt to capture the dynamic nature of vulnerability, they can only portray it at a particular point in time (Vincent & Cull, 2014). To address this challenge, current vulnerability is viewed as a proxy for future vulnerability, as detailed in section 2.2.3.3. Indices can also use socio-economic scenarios to address future climate change predictions (Moss, Brenkert, & Malone, 2001). To foster the most robust assessments, indicators can be used in combination with case studies, which this research aims to do (Malone & Engle, 2011).

2.4.2.2 Scales of Analysis and Weighting

Further to the discussion of scale in section 2.3.3.1, the scale to develop and apply vulnerability indicators depends on the needs of the particular system and their user groups (Queste & Lauwe, 2006). Local indicators can be categorized as those pertaining to households, a community or district, or economic sector. Regional and national level indicators can also be developed. Generic, process-based (contextual) vulnerability indicators should be predominantly developed at the local level, where the impacts of climate-related hazards occur most severely and where systems can be narrowly defined (Birkmann, 2006a; Hinkel, 2011; Queste & Lauwe, 2006). Furthermore, when scaling local level indicators up to the regional and/or national levels, context-based generic indicators are more likely to capture the local level determinants of vulnerability (Adger et al., 2004; Brooks et al., 2005).

A household-level index can examine how specific household characteristics (i.e. assets, perception or livelihood activities) are associated with vulnerability (Eakin & Bojórquez-Tapia, 2008). Scholars have presented aggregated indices at the household level, which are contextualized by qualitative data, such as the '*Household Adaptive Capacity Index (HACI)'* (Vincent, 2007b). Other scholars do not recommend aggregating indices at the household level, as it can be too dynamic and can change from season to season, and recommend that determinants remain descriptive and/or disaggregated (Eakin & Bojórquez-Tapia, 2008; Parkins & MacKendrick, 2007). These latter studies used household data to inform indicator development at the community (Parkins & MacKendrick, 2007) or district level (Hahn et al., 2009). Here community or regional data, which is considered less dynamic than household level data, is aggregated to represent the average vulnerability in the area over a longer time period.

Local level indicators can be combined (averaged/aggregated) into a composite index to enable a more detailed comparison of phenomenon at regional and/or national levels. This is demonstrated by Hahn et al. (2009) who used household data to construct the '*Livelihood Vulnerability Index*' and then aggregated the indicators at the district (regional) level in Mozambique. Higher-level aggregated indicators "*related to other sites or regions…can contribute to comparative analysis or benchmarking …*" p. 11 (UNWTO, 2004a). Moreover, regional level indicators can facilitate adaptation planning and distribution of resources, enable comparison between regions and provide information for national level planning processes (Queste & Lauwe, 2006; UNWTO, 2004a). National level indicators, though limited in their portrayal of higher level variation, can identify regions and countries with high levels of vulnerability, lead to more detailed studies at the sub-national level (downscaling) and identify contexts in which to prioritize adaptation (Birkmann, 2006a; Füssel, 2009; Leichenko & O'Brien, 2002). Examples of national and global level climate change indices include the '*Climate and Regional Economics of Development's Vulnerability Index (VI-CRED)*', the '*Climate Change Vulnerability Index (CCVI)*' and the '*Climate Vulnerability Monitor (CVM)*'.

National level generic indices of vulnerability to climate change have been found to be unsuitable for guiding international climate policy (Füssel, 2010; Tonmoy, El-Zein, & Hinkel, 2014). Füssel's (2009) study of three national-level indices of vulnerability to climate change ('*Global Distribution of Vulnerability*', '*Environmental Vulnerability Index-Climate Change*' and '*Index of Socioclimatic Exposure*') found that none could be used to develop climate policy due to conceptual, methodological, and/or empirical flaws. Such indicators cannot consider the vast differences in vulnerability within countries and often neglect any special conditions that make countries or population groups particularly vulnerable (Füssel, 2010). Furthermore, averaging /aggregating individual indicators into a final composite index can oversimplify or misrepresent the process-based contextual features of vulnerability at the local level (Adger et al., 2004; Füssel, 2009; Perch-Nielsen, 2010). Moreover, averaging is often subject to the preference of researchers and can mean that certain climate change impacts compensate for another (e.g. more suitable climate compensating for sea level rise) (Perch-Nielsen, 2010). For these reasons, disaggregated indices for different elements of vulnerability can be more useful than a single index as they provide more information on processes and contexts (Adger et al., 2004).

In addition, some scholars recommend sector, hazard or geographic criteria to guide climate change vulnerability indices, which this research undertakes (Cardona et al., 2012; Füssel, 2010; Hinkel, 2011). *"Priorities should be determined separately for key climate sensitive systems and sectors to account for large differences in the geographical distribution and predictability of climate impacts and in the… scales of adaptation measures*…" p. 20 (Füssel, 2009). Moreover, "…*Some vulnerability indicators are applicable across climate sensitive sectors whereas others are only relevant for a particular sector or system",* p. 22 (Füssel, 2009).

Vincent (2007b) notes that the "*central elements of adaptive capacity… are common at different scales, although the structure of each index is scale-specific*", p. 12. As a result, transferring indices to different scales requires modifications to the composite sub-indices, indicators and their weightings and adjusting them to the specific context they are applied to and to the function they are intended to serve (Birkmann, 2007; Vincent, 2007b). Future research needs to investigate vulnerability between different scales and the issue of up and down-scaling of different indicators to measure it, including how institutions operating at regional scales influence vulnerability at the individual and household levels, which this research aims to do (Birkmann, 2006a; Lebel et al., 2006).

Traditionally, as with the case of global indices such as the '*Disaster Risk Index'* or '*Hotspots'*, equal (uniform) weightings for constituent[10] (or sub) indices and/or final composite indices have been applied to aggregate indicators (Birkmann, 2006a). Equal weighting can be applied to constituent indicators at the local level as demonstrated by Hahn et al. (2009) and Parkins et al. (2007) and in the *Household Adaptive Capacity Index* of Vincent (2007b), which enables the assessment to be accessible to a diverse set of users. Indicators can also be weighed differentially as demonstrated by Perch-Nielsen (2010) and Vincent (2007b) in her '*National Adaptive Capacity Index'*. Such an approach can incorporate variance amongst the constituent indices, though it presents the additional challenge of determining which indicators and constituent indicators are the most important and the magnitude of any difference in importance (Alessa et al., 2008). Both options can be justified depending on the context of the study, the needs of the community and based on expert opinion and stakeholder judgement (Vincent, 2004; Vincent, 2007b).

[10] When final constituent parts of indicators are recognizable (Vincent, 2007b).

2.4.3 Place-Based Approaches

2.4.3.1 Overview

As approaches to quantitatively representing the dynamic nature of vulnerability and the characterization of uncertainty are not fully developed, climate change impact assessments can be strengthened by including storylines of changing vulnerability under diverse development pathways (Cardona et al., 2012). As a result, some scholars argue that the determinants of vulnerability are not so easily captured by indicators and should remain disaggregated and descriptive, especially at the household or community level (Eakin & Luers, 2006; Hahn et al., 2009; Parkins & MacKendrick, 2007). Data to develop indicators at the local level can also be limited (Bours et al., 2014; Gbetibouo, Ringler, & Hassan, 2010; WEF, 2014). In addition, averaging or aggregating of indicators can produce a final measure of vulnerability, though it can mask variances amongst its various determinants (Adger et al., 2004; Füssel, 2009). For these reasons a contextual analysis and a disaggregated and descriptive accounting of vulnerability, within a given system, also continues to be important (Bours et al., 2014; Parkins & MacKendrick, 2007).

Contextual, disaggregated and descriptive information pertaining to vulnerability can be collected by vulnerability assessments, as noted in section 2.3.2, in particular those which contribute to practical adaptation initiatives by identifying the determinants directly from a community (Cutter et al., 2012; Smit & Wandel, 2006). As also noted earlier, such studies can be considered '*bottom-up'*, due to their place-based and participatory approach to collect qualitative knowledge on geographical and social environments (Birkmann, 2006a; Füssel & Klein, 2006; Smit & Pilifosova, 2003; Smit & Wandel, 2006). Further to the notion of place discussed in 2.2.3.3, place-based studies involve in-depth case-studies that focus on a specific exposure unit, i.e. household, community or economic sector, with the majority focusing on communities (Ford et al., 2010). Moreover, case-studies are founded on the comprehensive investigation of a single system, though the consistency and rigor of individual studies have been critiqued for their partial applicability for wider generalization (Flyvbjerg, 2006). Nevertheless, case-studies can be key for linking vulnerability assessments to the scale of decision-making organizations, engaging information users, comprehending differential adaptive capacity and considering local climatic and biophysical conditions (Pearce et al., 2009; Schröter et al., 2005; Smit & Wandel, 2006).

This dissertation focuses on community place-based assessments to examine vulnerability to climate change. As vulnerability research is rooted in natural hazards research traditions, other community place-based approaches include participatory risk assessments (PRAs), which combine with hazard identification (Cutter, 1996; Cutter, 2003). PRAs encourage stakeholders to identify the hazards they face, to understand how climate change compares to other livelihood hazards and to highlight barriers to enhancing adaptive capacity (Tschakert, 2007; van Aalst et al., 2008; Patt & Schröter, 2008). Furthermore, participatory risk assessments gather information about livelihoods, their resilience, local risks and hazards (van Aalst et al., 2008). Tools include risk mapping, transect walks, asset inventories and livelihood surveys, historical and seasonal calendars, many of which can also be used in place-based climate change vulnerability studies (van Aalst et al., 2008).

Place-based assessments can face challenges in how they are conducted. Often studies are isolated, localized and face limits in their comparisons (generalizations) across and beyond communities, thereby limiting potential to develop adaptation interventions at non-local levels (Ribot, 2011; Rudel, 2008; Smit & Wandel, 2006). Meta-analysis, by integrating and synthesizing results of several locally place-based studies, can distinguish opportunities for adaptation policy at regional to national levels (Acosta-Michlik, Kelkar, & Sharma, 2008; Ford & Pearce, 2010; Polsky et al., 2007; Rudel, 2008). Such analyses can be facilitated through the application of a common framework to structure several studies, such as the '*Climate Change Adaptation and Mitigation in the Tourism Sector: Frameworks, Tools and Practices'* developed by Scott et al. (2008). The application of such frameworks could allow findings to be comparable, generalizations to be made and the detection of community traits that magnify or minimize vulnerabilities and the types of adaptive strategies that are successful (Smit & Wandel, 2006; Smit et al., 2008; van Aalst et al., 2008). To date such frameworks have facilitated comparisons within communities, but evidence regarding comparisons across and beyond communities has been limited (Ford & Pearce, 2012; Ford et al., 2012).

Another challenge in how place based-studies have been conducted is that they often focus on assessing vulnerability at the local level (i.e. community) and do not consider the larger determinants (i.e., regional, national, global) that can also affect the degree to which local adaptations are viable (Adger et al., 2009; Ford et al., 2010; Keskitalo, 2009; O'Brien & Leichenko, 2000). To address this, nested case studies can be used to distinguish the determinants of vulnerability at several scales and detail connections between causes and outcomes of vulnerability across governance and geographic contexts, which this dissertation undertakes (Adger, Eakin, & Winkel, 2009; Ford et al., 2010; Keskitalo, 2010; Schröter et al., 2005). Lastly, the implementation of place-based assessments entails prolonged, long-term research efforts, and considerable time and funding requirements (Ford et al., 2010).

2.4.3.2 Community-Based Vulnerability Assessments

Smit and Wandel (2006) discuss the strengths of community place-based approaches to assessing climate change vulnerability and identifying adaptation options, based on empirical assessments carried out in the Arctic, by Ford and Smit (2004), theoretically by Lim et al. (2005) and in the South Pacific by Sutherland et al. (2005). The assessments obtained information on the determinants of vulnerability to identify ways in which adaptive capacity can be increased and exposure-sensitivities decreased (Smit & Wandel, 2006). The studies were participatory as they empirically identified the most feasible and practical adaptation strategies directly from the community. The approach recognized the community as the primary system of interest, but also identified the broader conditions within which it functioned, including multiple stressors (Smit & Wandel, 2006).

Ford and Pearce (2012) and Ford et al. (2012) examined community-based climate change vulnerability assessments carried out in arctic regions and noted that while they provided a baseline understanding of vulnerability, they also faced certain limitations. Even though the studies attempted to capture the future determinants of vulnerability, they often represented the determinants at a particular point in time (Ford & Pearce, 2012; Ford et al., 2012). This occurred as participants only detailed what they had recently encountered and detected (subjective nature), the time in which the research occurred affected what was described, and particulars about the type of risks and coping strategies experienced faded with time. This lead to further challenges in comprehending the multiple drivers influencing vulnerability, distinguishing the place-specific nature of risks, positioning the current experience in the larger historical milieu and explaining the development of vulnerability over time (Ford & Pearce, 2012).

To more comprehensively capture the dynamic nature of vulnerability and to facilitate comparative assessments across and beyond communities, additional components to place-based studies are required, such as longitudinal studies, community-based monitoring, and focused adaptation research, which are explored in this study (Ford & Pearce, 2012; Ford et al., 2012; van Aalst et al., 2008). Longitudinal studies entail the frequent study of an experience over long periods of time, allowing the dynamics of vulnerability to be monitored. Even though such studies can be lengthy and costly, they can develop trust and facilitate the dedication of parties involved in the research. Community-based monitoring is when local people gather data on an issue regularly and collaborate with community members and decision makers. Targeted adaptation research, which can include elements of community-based monitoring and longitudinal studies, is when studies investigate and monitor a particular determinant of adaptive capacity to further comprehend how it is comprised and how it can be transformed into adaptation (Ford & Pearce, 2012). In addition, while several place-based studies note adaptations and coping strategies being employed, there is also a need to examine their usefulness, durability, socio-economic and ecological consequences, and long-term feasibility and cost. For this, community-based adaptation planning is being recognized as a key tool (Ford et al., 2012; Nurse et al., 2014; Pearce, Ford, Caron, & Kudlak, 2012).

2.5 Tourism and Climate Change

Sectors considered vulnerable to climate change are those with the greatest links to climate and include water, agriculture and food security, forestry, human health, and tourism (Handmer et al., 2012). This dissertation focuses on the tourism sector, which in addition to contributing to climate change, is highly exposed to its impacts (Scott et al., 2008; Scott et al., 2012). It is imperative to address climate change in fostering sustainable tourism development, as the economic sector is one of the least prepared for its associated risks (KPMG, 2008; Scott, 2011). The following section provides an overview of the tourism industry and the relationship between tourism and climate change. As this dissertation focuses on adaptation of the tourism sector to climate change, it also details the major climate change impact pathways on the sector. It then highlights key research gaps in the tourism and climate change literature, with a particular focus on adaptation in tourism-destination communities. It concludes by presenting empirical and methodological research gaps pertaining to the assessment of climate change vulnerability in destination-communities.

2.5.1 Tourism Overview

Tourism can be defined as "*a social, cultural and economic phenomenon which entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes*" (UNWTO, 2013a). Tourism is one the largest and fastest growing economic sectors in the world and in 2013 international tourist arrivals surpassed one billion (1087 million), contributing an estimated 9% of global total[11] gross domestic product (UNWTO, 2014). In 2013, international tourism's export value was US$1.4 trillion, accounting for 6% of total exports (UNWTO, 2014). The United Nations World Tourism Organization (UNWTO) predicts that international travel will double by 2030, with the number of international tourist arrivals increasing by an average 3.3% per year between 2010 and 2030 to reach an estimated 1.8 billion arrivals by 2030 (UNWTO, 2011). Furthermore, between 2010 and 2030, arrivals in emerging economy destinations[12] are projected to increase at double the rate (+4.4% a year) of that in advanced economy destinations (+2.2% a year) (UNWTO, 2011; UNWTO, 2013b).

The tourism sector consists of several stakeholders and include those involved directly in tourism or whose livelihoods are affected by the sector, those in other sectors that might be impacted by the sector's adaptations or whose adaptations might impact tourism and those who have other relevant expertise (Simpson, Gössling, Scott, Hall et al., 2008). Stakeholders involved directly in the tourism sector comprise of tourists, operators, service suppliers and destination communities[13] (Becken & Hay, 2007; Gössling & Hall, 2006b; Scott, 2006). More specifically, tourism destination communities can encompass "…*tourism businesses, public sector organizations, community groups and NGOs*…" p. 476 (Moreno & Becken, 2009).

As tourism is an economic sector, it is sensitive to any changes in the global economy, as most recently evidenced by the global economic crisis of 2008, which led to world GDP falling by 2.1% and significantly impacted the world's industry (UNWTO, 2011). Developed economies, a major source of demand for travel and tourism, were the most affected, with Americans having the highest level of tourist expenditure (UNWTO, 2011). In 2009, international tourist arrivals experienced its sharpest contraction, falling by 5.1% from 922 million visitors in 2008 to 877 million visitors in 2009

[11] Direct, indirect and induced.
[12] Asia, Latin America, Central and Eastern Europe, Africa and the Middle East (UNWTO, 2011; UNWTO, 2013b).
[13] *"… marketable destination… from a small nation to a region, or to a specific resort or site"* p21 (UNWTO, 2004a).

(UNWTO, 2009). By 2010, the global economy moved into a recovery phase, which resulted in over 935 million international arrivals that year, an increase of 6.6% as compared to 2009 (GOB, 2012). In 2014, tourist arrivals reached 1.138 million, an increase in 4.7% from 2013, marking the fifth consecutive year of growth in arrivals above the long term average since 2009 (UNWTO, 2015).

Tourism remains the primary source of foreign exchange for one-third of developing countries and one-half of least developed countries (UNWTO & UNEP, 2011). For many of these destinations, the sector is growing rapidly and plays an important role in attaining their UN Millennium Development Goals[14]. As a result, in many of these countries, the UNWTO and other development organizations promote pro-poor tourism to reduce poverty by emphasizing small-scale '*alternative'* cultural and ecotourism, though the majority of leisure tourism remains mass tourism (Gössling et al., 2009; UNWTO, 2004b). For these reasons, it is imperative to understand the tourism development–climate change nexus for developing countries that are highly vulnerable to climate change and highly economically dependent on tourism (Gössling et al., 2009). "*There is crucial interdependence between tourism, economies, community livelihoods and the environment and climate change is likely to undermine development objectives in many developing countries"*, p. 67 (Scott et al., 2008).

2.5.2 The Relationship between Climate Change and Tourism

Climate and tourism are linked in two key ways. Tourism is a contributor to global environmental change, including climate change, and is also a climate sensitive human activity and economic sector and therefore very exposed to climate change impacts. In 2005, the sector was estimated to contribute 5% to global CO_2 emissions and approximately 8% of all anthropogenic radiative forcing (Scott et al., 2008; Scott, Peeters, & Gössling, 2010). Transport generated approximately 75% of total CO_2 emissions, with an estimated 40% of this total caused by air transport (Scott et al., 2008). Accommodations and other tourism-related activities respectively accounted for 21% and 4% of CO_2 emissions. Long-haul travel, which many developing countries and rural and isolated regions depend on for tourism, represented 2.2% of all trips, and yet contributed 16% to global tourism-related CO_2 emissions (Scott et al., 2008).

[14] 1) Eradicate extreme poverty and hunger, 2) Achieve universal primary education, 3) Promote gender equality and empower women, 4) Reduce child mortality, 5) Improve maternal health, 6) Combat HIV/AIDS, malaria and other diseases, 7) Ensure environmental sustainability and 8) Develop a Global Partnership for Development (UNDP, 2013b).

Under '*business as usual'* conditions, the global tourism sector and associated greenhouse emissions are anticipated to grow by about 135% from the years 2005 to 2035 (Scott et al., 2008). The sector has declared 'aspirational' targets to reduce GHG emissions[15] (WTTC, 2009), though does not have a clear plan to achieve the targets (Gössling & Peeters, 2015; Scott et al., 2010). Growing emissions from the sector presents a major challenge for its sustainability, as tourism dependent communities might have to reassess their reliance on energy intensive or long-haul visitor based tourism (which include many SIDS), and restructure their industry towards low-carbon tourism or reconsider the industry as their primary sector for development (Gössling, Peeters, & Scott, 2008; C. M. Hall, Scott, & Gössling, 2013; Scott, 2011; Scott & Gössling, 2015). For these reasons, policies are needed to promote more sustainable forms of tourism and livelihood development, such as domestic tourism, along with a focus on income distribution and welfare issues at destinations (C. M. Hall et al., 2013; Scott et al., 2008; Zapata, Hall, Lindo, & Vanderschaeghen, 2011).

In addition to contributing to greenhouse gas emissions, the tourism sector is highly exposed to climate change impacts as some of its key natural environments, such as coastal zones, mountains and biodiversity, will be highly affected (Gössling & Hall, 2006b; C. M. Hall, 2008; Scott et al., 2008). Key factors that affect destination choice for tourists include climate, the natural environment, personal safety and travel cost, of which climate change could significantly impact all (Scott et al., 2008). Impacts will vary with geographic location and tourism subsectors and will result in negative and positive changes, though the literature presents mostly the latter (Gössling & Hall, 2006a; Scott et al., 2008). Furthermore, tourists from temperate countries, that presently dominate international travel, are projected to alter their travel patterns and take advantage of new weather opportunities closer to home (Scott et al., 2008; Scott et al., 2012). Interest for international travel to subtropical and tropical countries is anticipated to drop, with fewer arrivals from temperate countries (Scott et al., 2012). An alteration in travel patterns could significantly affect developing countries that depend on tourism and should thus be considered in national development plans, official development assistance programs and international adaptation financing discussions (Gössling et al., 2009; Scott et al., 2008; Scott et al., 2012).

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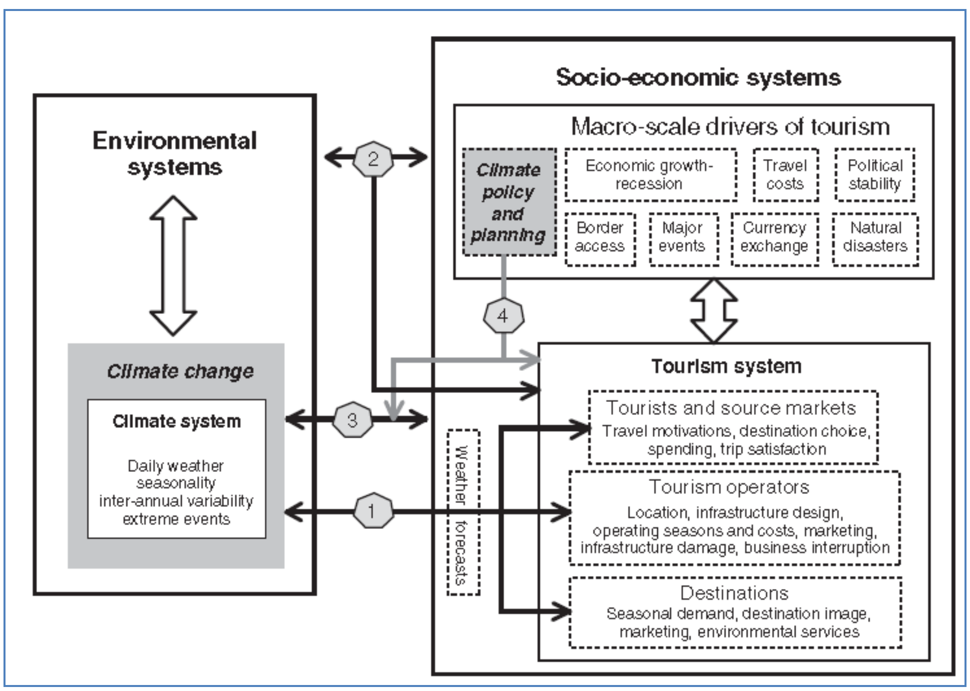
[15] In 2009, the World Travel and Tourism Council announced '*aspirational'* emission reduction targets to cut carbon emissions from the tourism sector, 50% by 2035 from 2005 levels (WTTC, 2009).

2.5.3 Impacts of Climate Change on the Tourism Sector

2.5.3.1 Key Pathways

There are four pathways in which climate change will affect the future of international tourism as depicted in Figure 1: 1) direct impacts of climate on the sector, 2) indirect climate-induced environmental changes, 3) indirect climate-induced socioeconomic changes and 4) impacts caused by mitigation and adaptation responses in other sectors (Scott et al., 2012). Livelihood issues are connected to all pathways. The Figure also demonstrates that climate change is one of the many drivers of tourism's future development and that further analysis is needed of the sector's connections with other macro-scale social, economic, technological and political factors. Such factors include globalization, increasing fuel prices, aging populations in industrialized countries, increasing travel safety, increased environmental awareness and environmental limitations (Scott et al., 2008; Scott et al., 2012). Moreover, the tourism sector links to many other sectors that are to be adversely impacted by climate change including agriculture, water supply, coastal management, human health, nature conservation and urban planning (Scott et al., 2008; UNWTO & UNEP, 2011).

Figure 1. Climate Change Impact Pathways on International Tourism



Source: Scott et al. (2012)

Direct impacts (*pathway #1*) to the tourism sector from climate change include changes in the length and quality of climate-dependent tourism seasons and in the magnitude of weather extremes. This could lead to infrastructure damage, higher seasonal operating costs and business interruptions, impacting upon tourism demand (Scott et al., 2012). All of these could further impact upon destination attractiveness and choice and the profitability of their tourism enterprises. Climate change could also lead to indirect climate-induced environmental changes on the sector (*pathway #2*), including effects on cultural and natural assets important for tourists and destination image (e.g. beaches and biodiversity) and environmental conditions that deter tourists (e.g. water scarcity) (Gössling et al., 2012; Scott et al., 2012). Operating costs and the capacity of tourism firms to operate sustainably could also be affected (Scott et al., 2012). In addition, tourism faces indirect climate-induced socioeconomic changes (*pathway #3*), as climate change impacts could risk future economic growth and the security of some nations, particularly those where tourism is very important to local economies, all of which could deter tourists (Scott et al., 2012). Unmitigated climate change could also result in decreased economic growth, thereby reducing the discretionary wealth of tourists and having negative implications for tourism dependent nations (Scott et al., 2012).

The tourism sector could also face impacts caused by climate change mitigation and adaptation responses in other sectors (*pathway #4*) (Scott et al., 2012). For instance, tourist mobility and behaviour are likely to be impacted by national or international mitigation policies in the transport sector, which aim to reduce greenhouse gas emissions through an increase in air-travel cost (Gössling et al., 2009). Long haul destinations may be particularly affected and government officials with highly tourism dependent economies, such as the Caribbean, have expressed concern that such policies could negatively impact their tourism industry (Scott et al., 2012). Adaptation policies related to water rights (i.e. continued use by tourism) or insurance costs (i.e. for coastal resorts), could also impact upon tourism development and operating costs (Scott et al., 2008).

2.5.3.2 Key Actions

Efforts to stabilize the world's climate will include environmentally, socially and economically sustainable tourism, which recognizes the right of people to rest, recovery and leisure (Scott et al., 2008). Coordinated mitigation and adaptation efforts amongst the range of tourism stakeholders could help with such efforts (Scott et al., 2008). In 2007, the '*Davos Declaration*' on climate change and tourism advocated that the tourism sector mitigate greenhouse gas emissions and adapt to current and future climate change (UNWTO & UNEP, 2007). The Declaration also advocated that developed countries ensure that resources are available to developing countries for both processes (Scott et al., 2008; UNWTO & UNEP, 2007). The '*Climate Change and Tourism: Responding to Global Challenges'* Report produced by the UNWTO, United Nations Environment Program (UNEP) and the WMO presents four key responses for the sector to address the impacts of climate change: 1) mitigate greenhouse gas emissions, especially from transport and accommodation services; 2) adapt tourism businesses and destinations; 3) improve energy efficiency by applying existing and new technologies; and 4) obtain financial resources to assist regions and countries in need (Scott et al., 2008). This dissertation focuses on the response of adaptation.

The tourism sector seems to have a relatively high capacity to adapt as demonstrated by its ability to cope with recent shocks, for instance tism attacks, natural disasters and the global economic crisis of 2008 (Scott et al., 2008; Scott & Becken, 2010). Tourists have been identified to have the greatest adaptive capacity as they can easily travel from one destination to another (Scott & Jones, 2006). Tourism service suppliers and operators at specific destinations have been recognized to have less adaptive capacity, but can still alter their supplies and services somewhat (Scott & Jones, 2006). Tourism destination communities and operators of hotels, resorts and attractions, due to their investment in immobile capital assets and/or reliance on local resources, have been identified to have the least adaptive capacity and be the most vulnerable to the impacts of climate change (Becken & Hay, 2007; Scott & Jones, 2006). To stay attractive in light of climate-induced changes to the tourism system, destinations thereby face the pressure to adapt (Kaján & Saarinen, 2013). As noted in section 2.2.3 and Table 1, the adaptive capacity of destination communities is influenced by inter-relationships between communities and their social, economic and biophysical features, such as infrastructure, ecosystems, and institutions, which this dissertation endeavours to further understand (Scott et al., 2008).

Further to the climate change adaptation measures noted in section 2.2.1, specific responses exist for the tourism sector and include beach nourishment (i.e. physical) or redirecting tourists from impacted destinations (i.e. institutional) (Scott et al., 2008; Scott et al., 2012; Wilbanks et al., 2007). Once tourism adaptation measures have been identified, they should be mainstreamed into existing sustainable development programs or policies (Gössling & Scott, 2008). Policy environments for tourism adaptation in small island states could be improved by governments raising climate change awareness and commitment of officials, industry and community members; better management of donor agency resources; and the establishment of policy instruments that encourage the implementation of adaptation policies (E. Wong, Jiang, Klint, Dominey-Howes, & DeLacy, 2013). Furthermore, Scott et al. (2009; 2012) present the following general barriers to climate change adaptation in the tourism sector: 1) uncertainty over climate change science, 2) inadequate technical, human resource and financial capacity, 3) the industry's sensitivity to imagery and in acknowledging any climate change risks and 4) limited public disclosure of any adaptation strategies by operators, to minimize competition.

2.5.4 Research Gaps Pertaining to Tourism, Climate Change and Adaptation

Over the past 25 years, there has been a considerable growth in tourism and climate change research (Becken, 2013; Kaján & Saarinen, 2013; Scott & Becken, 2010). Studies have focused on the impacts of climate change on the sector, tourism's role as a contributor to greenhouse gas emissions and how these can be mitigated, how tourism destinations can adapt, and policy dimensions. The geographic scope of the research has broadened beyond Europe, North America, and Oceania and studies are starting to arise from small island developing states and the Caribbean (Becken, 2013; C. M. Hall, 2008). Nevertheless, as detailed below, *s*ignificant research gaps remain and the level of preparedness for climate change by the tourism industry and government agencies remains low (Becken, 2013; KPMG, 2008; Scott et al., 2012). Greater research and capacity building of the tourism industry, international tourism organizations and national governments is needed to mainstream adaptation and augment the potential of the sector to alleviate poverty and contribute to the green economy (Scott et al., 2008; Scott, 2011). The following section presents an overview of gaps in the tourism and climate change literature, with an emphasis on those pertaining to adaptation for tourism destination communities, which will be examined further in this study.

Tourism and climate change adaptation research to date has focused on businesses; consumers; destinations and policy and frameworks, with all four themes having a limited focus on community perceptions (Kaján & Saarinen, 2013). More specifically, research has focused on the effectiveness of strategies to reduce vulnerability (mostly for ski tourism) and destination-scale studies to identify climate change impacts (risks and opportunities), evaluate adaptation options, stakeholder awareness, perceived risk and coping/ adaptive capacity (though very little for developing countries and tourism regions considered most vulnerable) (Scott et al., 2012). Research has also started to focus on adaptation policy, though policies specific to tourism need to be further developed (OECD and UNEP, 2011; Scott et al., 2012).

Three conceptual frameworks for adaptation in tourism have also been developed; though need to further evolve, through stakeholder involvement, integration of top-down and bottom-up approaches and combining climate policies with other policies (Kaján & Saarinen, 2013; Scott et al., 2012). Conceptual frameworks developed to date include one that undertakes a risk management approach (Becken & Hay, 2007), a comprehensive framework for the entire sector (Simpson, Gössling, Scott, Hall et al., 2008) and a framework which defines destinations at the regional level (Jopp, Delacy, & Mair, 2010). A methodology to assess climate change vulnerability for coastal tourism was also developed by Moreno and Becken (2009). As noted in section 2.2.1, vulnerability assessment is one stage within the adaptation planning process, and none of the three adaptation frameworks or the coastal vulnerability framework focus specifically on vulnerability assessment or tourism destinations at the community level. This research devises a new conceptual framework to assess the vulnerability of the tourism sector in a small island developing state, including '*community-destination scale*' (Figure 2, to be presented in section 2.6.1). Lastly, it is important to note the recent developments of the '*Destination Sustainability Framework'* to assess the vulnerability and resilience of destination communities to climatic and non-climatic stressors (Calgaro, Lloyd, & Dominey-Howes, 2014) and the '*Integrated Methodological Framework for Tourism Development and Community-Based Adaptation*' (Kaján, 2013), which were not published when this research was conceptualized and conducted. The Kajan (2013) and Calgaro (2014) frameworks consider communities broader than SIDS and the Kajan (2013) framework does not explicitly consider adaptation needs and options.

Due to their increased vulnerability to climate change, tourism destinations will need to adapt to reduce risks or to benefit from any opportunities linked with local impacts or impacts on competitors (Scott et al., 2012). Calgaro et al. (2014) note that the following factors can increase destination vulnerability: reliance on external marketing, limited disaster preparedness, image sensitivity to risk, access to resources, high seasonality, livelihood dependency, ecologically sensitive and hazard-prone, place-specific, destination remoteness and inaccessibility, institutional inflexibility and travel motivations and consumer choices. To date, the scale of destination studies has varied from specific resorts (e.g. ski) or larger regions such as municipalities or countries, with only a few focusing on the networks and perceptions of communities (Kaján & Saarinen, 2013). This dissertation will contribute to knowledge gaps in the coping capacity of tourism-dependent communities and their capacity to adapt to future climate change, in particular for developing countries (Kaján & Saarinen, 2013; Scott & Becken, 2010; Scott et al., 2012). "… *destination communities play a vital role since they have the potential to detect even detailed changes in their surrounding environments and through participation contribute to more general sustainable development within the community"*, p. 173 (Kaján & Saarinen, 2013). Furthermore, "...*there is a very strong link between resilience of tourism establishments and the resilience of communities in which they are located and their ability to recover from events*", p. 16 (CDEMA, 2009c).

By examining local perceptions, tourism destination studies can understand communities' valued attributes of concern, how they address risks and opportunities and their adaptive capacity in relation to local tourism development (Kaján & Saarinen, 2013). This includes examining the climate change impacts and vulnerabilities of tourism-dependent stakeholders whose livelihoods are most directly connected to the sector (i.e. workers, vendors, and small and medium-sized enterprise operators) (Kaján & Saarinen, 2013). Moreover, in addition to focusing on local businesses in a particular destination, *"the views of other community residents and livelihoods are also important to consider due to their inter-linkages within the destination areas*", p. 181 (Kaján & Saarinen, 2013). This means that examining household level vulnerability of tourism destination communities would be insightful as highly vulnerable individuals to climate change include those who live in areas with high exposure and are dependent upon climate sensitive industries such as tourism (Boruff & Cutter, 2007; Dunn, 2008; Massiah, 2006). It is important to note that destination communities are not homogenous and comprise of diverse groups with diverse inclinations and viewpoints on tourism and adaptation needs. These distinct sub-groups are not always equally involved in participatory processes, which can make the community approach difficult in the context of tourism and climate change adaptation studies (Kaján & Saarinen, 2013; Saarinen, 2006).

In recent years, tourism destination studies in developing countries have increased (e.g. Nepal, Fiji and China), though additional research is needed on their dependency to the sector, the effects of mass tourism and the impacts of increased extreme events (Becken, 2013; C. M. Hall, 2008; Kaján & Saarinen, 2013). Developing countries are among the most vulnerable to climate change impacts, due to poverty and low capacity, and their tourism activities and attractions are often nature-based and highly climate-dependent (Olsson et al., 2014; Saarinen, Hambira, Atlhopheng, & Manwa, 2012). For these reasons, many developing regions include '*tourism climate change vulnerability hotspots'*, where tourism is vital to the region's economy and/or because climate change impacts are predicted to be significant (Scott et al., 2008; Simpson, Gössling, Scott, Hall et al., 2008). '*Hotspots'* in developing countries include those in the Caribbean and the small-island states of the Indian and Pacific Oceans (Scott et al., 2008).

Another gap in the tourism and climate change literature is that the majority of tourism and climate change studies examine a single dimension of tourism and climatic stressors and do not consider other multiple climatic or non-climatic (i.e. socio-economic) drivers. As climate change is only one of the major drivers affecting the sector's future development, this study will provide additional insight into the research gaps pertaining to the assessment of multiple impacts of climatic and non-climatic stressors upon a single destination and how climatic drivers interact with other macro socio-economic processes (Handmer et al., 2012; Scott et al., 2008; Scott et al., 2012).

This dissertation will also explore adaptation and tourism destination community research gaps pertaining to tourism stakeholder information needs and their perception of climate change and whether it influences their need to plan adaptation measures (Gössling & Scott, 2008; Kaján & Saarinen, 2013; Scott & Becken, 2010). Lastly, in the context of sustainable tourism and livelihoods*,* tourism studies to date have focused on the challenges of the past or the present (Wall & Mathieson, 2006). Studies that examine future issues could be useful for managers and policy-makers, particularly those searching for adaptive measures and governance approaches to improving tourism–community interactions (Bramwell & Lane, 2011; Wu & Pearce, 2014)***.***

2.5.5 Research Gaps Pertaining to Methods to Assess Tourism Destination Vulnerability

To know which tourism destination communities will benefit from climate change and which ones will not, impact and vulnerability assessments are needed to understand the effects of multiple stressors and the biophysical, economic and social impacts upon the sector's resources (Amelung, Moreno, & Scott, 2008; C. M. Hall, 2008; Scott et al., 2008; Simpson, Gössling, Scott, Hall et al., 2008). *"A key objective… is to identify where the greatest vulnerability exists at destination or community level (clusters of operators at risk), because it is here that implications for employment and livelihoods, and thus social conditions, are the most significant*", p. 263 (Scott et al., 2012). Such assessments can identify the need for and best practices in adaptation planning in tourism destination communities (Kaján & Saarinen, 2013; Scott, 2008). The development of robust indicators specific to the tourism sector, which will be piloted in this study at the community level, could assist with such assessments, (Perch-Nielsen, 2010; Scott et al., 2012). Place-based case-studies can also play a role in such assessments (Becken, 2013; Kaján & Saarinen, 2013). This section details the viability of indicator and place-based approaches to assess the vulnerability of a tourism destination to climate change, with the specific approach that this research undertakes detailed in section 2.6.

2.5.5.1 Utility of Tourism Specific Indicators

Tourism destination assessments need to improve the integration of vulnerability, adaptation and impact indicators that are relevant to the sector and communities that rely on it to present useful information to governments and industry decision-makers (Scott et al., 2012). Scott et al. (2008; Scott et al., 2012) further argue that it would be valuable to develop and apply common indicators to assist with impact comparisons amongst destinations and the synthesis of studies. *"A tourism-specific vulnerability index could be used to identify hotspots in need of priority assistance",* p. 371 (Scott et al., 2012). Though one must be cognisant of the fact that investors could use such rankings to identify countries and destinations that present a larger financial risk (Scott et al., 2012). Table 2 presents the benefits from indicators in the context of sustainable tourism as outlined by the United Nations World Tourism Organization (UNWTO, 2004a).

Table 2. Benefits from Indicators in the Context of Sustainable Tourism

Better decision-making (lowered risks or costs)
Identification of **emerging issues**, allowing prevention (i.e. adapt to future climate change)
Identification of **impacts**, allowing correction action when needed.
Performance measurement of the implementation of plans and management activities (i.e. evaluating progress in reducing vulnerability, increasing adaptive capacity. and implementation of adaptation plans).
Reduced risk of planning mistakes – identifying limits and opportunities.
Greater accountability – credible info for the public and other tourism stakeholders fosters accountability for its wise use in decision-making.
Consistent monitoring can lead to continuous improvement – building solutions into management.

Source: (UNWTO, 2004a), p. 9.

The United Nations World Tourism Organization published a '*Guidebook'* to develop sustainable development indicators for tourism destinations, including a general set of indicators for climate change adaptation and mitigation (UNWTO, 2004a). The Guidebook details 12-steps to develop the indicators (Appendix A, Figure 16), which were used to guide this research's indicator development process as detailed in chapter 3 (UNWTO, 2004a). Furthermore, step 8 '*selection procedures'* presents five criteria that can be used to evaluate each indicator, which were used in this research and are also presented in chapter 3 (Table 5). In addition, the UNWTO defines destination level indicators as *"essential inputs for regional level planning processes that can further accumulate information to support the development of indicators at the national level*" p. 11 (UNWTO, 2004a). Scaling the indicators further to the regional or national level, could detect broad changes in the tourism sector, allow comparison with other regions and nations and provide a baseline for identifying local level changes and support strategic planning (UNWTO, 2004a). As further detailed in chapter 5 (section 5.2.5), Perch-Nielsen (2010) collected secondary data to develop tourism-related national level indicators for exposure (by the 2050s), sensitivity and adaptive capacity (to the current climate of the 2000s). The author recommends downscaling her study and using it as "*a starting point for a more detailed comparison of individual indicators including local knowledge for the countries of interest"*, p. 602 (Perch-Nielsen, 2010). In particular, the author recommends applying her framework at a destination level to derive local indicators and compare competing beach destinations, which this research aims to do at the destination community level.

2.5.5.2 Utility of Place-Based Approaches

Tourism climate change adaptation studies have for the most part focused on the use of climatic projections and models to assess climate change impacts and vulnerability, rather than on experience-based research relying on local knowledge, history and current experiences (Kaján & Saarinen, 2013). For these reasons, combining local perspectives with modeled (macro-level) climate change impacts can enhance and generate new adaptation methodologies at the tourism destination level and inform the implementation of adaptation initiatives by policymakers (Becken et al., 2013; Kaján & Saarinen, 2013; Kaján, 2013). Furthermore, incorporating contextual community-based research enables the consideration of climate conditions and tourism adaptation needs that are pertinent to community members (Becken et al., 2013; Kaján & Saarinen, 2013).

In the context of small island developing states, place-based studies can allow for the better integration of bottom-up and top-down approaches to examine climate change, which is important due to SIDS' short data record lengths and inadequate representation through General Circulation Models[16] (GCMs) and Regional Climate Models[17] (RCMs) (Campbell, Taylor, Stephenson, Watson, & Whyte, 2011; Kelman & West, 2009; Seneviratne et al., 2012). Place-based studies could also assist with long term baseline-monitoring and the assessment of community-based adaptation in small island systems (Nurse et al., 2014).

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[16] Depict the climate using a three dimensional grid over the earth, usually a horizontal resolution of 250-600 km, 10 to 20 vertical layers in the atmosphere and up to 30 layers in the oceans (IPCC, June 18, 2013).

[17] Can have resolutions up to 50 km (Karmalkar et al., 2013).

2.6 Summary of Research Gaps and How They will be Addressed

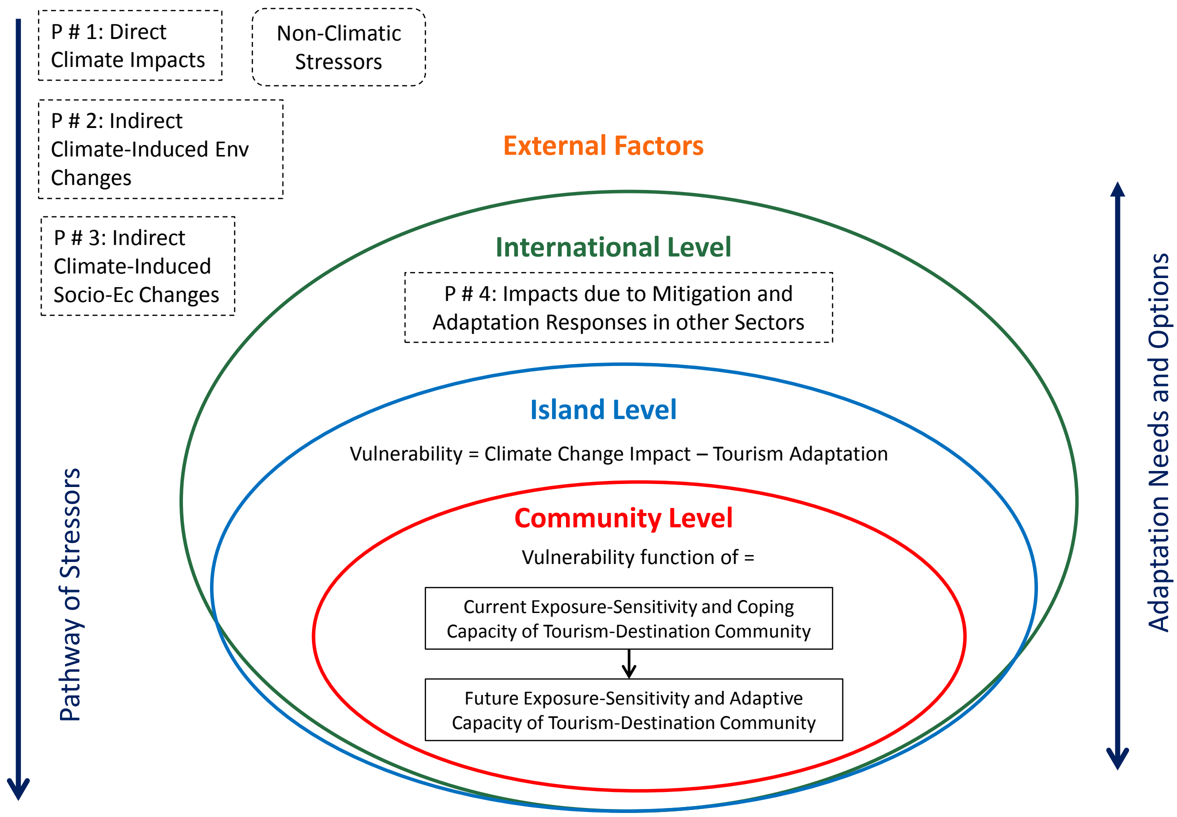
The following section presents the research gaps highlighted in chapter 2, which this dissertation aims to advance. It focuses on empirical gaps pertaining to tourism, climate change and adaptation and methods to assess the vulnerability of destination communities.

2.6.1 Tourism Research Gaps that this Research Will Address

This research will examine knowledge gaps pertaining to the understanding of climate change vulnerability in a tourism destination community in a developing country. This includes investigating gaps in the destination community's coping and adaptive capacities, including for those stakeholders whose livelihoods depend upon the sector and those who live within the destination, based on the range of determinants noted in Table 1. Climatic and non-climatic stressors, that influence the vulnerability of the tourism destination community, will also be considered.

Further to the tourism, climate change and adaptation conceptual research gaps noted in section 2.5.4, Figure 2 presents a conceptual framework to assess the vulnerability of the tourism sector in a small island developing state, including community level. It portrays the various scales, exogenous, international, island and community, in which climatic (*pathways #1 to #4*) and non-climatic stressors can influence tourism vulnerability. The stressors predominantly arise in the exogenous scale and impact the sector downwards to the community scale, with the exception of *pathway #4* (impacts of responses in other sectors) being developed distinctly by international parties. Furthermore, '*contextual vulnerability'* can be assessed at the community and island levels, while *'outcome vulnerability'* is predominantly considered at the island or broader sectoral level. The Figure also demonstrates that adaptation needs and options can be identified and implemented by the community, island and international scales. The conceptual framework adds to the tourism and climate change literature as it considers vulnerability assessment at the tourism destination-community level, including their adaptation needs and options.

Figure 2. Conceptual Framework for a *'Vulnerability Assessment of the Tourism Sector in SIDS'*

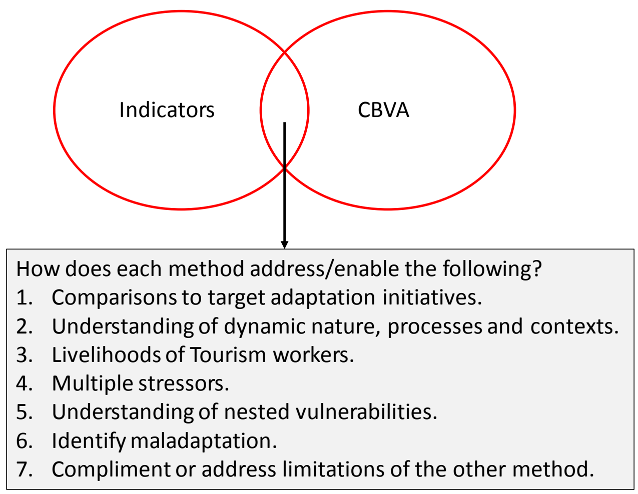


2.6.2 Methodological Research Gaps that this Research Will Address

Further to the strengths and limitations of the indicator and place-based methods noted in section 2.4, this research applies both to understand the impacts of climatic and non-climatic stressors on the pre-existing vulnerability of a tourism destination community. The purpose of this is to investigate whether either or both methods can advance gaps in the understanding of vulnerability at the destination community level. Figure 3 presents a conceptual framework of how the two methods' assessment of vulnerability at the destination-community scale will be examined, with the overlapping circle representing data gaps. The Figure also outlines the following seven normative criteria to investigate each method, not in order of importance: 1) to facilitate comparisons of vulnerability, within and amongst the community, to target tourism sector adaptation initiatives; 2) to capture the dynamic nature of vulnerability and understanding of its processes and contexts; 3) to be inclusive of stakeholders and consider their livelihoods; 4) to account for multiple stressors; 5) to be sensitive to scale and demonstrate how locally identified vulnerabilities link to those identified nationally and regionally (nested); 6) to identify maladaptation; and 7) to examine whether the two approaches can be used in combination or offset any limitations of the other.

The research also examines whether tourism-destination vulnerability indicators are best for identifying vulnerable systems at the destination-community scale or to compare vulnerability amongst communities and ascertain where adaptation funding is needed. Furthermore, to address the limitations of place-based assessments, this research considers whether longitudinal studies, community-based monitoring, and focused adaptation research can help such studies more comprehensively capture the dynamic nature of vulnerability and facilitate comparative assessments.

Figure 3. Conceptual Framework to Examine Methods to Assess Vulnerability at the Tourism Destination Community Scale



2.7 Summary and Conclusion

Chapter two has presented the conceptual terms pertaining to this research, including the types of studies that can be undertaken to assess climate change impacts and vulnerability. It also presented two methods that can be used to assess the vulnerability of communities. The chapter then highlighted the importance of the tourism sector and why it was considered, with a focus on climate change impacts to the sector. It concludes by outlining research gaps that this research aims to advance pertaining to tourism climate change adaptation, in particular vulnerability assessment in tourism destination communities. The following chapter presents the research methodology for conducting the research.

Chapter 3
Methodology

3.1 Introduction

The following chapter presents the methodology that this research undertook to assess the factors influencing climate change adaptation at the tourism destination community scale, including the use of two methods to examine the destination's vulnerability. It commences by detailing the key stakeholders consulted and the mixed-methods approach undertaken through the use of indicators and a Community-Based Vulnerability Assessment. It then justifies the selection of Barbados and its tourism destination community of Oistins as the study site. The chapter then outlines the process to develop and apply the destination and household level indicators, followed by the process to collect and analyze data for the Community-Based Vulnerability Assessment. The chapter details how data from both methods was analyzed, further to the criteria presented in Figure 3. Research challenges and considerations, including ethics approval are then discussed.

3.2 Research Overview

3.2.1 Selection of Stakeholders

As local stakeholders are a key source of adaptive capacity, they can be instrumental in identifying and priority ranking vulnerabilities in a tourism destination (Conde & Lonsdale, 2004; Handmer, 2003; Simpson, Gössling, Scott, Hall et al., 2008). This research approach was place-based, as information on local-level determinants was directly obtained from the community (Smit & Wandel, 2006). To overcome some of the challenges associated with incorporating stakeholder input into a vulnerability assessment, a focused approach was undertaken that facilitated the participation of the most influential (key informants to develop the destination and household level indicators and for the CBVA interviews) and the most vulnerable stakeholders (consulted via the household surveys and the CBVA interviews) in the tourism destination community (Few et al., 2007; Kloprogge & Sluis, 2006). Dunn (2008) and Massiah (2006) note that vulnerable individuals to climate change in the Caribbean include those dependent on climate sensitive industries such as tourism or fisheries, particularly when employed in low-paid staff or seasonal positions. Both of these groups were identified within the case-study site by key informants, including tourism, government and community representatives and a local non-government organization (NGO), The CARIBSAVE Partnership. Key informants to develop and apply both sets of indicators and to consult via the CBVA approach were selected via '*criterion'* or '*purposive'* sampling, where respondents were selected based on their knowledge and connection to Barbados' tourism industry, cross-cutting sectors and/or destination community of Oistins (Bradshaw & Stratford, 2010; McGuirk & O'Neil, 2010). The parameters of the destination community were also defined by these stakeholders, as detailed in chapter 4, section 4.3.1.

As noted in chapter 2, section 2.5.1, tourism stakeholders are "…*those directly involved in the tourism sector or whose livelihoods are affected by tourism* (i.e. government ministries, local government, tourism industry representatives, tourism labour representatives, local businesses and communities), *and those in other sectors that might be affected by tourism adaptations* (e.g. energy or agriculture), *whose adaptations might affect tourism* (e.g. transportation or insurance industry), *or that have other relevant expertise* (e.g. universities or NGOs)", p. 36 (Simpson, Gössling, Scott, Hall et al., 2008). This research involved tourism stakeholders i) whose livelihoods were most connected to the tourism related activities of the destination community (via the CBVA approach), ii) residents who lived in neighbourhoods adjacent to the key attractions of the destination community (via the household surveys) and iii) who were decision-makers and/or tourism, government and community representatives who had relevant expertise and/or information (via focus groups to develop the indicators and CBVA key informant interviews). There was some overlap between stakeholders consulted to develop the two sets of indicators and those approached through the Community-Based Vulnerability Assessments [Govt Orgs 1 and 5 and Emergency Management Org 1]. Furthermore, not all of the stakeholders had a tourism expertise, but were able to address other cross-cutting sectors and expertise relevant to the sector (i.e. coastal zone management and fisheries). Further details on the various stakeholders consulted are presented in Table 3, Table 6 and Table 7.

3.2.2 Research Approach

This research undertook a mixed methods approach as it involved the use of qualitative and quantitative methods (Creswell, 2009b). There are several approaches to mixed methods, including sequential, concurrent and transformative (Creswell, 2009b). The research undertook concurrent mixed methods, in particular concurrent triangulation strategy as it collected quantitative and qualitative data concurrently and compared the two sources for convergence, differences or some combination (Creswell, 2009a). Such a strategy can also mean comparing the results of the two approaches side by side (Creswell, 2009a). The philosophical approach was pragmatic as the study emphasized the research problem and used two available approaches to understand it (Creswell, 2009b). As detailed below, quantitative data was collected to develop and apply the indicators and qualitative data was collected for both the indicator and the CBVA approaches.

Qualitative approaches can employ several research strategies, including participatory action research, discourse analysis and case-studies (Creswell, 2009b), with this research undertaking the latter. The case-study involved assessing the climate change vulnerability of a key economic sector in a specific country and one of its communities (Stake, 1995). Furthermore, place-based studies to understand climate change vulnerability often undertake case-studies (Ford et al., 2010). Further to the strength and limitations of undertaking a case-study noted in chapter 2, section 2.4.3.1, another strength is that it can allow generalizations to be made from its findings to other similar systems (Evans & Gruba, 2002), though at the same time the validity of individual studies have been critiqued for their limited applicability for broader generalization (Flyvbjerg, 2006). This research collected qualitative information via the focus groups to develop both sets of indicators and through the semi-structured interviews for the CBVA.

Quantitative research can involve survey research, which provides a numeric description of trends, attitudes or opinions of a population by studying a sample of it. This can include the use of questionnaires or structured interviews for cross-sectional and longitudinal studies, with the intent of generalizing from a sample to a population (Babbie, 1990). This research used quantitative methods to develop and apply both sets of indicators, in particular a pre-determined evaluation criteria and scoring framework to select the indicators, a household survey (i.e. instrument based questionnaire) to collect household data and statistical analysis and interpretation to analyze it.

3.2.3 Justification of Study Site and Timeline of Activities

As further detailed in chapters 4 and 5, this research examines a tourism destination community in the Caribbean island of Barbados. The island and its tourism sector face high exposure to climate change due to its low-lying topography, pressure placed on its limited resources by a dense population and a high reliance on coastal infrastructure (Bishop & Payne, 2012; Boruff & Cutter, 2007; Mycoo & Chadwick, 2012). The island also has a higher adaptive capacity to climate change than other islands in the region, due to the fact that it has a high performing economy and has produced some documents and initiatives pertaining to climate change and to tourism (Bishop & Payne, 2012; Climate Investment Funds, 2009). Due to this potentially higher capacity, it was assumed that Barbados is fairly information rich relative to other SIDS and that the data availability and the capacity of its organizations would provide insight as to what type of data and capacity might exist in its less developed neighbouring islands. Initially, the research envisioned examining two tourism destination communities in Barbados and developing indicators for one that engages in small-scale lower-end tourism and for another that engages in higher-end (luxury) tourism. After hosting the first focus group to develop the indicators with national-level stakeholders in the fall of 2010, it was realized that very little data was currently available at the tourism destination community scale, though stakeholders thought that the exercise to develop such indicators would be useful (further detailed in chapter 8). Furthermore, they encouraged a more detailed study of the tourism destination community of Oistins, as it was one of the island's unique communities that could enable a study of tourism and related livelihood issues. The research was then modified to focus on the one community of Oistins, and in addition to investigating the utility of developing indicators, also to examine the feasibility of collecting tourism relevant data with the Community-Based Vulnerability Assessment approach. Furthermore, to integrate with on-going initiatives in the Caribbean, the research was affiliated with The CARIBSAVE Partnership, which was headquartered in Barbados and provided research support.

Desk based research activities commenced in the summer of 2010. Field research in Barbados was carried out in the late summer and fall of 2010 and winter of 2011, through which approximately 150 individuals participated. In September of 2010, the first focus group to develop the destination-level indicators was held and the household surveys commenced. From November to December 2010, the three remaining focus groups to develop the destination-level indicators were held, data to apply the destination level indicators started to be collected and the households surveys completed with the help of a Research Assistant. From mid-February to mid-April of 2011, remaining data to apply the destination-level indicators was collected, the household level indicator focus group held and additional stakeholders interviewed via the CBVA, along with the help of a Research Assistant. Data analysis was carried out between 2011-2012 and 2013-2014.

3.3 Indicators

3.3.1 General Layout

As detailed in chapter 2, when examining the biophysical and socio-economic determinants for exposure, sensitivity and adaptive capacity, some scholars choose to examine each of them distinctly (Hahn et al., 2009; Perch-Nielsen, 2010). Other scholars choose to focus solely on the socio-economic determinants of adaptive capacity and present them based on assets pertaining to economic resources, human skills, social capital, physical infrastructure, natural resources and political (institutional) capital (Smit & Pilifosova, 2001; Vincent, 2007a; Vincent, 2007b). As the relationship between exposure-sensitivity and adaptive capacity of a system is not always inverse, this research examines the determinants of exposure, sensitivity and adaptive capacity distinctly (Gaillard, 2010; Handmer, 2003; Vincent, 2007a).

3.3.2 Destination Level Indicators

3.3.2.1 Indicator Development

Prior to commencing the field research, a draft list of 37 conceptually relevant indicators was developed for tourism destinations communities (presented in chapter 6, Table 13 and Appendix B, Table 32). The list was founded on academic literature pertaining to the development and application of vulnerability assessment indicators at the community, district (regional) and national and sectoral levels. The methodology to develop the indicators was based on the United Nations World Tourism Organization's report on '*Indicators of Sustainable Development for Tourism Destinations',* in particular its 12 steps as noted in Appendix A, Figure 16 (UNWTO, 2004a). Also referenced were community vulnerability assessments undertaken by Parkins and MacKendrick (2007) and the '*Livelihood Vulnerability Index'* by Hahn et al. (2009), both of which used household data, other primary data and secondary data to develop indicators at the community and district levels. The '*Community-Based Disaster Risk Index'* was also referenced, which obtained primary and secondary data to develop and apply each indicator (Bollin & Hidajit, 2006). National-level indicators, including those developed for the beach tourism sector, were referred to and modified to suit the destination scale (Perch-Nielsen, 2010; Simpson & Ladle, 2007). An attempt was made to select the most comprehensive and representative list of indicators for a tourism destination community, yet not create too large of a list that could overwhelm the stakeholders. The literature recommended a list of 12-24 indicators as optimal (UNWTO, 2004a). A few more indicators were presented, realizing the list would be further narrowed by stakeholders. Indicators pertaining to sensitivity and adaptive capacity were categorized according to the sustainable livelihoods capitals, as presented in chapter 2 (Table 1). Only indicators pertaining to cultural capital were not presented, as none were identified in the literature.

To further develop the destination-level indicators, four focus groups were held with 17 key informants from the *3rd group of stakeholders* (representatives from tourism, local and national government, non-government and community organizations). Seventeen other individuals were also interviewed, who were not able to attend the focus groups, regarding the development (ranking and selection) and applicability of the indicators. Consulting different types and levels of stakeholders (constituency, destination, national, regional), allowed the researcher to ascertain whether the different stakeholders came up with the same list and relative ranking of indicators. Table 3 presents the 34 stakeholders consulted to develop and apply the destination-level indicators, also noting overlap with those consulted as key informants for the CBVA interviews (Table 7). In summary, individuals from the following types of organizations were consulted.

1. Six *tourism organizations* representing government departments, destination-specific groups, hotels, tourism-related businesses and regional tourism.
2. Five other *government organizations* representing local and national issues (coastal zone management, economics, meteorology and statistics).
3. Three *emergency management organizations* representing constituency, community and national level issues.
4. Four *fisheries organizations* representing destination-specific and national issues.
5. *Academic experts* pertaining to tourism, socio-economic, fisheries, environmental management, and hydrology issues.

Table 3. Stakeholders Consulted to Develop and Apply Destination Level Indicators

Type of Organization	Organization Level	Development or Application of indicators	Date(s)
Tourism Org 1 [BGVA], R1	Destination	Application	December 2010
Tourism Org 2 [M of T], R1	National	Development & Application	September & Dec 2010
Tourism Org 2, R2	National	Application	Dec 2010
Tourism Org 2, R3	National	Application	Dec 2010
Tourism Org 3 [BHTA]	National	Development & Application	November 2010
Tourism Org 4 [BTPA]	National	Application	Dec 2010, April 2011
Tourism Org 5 [NCC]	National	Application + CBVA	April 2011
Tourism Org 6 [CTO], R1	Regional	Application	Dec 2010
Tourism Org 6, R2	Regional	Application	April 2011
Govt Org 1 [CC]	Constituency	Development & Application	April 2011
Govt Org 2 [CZMU], R1	National	Development & Application	Sept & Dec 2010
Govt Org 2, R2	National	Development & Application	Sept & Dec 2010
Govt Org 2, R3	National	Application	April 2011
Govt Org 3 [Ec Aff]	National	Development & Application	November 2010
Govt Org 4 [Met Dept], R1	National	Development & Application	September 2010
Govt Org 4, R2	National	Application	December 2010
Govt Org 5 [Stats], R1	National	Development & Application	November 2010
Govt Org 5, R2	National	Development & Application	November 2010
Em Mgmt Org 1 [DEO]	Constituency	Development & Application + CBVA	Dec 2010, April 2011
Em Mgmt Org 2 [DEM]	National	Development & Application	September 2010
Em Mgmt Org 3 [Red Cross], R1	Community/ National	Development & Application	November 2010
Em Mgmt Org 3, R2	Community/ National	Development & Application	November 2010
NGO 1 [CERMES]	National	Development & Application	November 2010
Fisheries Org 1 [Govt]	Destination	Development & Application + CBVA	August & Oct 2010, February & March 2011
Fisheries Org 2 [OFFA], R1	Destination	Development & Application	August & Dec 2010
Fisheries Org 2, R1	Destination	Development & Application	August & Dec 2010
Fisheries Org 3 [OSMBO]	Destination	Development & Application	August & Dec 2010
Fisheries Org 4 [Dept of F]	National	Development & Application	September 2010
Fisheries Org 5 [OUC]			
Academic 1 [Fisheries & Socio-Econ Prof]	Regional	Development & Application, in particular of Exposure & Sensitivity	November 2010, February 2011
Academic 2 [Fisheries Biology & Mgmt Prof]	Regional	Development & Application, in particular Exp, Sensitivity + CBVA	November 2010, April 2011
Academic 3 [Env & Social Mgmt, Tourism]	Regional	Application, in particular of adaptive capacity and discussion of destination boundaries	November 2010
Academic 4 [Hydrology Prof]	Regional	Development & Application, in particular of Exp & Sensitivity	November 2010
Police officer 1	National	Application	November 2010

The CARIBSAVE Partnership staff assisted in the organization of the first destination-level focus group, by introducing the Researcher to local stakeholders and sending invitations on her behalf to nine federal ministries. Participants for the three remaining destination-level focus groups and household focus group were selected based on the type of indicator being discussed, sources suggested by the literature, by building on networks developed in the first focus group and by consulting The CARIBSAVE Partnership staff. Most stakeholders contacted were willing to share information and participate in the research. To invite key informants to the focus groups, an invitation was extended twice, by phone and email. If an informant was not able to attend a particular activity, the Researcher followed up with them afterwards if they requested it, if they were identified as key informants or if other stakeholders recommended it. For stakeholders involved in follow-up meetings, a list of indicators was sent to them ahead of time, which they were asked to rank and comment on before the meeting. Many did not comment due to their lack of time. Therefore, when meeting with them and to work with their time constraints, they were asked to comment on the indicators chosen by other stakeholders to date, those for which they might have a role in or insight as to data applicability or recommend any additional indicators.

The four focus groups ran approximately three hours each, with each presenting the purpose of the research, predicted climate change impacts to small islands and tourism destinations, the utility of indicators, selection criteria and a draft list of indicators. Feedback was also solicited from participants as to the parameters of the tourism destination community and the rational for choosing Oistins as a study site. In each focus group, stakeholders were separated into three groups (exposure, sensitivity and adaptive capacity), based on their expertise to discuss the development of the indicators (presented in Table 4). Due to stakeholder availability, the Researcher was not able to run focus groups based on similar expertise or sector (i.e. tourism or disaster management), which could have allowed for a more uniform scoring of indicators. Nevertheless, running the focus group with a mix of expertise, allowed for the sharing of ideas amongst the different organizations. As argued for the in the UNWTO report, the approach was a mix of data-driven[18] (inductive) and theory driven[19] (deductive) and asked 1) what information is needed (deductive) to apply the particular

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[18] i.e. *"what can we do with the data we have, or for what issues do we have data*?', p38 (UNWTO, 2004a).

[19] i.e. *"what issue or policy questions are most important and can we obtain data to address them*?" p38 (UNWTO, 2004a).

indicator and 2) what can be created or obtained now (inductive) and 3) how information sources could be improved in the future (UNWTO, 2004a).

Table 4. Stakeholders Consulted Through Destination Level Focus Groups

Focus Group	Exposure	Sensitivity	Adaptive Capacity	Dates & Scale
1	Govt Org 2, R1 (Coastal Zone), Govt Org 4, R1 (Meteorology)	Govt Org 2, R2 (Coastal Zone); The CARIBSAVE Partnership	Em Mgmt Org 2, Tourism Org 2, R1	September 3, 2010 National
2	Fisheries Org4	Tourism Org 3, Govt Org 5, R1 (Statistics)	Govt Org 5, R2 (Statistics), Govt Org 3 (Finance, Economic Aff)	November 19, 2010 National
3	NGO 1 (CERMES)	Em Mgmt Org 3, R1	Em Mgmt Org 3, R2	November 25, 2010 National, community
4	Discussed #9-11 collectively.	Fisheries Org 2, R1 & R2, Fisheries Org 3, Govt Org 1	Fisheries Org 2, R1 & R2, Fisheries Org 3, Govt Org 1	December 3, 2010 Community, destination

To evaluate the indicators, a *'scoring framework'* and an '*indicator development worksheet'* was developed based on criteria presented by Perch-Nielsen (2010) and the UNWTO (2004a) (see Appendix B). Stakeholders were presented with the list of indicators and the *'scoring framework'* and asked to rank the indicators most appropriate for the destination, individually or with a partner in their group. The '*scoring framework*' presented five criteria, which are defined in Table 5, that stakeholders used to rank each indicator from 1 to 3 (low, medium, high): relevance, feasibility, credibility, clarity and comparability, to a maximum total of 15. Stakeholders were also presented with an '*indicator development worksheet*' to provide more details for the top three indicators chosen, based on conceptual relevance and potential applicability at the destination level. The worksheet also asked more specific questions on the indicator's relevance (to whom and how it will be used), feasibility (current and future data availability), comparability, data availability, organization (s) responsible to provide the data and form of available data. Finally, stakeholders were asked to comment on whether the narrowed down list of indicators should be weighted equally or differentially. To conclude, the four groups shared their results and obtained feedback from other participants, which sometimes resulted in a re-scoring of some of the indicators. Next steps were then discussed, including follow-up with participants to collect any further data. For the fourth focus group (fisher-focused), participants were asked to score only those indicators for which it was already ascertained that local level data still might be available. This modification to the methodology occurred to simplify the exercise and make it accessible to participants who were not used to academic exercises.

Table 5. Criteria Used to Score each Indicator

Criteria	Description
Relevance	Does the indicator respond to the specific issue (determinant of exposure, sensitivity or adaptive capacity) and provide information that will aid in its management?
Feasibility	Is it useful, practical and affordable to collect and analyze data at the Destination Level?
Credibility	Is it currently supported by valid and reliable information from credible sources (or could be)?
Clarity	Is it easy to understand and clear to users?
Comparability	Is it useful for comparisons over time and across jurisdictions?

Based on: UNWTO (2004a)

For each successive focus group, the list of indicators was modified to reflect comments from the previous focus groups and follow-ups with key informants, with any noteworthy comments from earlier groups shared with latter groups (a modified Delphi technique). Only those indicators that scored very low (below 8), or that stakeholders explicitly asked to remove, were removed from the original list and not presented to the next focus group. Some new indicators were developed by stakeholders and shared with subsequent focus groups.

3.3.2.2 Indicator Application and Analysis

Depending on which indicators were identified, and their associated data availability in the destination community, some were applied (operationalized) by collecting primary and secondary data from local, regional and national organizations. As this research examines one community in-depth, including what destination community indicators are conceptually feasible and potentially applicable to collect data for, any data obtained from the indicators was not aggregated. The refined list of selected destination-level indicators, including their applicability, is presented in chapter 6, Table 14 and Appendix B, Table 33.

3.3.3 Household Level Indicators

3.3.3.1 Overview and Selection of Households

Households are one of the local levels at which climate-related hazards occur (Birkmann, 2006a; Hinkel, 2011; Queste & Lauwe, 2006). A household-level index can examine how specific household characteristics (i.e. assets, perception or livelihood activities) are associated with vulnerability (Eakin & Bojórquez-Tapia, 2008; Vincent, 2007b). As a result, this research also developed household level indicators to determine whether they can assist with the identification of vulnerable stakeholders in a tourism destination community and examine how the determinants of vulnerability are related at the destination and household levels. This also involved investigating how connected the livelihoods of households within the destination community are to tourism and what this implies for the best method to collect and analyze data pertaining to destination household vulnerability: in the surrounding neighbourhoods to the tourism attraction(s) (via household level indicators) or on-site in the particular attraction(s) (like the CBVA). The former approach was chosen to develop the indicators based on examples provided in the literature.

As further detailed in chapter 4 (section 4.3), Oistins is considered vulnerable to climate change due to its tourism activities and infrastructure being located at the coast (Simpson et al., 2012; The CARIBSAVE Partnership, 2010). The community also has neighbouring households, which are considered socioeconomically vulnerable, due to lower income status, high housing density and a high percentage of older and retired persons (Boruff & Cutter, 2007). Based on the 2000 '*Household and Labour'* census, the town of Oistins has four enumeration districts (Ashby Lands, Scarborough, Enterprise and one that is un-named) with a total population of 1200, comprised of 466 households (presented in chapter 4, section 4.3.4) (GOB, 2000). Household-level vulnerability was examined, via an indicator approach, in the two neighbourhoods (enumeration districts (EDs)) in the center of Oistins, directly adjacent to the Bay Garden Vendors Area, the Oistins Fish-Market and close to other key tourist attractions (beaches, hotels and restaurants) (*2nd group of stakeholders*). These two districts were Ashbee Lands and Scarborough and were examined jointly as they are neighbouring and have very similar attributes. The two districts comprise a total of 270 households with a total population of 719, which resulted in a statistically significant sample size of 71[20].

3.3.3.2 Indicator Development

A draft list of 31 household level indicators (presented in chapter 6, Table 15 and Appendix C, Table 34) was developed based on the '*Household Adaptive Capacity Index'* developed by Vincent (2007a; 2007b) and household level data collected by Parkins and MacKendrick (2007) and Hahn et al. (2009), though the latter two used household data to inform the development of community and district (regional) level indicators. Hahn et al. (2009) and Vincent (2007b) based their household indicators in rural settings. As Caribbean tourism destination communities are for the most part based in urban or peri-urban settings, questions were left out pertaining to rural communities (i.e. how long it takes to walk to a water source). The majority of the indicators were developed from the academic literature (24), with five additional indicators developed from the original CARIBSAVE Partnership household survey and two that the Researcher developed, building on sources in the literature to suit the particular context. Indicators pertaining to sensitivity and adaptive capacity were also categorized according to the sustainable livelihoods capitals, except for cultural capital (as noted earlier).

Data for the household level indicators was collected via a household survey derived from The CARIBSAVE Partnership's methodology for their '*Caribbean Climate Change Risk Atlas'* Project. The organization's survey collected demographic data and information pertaining to financial, social, human, physical and natural assets that would influence a household's capacity to adapt to climate change. It also examined any health, water and food issues that would determine a household's sensitivity to any climate change impacts. The Researcher's modifications and additional questions pertained to data collection on tourism related livelihoods and to determine exposure and sensitivity to climate-related hazards and extreme events at the household level: strong winds, flooding, high waves (for storm surge), water-shortages (for drought) and landslides. Questions pertaining to sea-level rise were not included, to avoid respondents confusing the term with storm surge. The household survey is presented in Appendix C.

[20] Using household as the unit of measurement (giving a population of 270), a confidence level of 95% and a confidence interval of 10%.

As detailed in Table 6, a focus group was held in March of 2011 with six key informants as to which household indicators were the most conceptually relevant and feasible to collect in the long-term at the destination community level. The stakeholders represented community policing, national government organizations for statistics, gender and social development and a NGO involved in social development. Two other community key informants, representing local government and emergency management, were also consulted individually. Tourism organization representatives were not able to attend, though participating government and community organization representatives were able to speak for the household data relevant for the three tourism related livelihoods indicators. A similar exercise, as outlined in section 3.3.2.1 pertaining to destination level indicators, was then used to evaluate the draft set of household level indicators. The focus group also discussed:

- The definition of '*vulnerability*', in particular by the National Assistance Board and the Police Station in their '*vulnerable persons*' list.
- The best way to collect household data in tourism destinations - Neighbourhood surveys or a survey of tourism stakeholders directly at their workplace?

Table 6. Stakeholders Consulted to Develop Household Level Indicators

Type of Organization	Scale	Development/ Application	Date(s)
Govt Org 1 [CC]	Constituency	Development & Application	April 2011
Emergency Mgmt Org 1 [DEO]	Constituency	Development & Application	April 2011
Police Officer 2	Community	Development & Application	March 2011
Govt Org 5, R1 [Stats]	National	Development & Application	March 2011
Govt Org 5, R2 [Stats]	National	Development & Application	March 2011
Govt Org 6 [NAB]	National	Development & Application	March 2011
Govt Org 7 [Gender Bur]	National	Development & Application	March 2011
NGO 2 [CPDC, CC Programmer]	Regional	Development & Application	March 2011
Govt Org 8 [Ministry of Labour]	National	Follow-up re Application	June 2011

3.3.3.3 Household Survey Application

The Researcher applied the household level indicators by randomly[21] surveying households in the Ashby Lands and Scarborough districts along with a Research Assistant and The CARIBSAVE Partnership staff. An equal number of households were surveyed in each district, with every second or third house approached until the desired sample size was achieved. Of the total sample size of 71, twenty-seven households (38%) were surveyed in September of 2010, with the remaining 44 surveys (62%) carried out in November and December of 2010. The second sample was collected after Tropical Storm Tomas struck Barbados on October 29th, 2010, the storm to cause the highest economic damage in over 100 years (further detailed in chapter 4, section 4.2.2.2). This providing interesting insight as to pre-storm and post-storm experience and whether households and/or their livelihoods were impacted by climate-related events or whether they thought their homes were at risk from climate-related events.

To make the survey applicable in plain-language, terms such as '*well-being*' were at times used as an alternate to '*vulnerability*'. The surveys took approximately 20 to 45 minutes to complete, depending on the participant, and were conducted primarily in the evenings and weekends to have the greatest likelihood of interviewing the household head. If the household head was not available, an adult member of the household was asked to respond to the best of their ability, or the survey occurred at a later time. Approximately 90% of the households approached were receptive to being interviewed.

3.3.3.4 Household Survey and Indicator Data Analysis

As noted earlier, this research examines one community in-depth. The Statistical Package for the Social Sciences (SPSS) was used to aggregate and analyze the results of the household surveys, provide descriptive statistics to match the type of information being collected by other sources and to develop any relevant household indicators. Qualitative data from the household surveys was examined thematically. Data obtained from the household level indicators was not aggregated beyond the community.

[21] Random sampling is where each individual has an equal probability of being selected from the population, ensuring that the sample will be representative (Keppel, 1991).

3.4 Community-Based Vulnerability Assessment

3.4.1 Data Collection

To obtain contextual, disaggregated and descriptive information pertaining to climate change vulnerability at the community level, in the winter of 2011, 48 semi-structured Community-Based Vulnerability Assessment interviews were carried out with stakeholders whose livelihoods were most dependent on the destination community's tourism related activities (*1st group of stakeholders*) based on similar community vulnerability studies (Ford & Smit, 2004; Lim et al., 2005; Smit et al., 2008). The purpose of this exercise was two-fold. First, as detailed in Appendix D, the interviews assessed the past and current exposure-sensitivity and coping capacity of stakeholders to changing environmental (including climatic) and/or social conditions in the past ten years. The interviews then assessed the future exposure-sensitivity of stakeholders to changing conditions and the resources and support that would be needed to adapt. The focus of the interviews was on the '*most vulnerable'* and '*most influential'* stakeholders as suggested by Few et al. (2007) and Kloprogge and Sluis (2006). The larger purpose, as noted in chapter 2, section 2.6, is to examine the CBVA findings and determine whether it advances knowledge gaps in the understanding of vulnerability at the tourism destination community scale. Stakeholder perceptions were considered in the context of recorded climatic and non-climatic trends as documented by academic and grey literature in chapters 4, 5 and 7.

Stakeholders were interviewed in the Oistins Fish-Market (food and craft vendors and fishers), at the two beaches of Oistins (beaches #1 and #2) and any available hotels and restaurants within and west of the town (the particular stakeholders are detailed in chapter 4). After interviewing stakeholders at beach #1 and beach #2, and to obtain a greater sample size, three additional stakeholders were interviewed on beach #3 west of Oistins (a vendor, water-sports operator and taxi driver). Six institutional key informants were also interviewed regarding the institutional and macro issues affecting the destination. There was some overlap between the institutional key informants consulted for the Indicators and the CBVA approach. To avoid consultation fatigue and bring in additional perspectives, another key tourism stakeholder was consulted [Tourism Org 9], in place of re-consulting Tourism Org 2 and Tourism Org 3. The interviews involved the following groups of stakeholders. Table 7 provides further details on the particular stakeholders interviewed via the CBVA approach.

1. *Bay Garden Food* and *Craft Vendors* + 1 Institutional (also consulted in C) = 14
2. *Fishers* (9) + 2 Institutional = 11
3. *Beach-related activities* = water sports operators, clothes vendors, food vendors and lifeguards + 1 Institutional (also consulted in A) = 10
4. *Accommodation and Restaurants* (Managers and Staff) = 4 large and 2 small hotels (which included restaurants), 3 individual restaurants and taxi-drivers (1) = 10
5. *Key institutional informants*: Apart from the three informants mentioned above, three other informants were interviewed representing tourism development, local government, local emergency management and fisheries (total of 6).

Table 7. Stakeholders Interviewed via Community-Based Vulnerability Assessment

Type of Organization	**Scale**	**Date(s)**
Tourism Org 1 [Food vendors, R #2 - 8]	Destination	February to March 2011
Tourism Org 1 [Craft vendors, R #9 – 13]	Destination	February to March 2011
Tourism Org 3 [BHTA, Restaurants # 1 – 3]	Destination	March 2011
Tourism Hotel Org 1 R1, R2	Destination	March 2011
Tourism Hotel Org 2, R1, R2	Destination	March 2011
Tourism Hotel Org 3	Destination	March 2011
Tourism Hotel Org 4	Destination	March 2011
Taxi-driver 1	Destination	April 2011
Tourism Org 5 [NCC, Lifeguards, R 2-4]	Destination	March to April 2011
Tourism Org 5 [NCC, DG Mgr, R1]	National, KI	April 2011
Tourism Org 7 [Water Sports Operators # 1 – 4]	Destination	March to April 2011
Tourism Org 8 [Clothes and food vendors # 1-3]	Destination	March to April 2011
Tourism Org 9 [Nat Adv Council, Chair]	National, KI	April 2011
Government Org 1 [CC Chair]	Constituency, KI	April 2011
Emergency Mgmt Org 1 [DEO Chair]	Constituency, KI	April 2011
Fisheries Org 1 [Govt, EB]	Destination, KI	April 2011
Fisheries Org 2 & 3 [Fishermen, R #1-9]	Destination	February to March 2011
Academic 2 [Fisheries Biology & Mgmt, *HO, CERMES]*	National/ Regional, KI	April 2011

KI = Key informant

The CBVA portion of the research was conducted during the peak tourist and fishing season. Stakeholders were approached at their place of work, either in person or by phone, until the desired interview sample was achieved. The majority (95%) of vendors, fishers and tourism operators contacted were receptive to participating in the interviews. The only challenge was in obtaining interviews with the managers and staff of hotels and restaurants, due to the research being carried out in the peak tourist season. As a result, several hotels had to be approached to achieve the desired number of interviews (eight small hotels were approached and two were interviewed, five large hotels were approached and two were interviewed). The interviews were semi-structured and ranged from 30 minutes to an hour, depending on the amount of time the respondent was able to give. Compensation was provided to some of the interviewees for their time, by purchasing one of their services (i.e. food, a craft or engaging in a water-sports activity). The majority of the 48 interviews (35 = 73%) were either recorded with a tape recorder (19) or dually by hand by the Researcher and the Research Assistant (16) or a combination of the two. The remaining 13 were recorded by hand by the Researcher as the respondents were not comfortable in being audio-recorded and/or the Research Assistant was not available. These notes were transcribed shortly afterwards.

3.4.2 Interview Structure and Data Analysis

Appendix D presents the interview guide and key themes used to undertake the Community-Based Vulnerability Assessment interviews. To reduce, organize and analyze the large amount of qualitative data obtained from the CBVA interviews, data was coded thematically (Cope, 2010). '*In vivo*' codes, common phrases in the material, were used to thematically code the information collected. Discernible and underlying messages, including descriptive themes and patterns, were also looked for when coding the material. Patterns were examined by investigating conditions, interactions among actors, strategies, tactics and consequences (Cope, 2010). Research results by themes are presented in chapter 7.

3.5 Analysis of Indicator and CBVA Approaches

Once data was collected from the indicator and CBVA approaches, their data was analytically compared to the seven criteria presented in chapter 2, Figure 3. This involved examining the types of vulnerability determinants that emerged from both methods, including their spatial and temporal scales and information brought forth. It also involved examining the strengths and limitations of both and whether could they be used in combination or address the limitations of the other (criteria #7). In particular, the last criteria examined whether the use of indicators could overcome the scaling limitations of the CBVA approach. Furthermore, for any indicators that were found relevant to develop, but challenging to apply at the tourism destination community-scale, the research also examined whether their determinants could still be portrayed through the CBVA approach (as noted in chapter 8, section 8.3.3).

3.6 Research Challenges and Considerations

This section presents the challenges encountered while undertaking the research and how they were overcome.

3.6.1 Conducting Research in a Foreign Country

The Researcher had not previously spent any prolonged time in Barbados or in the Caribbean, so a challenge was to quickly familiarize herself with the island's history, governance, culture, stakeholders, study site and stressors affecting it. For these reasons, it took time to establish rapport with local stakeholders and collect relevant information. Collaborating with a local partner, The CARIBSAVE Partnership, and a Research Assistant proved useful to overcome this challenge.

3.6.2 Indicator Selection

To complete the research in a timely manner and to not overwhelm stakeholders with too much information, and based on other methodologies referenced, a list of *a priori* indicators was presented in the focus groups. This meant that the stakeholders were not able to develop their own indicators. This challenge was mitigated in part by presenting stakeholders with the rationale and limitations for each indicator and encouraging their input in the refinement or creation of any new indicators and subsequent data collection and analysis. Sections 3.2.1 and 3.3.2.1 discussed any implications of how stakeholders were chosen to participate in the indicator development exercise.

3.6.3 Conducting the Household Surveys with the Local Partner Organization

While it was useful to link with The CARIBSAVE Partnership as a local partner to provide contacts and an introduction to the community, it presented certain challenges. In particular, when developing and applying the household surveys, the Researcher had to work with the organization's timeline and was constrained as to how many revisions she could make independently to the survey. This also meant that the Researcher had to carry out the initial household surveys with one of their staff, which with their timeframe, resulted in the surveys being executed in the fall of 2010 before the focus group to develop the household surveys was held in the spring of 2011. This challenge was mitigated by informing the stakeholders of the household focus group of this fact and discussing with them the initial list of indicators and any that were refined prior to the focus group.

3.6.4 Defining the Household Head

The majority of household level data, as presented in chapter 6 (Table 16), was analyzed via the household head. The academic literature referenced does the same, but does not precisely define the criteria for determining a household head. The Researcher discussed with the household focus group how, when executing the household surveys, confusion was noted by survey respondents as to the exact definition of '*household head'*. Respondents had a range of interpretations: the owner of the house (if so might not be bringing in income), the most senior/ elderly person, shared between two individuals, the primary income earner in the house or an absent individual who supports the household. The Researcher and the Research Assistant let the respondents choose their own definition, with the majority either choosing the owner of the house, the most senior/ elderly person or shared between two individuals.

3.6.5 Over Consultation

Some of the participating stakeholders in the research were found to be experiencing consultation fatigue due to other consultation initiatives in Oistins or across the island. People in Oistins, as it is a key tourism and fishing community, have and are experiencing extensive research and consultation by academics, non-government organizations, government organizations and religious groups. As detailed in chapter 4 (section, section 4.3.4), this included the University of West Indies' Center for Resource Management and Environmental Studies (CERMES) and the Barbados Red Cross both conducting household surveys in the community in 2008 and the spring of 2010 respectively. The Researcher and her local partner, The CARIBSAVE Partnership, did not know this when they chose to carry out their research in Oistins, which highlights the need for greater dialogue amongst local stakeholders and the research community. Furthermore, when the Researcher was conducting the household surveys, she observed the solicitation of the households by two other groups at the same time (a Jehovah's Witness and a skills survey).

3.7 Ethical Considerations

As the research engaged extensively with human subjects, the proposal underwent an ethics review through the University of Waterloo's Office of Research Ethics in August of 2010, acknowledging matters of privacy, informed consent and harm (Dowling, 2010). Ethical issues were addressed for the focus groups, household surveys and semi-structured interviews. Informed consent from all stakeholders was obtained via an '*Informed Consent Letter'* detailing the purpose and nature of the particular activity, how it could be of benefit to them and that participation was voluntary. Participants were also informed that any information to be provided would be considered confidential (anonymous) in the research results. Participants were asked for their permission before audio recording any interviews, to ensure an accurate recording of responses. Lastly, participants were notified that any data collected would be kept in a safe location and confidentially disposed of in seven years' time.

3.8 Summary and Conclusion

The methodology chapter has presented an overview of methods undertaken in this research, including a concurrent mixed-methods approach. Research methods consisted of several techniques to consult a diversity of tourism stakeholders, including focus groups, semi-structured interviews with key informants, household interviews, semi-structured CBVA interviews, and lastly an analysis of secondary sources. This allowed for an investigation of perspectives at multiple-scales, whereby individual/ household and community level data were obtained via the household and CBVA interviews, a community level understanding via the focus group discussions and key informant interviews, and larger-scale (national and international) perspectives on climate change and the vulnerability of the tourism sector discussed via expert interviews and focus groups. The chapter concludes by discussing any research challenges and ethical issues considered. The following chapter details the study site chosen for this research, the island of Barbados and its tourism-destination community of Oistins.

Chapter 4

Study Area

4.1 Introduction

This chapter presents this research's study area, the island of Barbados and its tourism destination community of Oistins. It commences by providing an overview of the island's geography, weather patterns, recent and predicted climatic changes, national initiatives to address climate change and current and future trends of its tourism sector. The chapter then details the destination community of Oistins, its rationale for being chosen, its key tourist attractions and household districts surveyed.

4.2 Barbados

The following section outlines Barbados' geography, including history, government and development patterns; weather patterns, past and future climatic changes; and any national-level action to address climate change. It also details current and future trends of its key tourism industry.

4.2.1 Geographic Overview

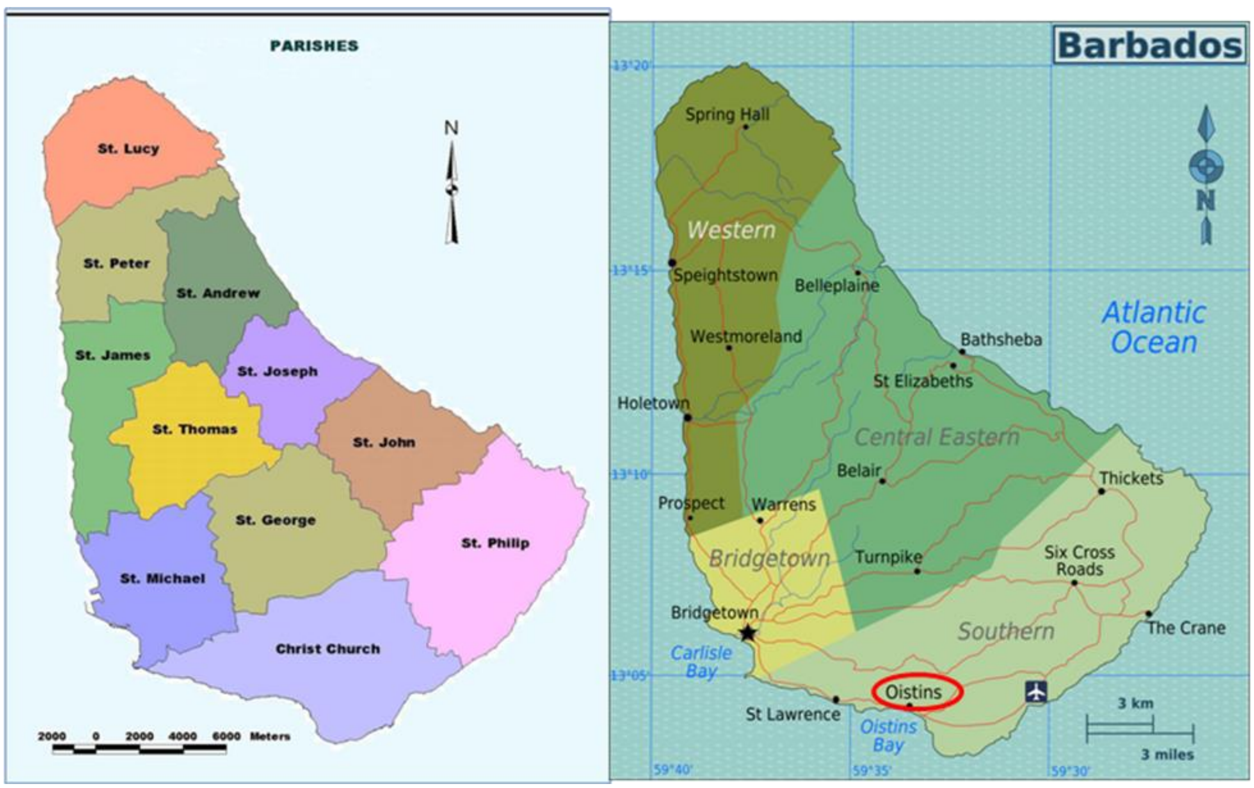
Barbados is located in the eastern Caribbean (see Figure 4) and is relatively flat, 34 km long, 23 km wide, has a coastline of 92 km and a total land area of approximately 432 km^2 (GOB, 2010b). The majority of its land area (86%) is made up of a karst (coral limestone) landscape. Its eastern Atlantic coast is rugged as it faces the trade winds and is exposed to high wave energy. In contrast, its western Caribbean coastline, due to its protected bays and shorelines, sandy beaches, fringing reefs and calm waters, has been the focal point for Barbados' tourism industry, in particular high-end developments (GOB, 2010b). The south coast is also densely populated with key residential and tourism-related infrastructure and both the west and south coasts are low lying, sandy and very erodible (UNECLAC, 2011). Even though Barbados is situated outside of the principal hurricane strike zone, the island remains at high risk to coastal erosion, as karst is easily erodible (Mycoo & Chadwick, 2012).

Figure 4. Map of the Caribbean

Source: Holiday Planners (2015)

The island was largely uninhabited when settled by the British in 1627 (Boruff & Cutter, 2007). African slaves then worked the sugar plantations developed on the island until the abolishment of slavery in 1834 (P. F. W. Wilkinson, 1997). The colonial agricultural processes removed 90% of Barbados' native vegetation, with the economy depending on the production of sugar, rum, and molasses through most of the 20th century (Murray, 2003). In 1966, Barbados became independent and its population drifted from inland agricultural areas to the western and southern coasts, as its economy diversified to include activities such as tourism (P. F. W. Wilkinson, 1997). Traditional fishing villages on the coasts also became attractions for residential and tourism development (P. F. W. Wilkinson, 1997). Large-scale tourism became more prominent in the 1950s and 1960s and by the 1990s tourism, financial, light manufacturing (i.e. rum, cement and textiles) and international business services surpassed the sugar industry in economic importance (Callaghan, 2015; CIA, 2013). Today, Barbados has one of the highest standards of living in the Caribbean and one of the highest per capita incomes in Latin America (Bishop & Payne, 2012). Literacy has hovered around the 98% mark for the last two decades and in 2013 the island had a life expectancy of 75.4 years, which can be considered high as the Unites States was 78.9 years (UNDP, 2014). In 2013, the Human Development Index (HDI) ranked Barbados in the '*high human development'* category, with a rank of 59 out of 187 countries and territories, when it had a GDP of US $3.5 Billion and a gross national income per capita of US $13,604 (2011 PPP[22] estimate) (UNDP, 2014). The 2013 HDI ranking was a sharp drop from 2012, when the island ranked 38 out of the 187 countries in the '*very high human development'* category (UNDP, 2013a). This drop in ranking points the fact that Barbados' economy has not yet recovered from the impact of the global economic crisis, to be detailed in section 5.3. Furthermore, the island practices a parliamentary form of democracy and is divided into eleven administrative parishes (see Figure 5) and thirty Constituency Councils, which were created in 2008 (GOB, 2010b).

Figure 5. Maps of Barbados, listing Parishes and Communities



Sources: Government of Barbados (2010b) and Burmese Days (2012).

Barbados is the fourth most densely populated countries in the Americas (18th globally) and in 2014 had a population of 285,916 mainly of African descent (WPR, 2014). The majority of the island's population is settled along its south-east, south and west coasts, predominantly in the parishes of St. Philip, Christ Church, St. Michael, St. James, and the southern reaches of St. Peter

[22] Purchasing parity power.

(GOB, 2010b). Its four main towns are the capital Bridgetown, with a population of 4751 located in St. Michael's Parish, Holetown and Speighstown on the west coasts in St. James' and St. Peter's parishes, with respective populations of 174 and 1420, and Oistins on the south coast in Christ Church Parish, with a population of 1037 (GOB, 2010c). Approximately 25% of the island's population lives within a continuous linear urban corridor, 2 km off the western and southern coasts (GOB, 2001a). Many of the island's residents live in areas prone to risk of flood, drought, fire and tropical storms[23], with high levels of physical and social vulnerability occurring along the coast (Boruff & Cutter, 2007; Mycoo & Chadwick, 2012). In addition, high levels of social vulnerability have been found to occur in the coastal lowlands, in rural and agricultural parishes, areas with housing-unit density and/or a high percentage of older, retired, and/or disabled persons (Boruff & Cutter, 2007). Furthermore, in the past, many Barbadians lived in villages and '*tenantries'*, consisting of wooden houses located on the limits of large estates (GOB, 2001a). Over the years homes have converted from wood to concrete, however, issues of quality and design remain pertaining to resistance to natural hazards (GOB, 2001a). The majority of coastal properties are high value real estate and the majority of homes in Barbados are owner occupied, although coastal properties have a lower incidence of owner occupation (GOB, 2001a).

4.2.2 Weather Patterns and Climate Change

This section presents general weather trends, recent and projected climatic changes for Barbados.

4.2.2.1 General Weather

The Barbadian climate is considered as dry sub-humid with an average annual temperature of 26.8^{o}C (GOB, 2001a). It has a dry season from December to May and a wet season from June to November, which coincides with the Atlantic hurricane season, during which the island may experience extreme weather events (GOB, 2010b). The wettest month is October and the driest month is March, with monthly rainfall averaging approximately 168 mm and 39 mm respectively (GOB, 2001a). Barbados is categorized among the 10 most water scarce countries in the world, as it has little surface water and is dependent on groundwater from underground aquifers for the majority (98%) of its potable water (GOB, 2010b; Simpson et al., 2012). The island has one of the

[23] *"A tropical storm is a tropical cyclone with one-minute average surface winds between 18 and 32 m s^{-1}. Beyond 32 m s^{-1}, a tropical cyclone is called a hurricane, typhoon, or cyclone…"* p. 564 (IPCC, 2012).

largest desalinization plants in the Caribbean, operating out of St. Michael's Parish, and can provide up to 20% of its drinking water supply (Ionics, 2015).

4.2.2.2 Recent Climatic Changes and Extreme Events

A significant warming trend of surface air temperature has been noted in the Caribbean over the past fifty-years (1961-2010), with the annual mean of daily minimum temperature increasing more (average of 0.28°C per decade) than the annual mean of daily maximum temperature (average of 0.19°C per decade) (Stephenson et al., 2014)[24]. Furthermore, the occurrence of warm[25]days, warm nights and extreme high temperatures has increased in the region, with cool[26] days, cool nights and extreme low temperatures decreasing, with changes for both more pronounced during the past twenty-five-years (1986-2010) (Stephenson et al., 2014). Variations in precipitation indices have been found to be less reliable in the Caribbean, though from 1986–2010, small positive trends were noted in annual total precipitation, daily intensity rainfall, maximum number of consecutive dry days and heavy rainfall events (Stephenson et al., 2014). Simpson et al. (2012) examined climatic trends for Barbados based on General Circulation Model data sets from 1960-2006 and noted similar trends to that by Stephenson et al. (2014), in particular that mean annual average temperatures increased at an average rate of 0.14˚C per decade, while rainfall observations did not indicate any noteworthy trends. Furthermore, small increasing trends were noted for sea-surface temperatures, averaging 0.07˚C per decade (Simpson et al., 2012). Mean monthly marine surface wind speeds were noted to have increased by 0.86 knots per decade annually around the island (Simpson et al., 2012). In regards to tropical storms, Kossin et al. (2010) examined North American hurricane tracks between 1950 and 2007 and found no consistent trends in the frequency of Gulf of Mexico storms, which represent most of the land-falling storms. The Caribbean is also currently experiencing 1.5 - 3 millimeters/ year of sea-level rise (Bindoff et al., 2007; Rahmstorf, 2010).

Barbados faces high exposure to climate-related events, with flooding being the most frequently occurring, affecting communities through impacts to infrastructure and agricultural land (Boruff, 2005). Drought conditions are the second most common and with economic activity focused on heavy water users, such as tourism and golf courses, the issue of water scarcity continues (UNCCD,

[24] Based on data trends from weather stations in the region (Stephenson et al., 2014).
[25] Warm days (nights) = number of days when max (minimum) temperature >90th percentile (Stephenson et al., 2014).
[26] Cool days (nights) = number of days when max (minimum) temperature <10th percentile (Stephenson et al., 2014).

2000). Moreover, the island has experienced severe drought conditions in the last decade (2002-2012), with the six of the last ten years (2006-2012) being abnormally dry (Simpson et al., 2012).

The island's eastern location in the Atlantic Ocean places it outside the principal hurricane strike zone (at moderate risk) (UNECLAC, 2011). Nevertheless, Barbados has been affected by tropical storm systems approximately every three years and experiences a direct hit once every 27.8 years, resulting in significant damage to trees, houses and infrastructure (UNECLAC, 2011). Based on evaluations spanning from 1990 to 2008, the '*Disaster Deficit Index*' identifies Barbados as the second most prone country in Latin America and the Caribbean, after Honduras, to future extreme disaster risk and to suffer significant losses, based on low economic resilience (Cardona, 2010). Bishop (2012) and Kelman (2010) note that one extreme event in a SIDS can counter years of development gains. Table 8 presents the top storms impacting Barbados from 1900 to 2014, in terms of economic impact, number of people affected and number of deaths, with Hurricane Janet, Hurricane Ivan and Tropical Storm Tomas being the most significant (EM-DAT, 2010). The Table demonstrates that the intensity of storms has increased in terms of economic impact.

Hurricane Janet was the last hurricane to directly hit Barbados in 1955 and affected the most people (EM-DAT, 2010). In 2004, Hurricane Ivan was the second most powerful storm to affect the Caribbean in terms of economic damage (WMO, 2013). The most recent storm to cause severe damage and the highest economic impact to the island (US $8.5 million) was Hurricane Tomas on October 31st of 2010, which impacted the island as a Tropical Storm (CDEMA, 2010). The storm resulted in intensive rainfall, flooding and high winds, damaging the housing stock (roofs in particular), agricultural sector, trees, roads, utilities and power lines (CDEMA, 2010). Barbados received a full payout to address the economic impacts of the storm from the Caribbean Catastrophe Risk Insurance Facility (CDEMA, 2010). In the past 20 years, Barbados has spent over US $106.7 million on economic damage due to natural disasters (EM-DAT, 2010).

Table 8. Top Storms to Impact Barbados from 1900 to 2014

Month, year - **Storm name**	**Economic Impacts (US $ 000s)**	**# of People Affected**	**# of Deaths**
October 2010 - **Tropical Storm Tomas**	8,500 (CDEMA, 2010)	2,500	0
September 2004 - **Hurricane Ivan**	5,000	880	1
September 2002 - **Tropical Storm Lili**	200	2,000	0
September 1987 - **Hurricane Emily**	100 (Case & Gerrish, 1988)	230	0
August 1980 - **Hurricane Allen**	1,500	5,007	0
September 1955 - **Hurricane Janet**	2,800 (Davis & Moore, 1955)	20,000(GOB, 2001a)	57

Source: (EM-DAT, 2010), unless otherwise noted.

4.2.2.3 Predicted Climatic Changes

Small islands contribute an estimated less than 1% of global greenhouse gas emissions; yet will suffer disproportionately from the consequences of climate change (Kelman, 2011; Nurse et al., 2014). In the Caribbean, annual average temperatures are projected to increase by 1 to 4°C over 2071-2100, relative to 1961-1990 baselines (Campbell et al., 2011). For Barbados, mean annual surface temperature is predicted to increase by 3°C by 2075-2099, relative to 1979-2003 baselines, with the number of hot days[27] and hot nights[28] increasing up to 20 days and 20-60 nights per year (T. C. Hall et al., 2013)[29]. General Circulation Models project annual sea-surface temperature increases in Barbados ranging from + 0.8˚C to 3.0˚C by the 2080s, relative to 1960-2006 baselines (Simpson et al., 2012). Furthermore, annual rainfall is predicted to decrease between 10-20% in the Eastern Caribbean (T. C. Hall et al., 2013). For the wet season, basin-wide drying is to continue and predicted to more severe for the earlier part of the wet season (May to July), when the Eastern Caribbean is expected to become drier in excess of 20% (T. C. Hall et al., 2013). In addition, changes in mean wind speeds by the 2080s are predicted to be very small, between -0.39 and +0.78 knots with GCMs and Regional Climate Models projecting an average of +1.56 knots (Simpson et al., 2012).

The observation of long-term trends in tropical storms and their connection to increasing greenhouse gases levels is challenging due to their fluctuations and limited availability and quality of global historical records (Knutson et al., 2010). Nevertheless, mid to late century projections suggest that atmospheric warming will cause the globally averaged intensity of tropical cyclones to

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[27] Extremely hot days = The annual count of days with maximum temperature Tmax $\geq$ 35°C (T. C. Hall et al., 2013).
[28] Tropical nights = The annual count of nights with minimum temperature Tmax $\geq$ 25°C (T. C. Hall et al., 2013)
[29] Used a high resolution GCM of 20 km for A1B (medium) scenario (T. C. Hall et al., 2013).

increase by 2-11%, while also decreasing in frequency by 6 - 34% (Knutson et al., 2010). Thus any storms that might develop in Barbados could be stronger in intensity and continue to bring more economic damage.

Projections for sea-level rise worldwide are 0.5 - 2.15 metres by 2100 (Bindoff et al., 2007; Rahmstorf, 2010). Due to the Caribbean's close location to the equator, it is predicted to experience greater SLR than most areas of the world (Simpson et al., 2010). Moreover, sea-level rise is predicted to continue for centuries after 2100, even if global temperatures are stabilized at 2°C or 2.5°C and thus represents a long-term threat to the region (Simpson et al., 2010). The impact of a one-metre rise in sea-level and resulting water inundation in the Caribbean could result in the loss of 1,300km^2 of land*,* destroy 1% of agricultural land and displace over 110,000 people (Simpson et al., 2010). It could also greatly damage 28% of the region's airports and 80% of its seaports. The total financial cost of such an impact is estimated to be up to US $187 billion by 2080 or between US $4 - 6 billion per year (Simpson et al., 2010). A two-metre sea level rise could lead to the loss of 3,000km^2 of land, destroy 3% of agricultural land and displace over 260,000 people (Simpson et al., 2010). Smaller islands in the Eastern Caribbean, including Barbados, are predicted to face high per capita economic costs from sea-level rise (Simpson et al., 2010).

4.2.3 Action on Climate Change

Barbados has been one of the most vocal countries in the Caribbean in regards to climate change action (Bishop & Payne, 2012; GOB, 2010b). In 1994, Barbados hosted a conference on the sustainable development of SIDS and highlighted the uncertain position of the islands due to climate change, which resulted in the Barbados Program of Action (BPOA) and the creation of the Alliance of Small Island States (AOSIS) (UNDSD, 1994). The BPOA identified priority areas and actions to address the challenges faced by SIDS, including climate change, sea-level rise and tourism (UNDSD, 1994). Actions pertaining to tourism related to sustainable tourism development and environmental management, with no links to climate change or adaptation (UNDSD, 1994). In 2001, the island's '*First National Communications to the UNFCCC*' noted the island's vulnerability to climate change due to an economic dependence on tourism and location of valuable tourist infrastructure close to the coast, a low water table, heavy coastal erosion (resulting in 15% of coral cover removed from its total surface), high population density, heavy consumption and cost of imported energy and a high import-ratio for food (GOB, 2001a)**.**

The island is also one of the few Caribbean countries to produce a Mauritius+5 National Assessment Report (NAR)[30], which notes environmental measures implemented to date, including coastal and ground-water protection, land-use planning, and the development of a solar water heating industry (Bishop & Payne, 2012; GOB, 2010b). The NAR also notes climate change adaptation and mitigation projects in the inception stage or on-stream, with adaptation initiatives including physical measures such as improved water management, stabilized shoreline and control erosion, drainage management and flood prevention and reduced land degradation (GOB, 2010b). Specific mentions to tourism and climate change adaptation include in-land tourism development (such as Harrisons Cave) and the development of a *'National Adaptation Strategy to Address Climate Change in the Tourism Sector'* (CCCCC, 2009a), to be discussed in section 5.4. General mitigation efforts include the national government's *'Green Economy vision'*, which aims for the largest reduction in fossil fuel consumption of any Latin American or Caribbean country within the next 10 to 15 years, by focusing on renewable energy and energy efficiency and conservation (GOB, 2012). Compared to other SIDS in the Caribbean, some scholars note that Barbados has the ability to develop a plan to address climate change, though increased funding and technological support is required from the international community (Bishop & Payne, 2012; Griffith & Gibbs, 2009).

4.2.4 Importance of Tourism

4.2.4.1 Current Trends

It is useful to assess the vulnerability of Barbados within the tourism context, as the Caribbean region is considered a '*tourism climate change vulnerability hotspot'* (C. M. Hall, 2008; Scott et al., 2008). The World Travel and Tourism Council classifies the Caribbean as having the most tourism intensive economy among its 12 regions, as the sector represents the greatest proportion of the region's economy (WTTC, 2015b). In 2014, tourism accounted for 14.6% of the region's total GDP contribution (US$ 51.9 Billion), 13% of total employment, 12.2% of total investment and 18.1% of total exports (WTTC, 2015b). The Caribbean has developed a variety of tourism products which

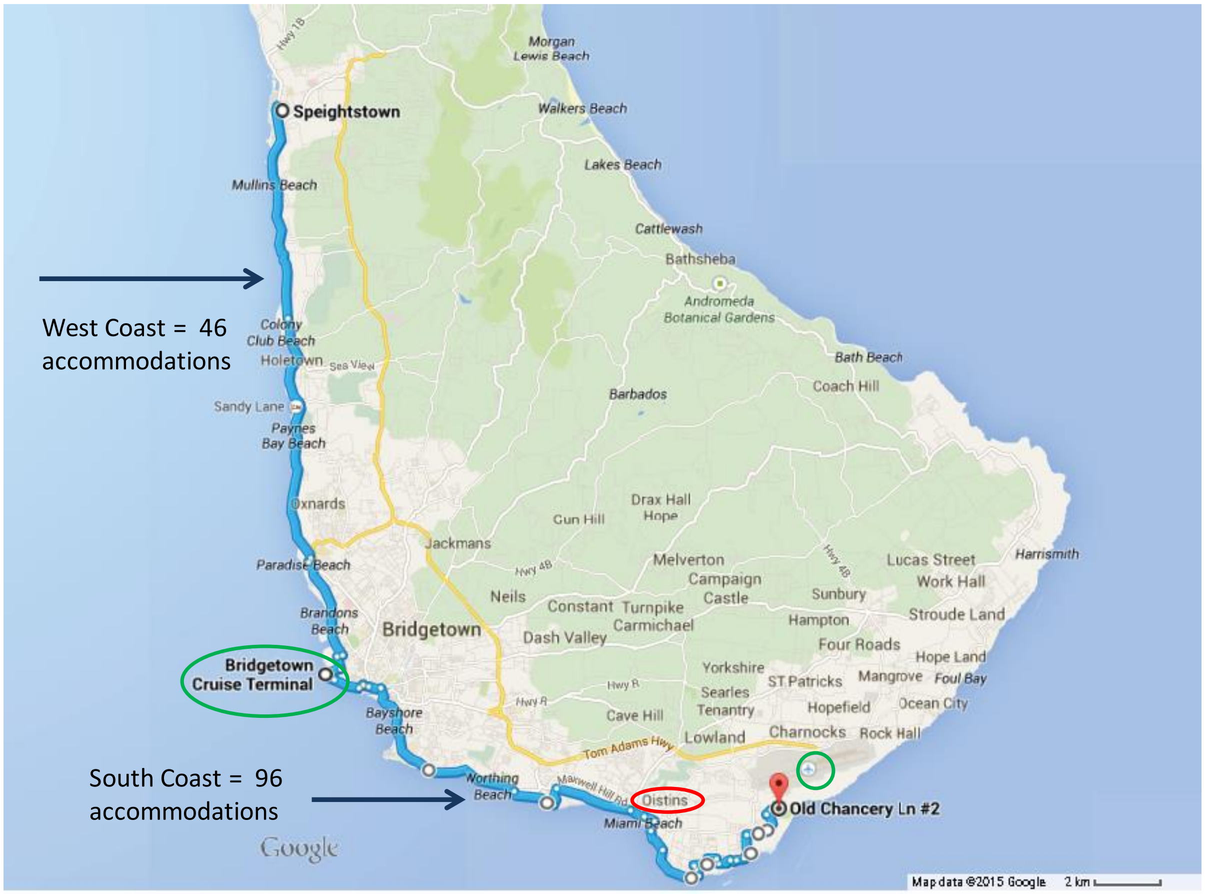
[30] Took place in 2010 (and dubbed Mauritius+5), based on the '*Mauritius Strategy'* developed in 2005 to further develop the BPOA (Bishop & Payne, 2012).

highlight its natural assets of sea and beaches, including “*sea-sand-sun*” (3S) resorts, cruise tourism, sports tourism, cultural events, ecotourism and health tourism (Zappino, 2005). Furthermore, the region’s tourism sector is comprised of international, national, regional and local level stakeholders for both the supply side (hotel operators and tour companies) and demand side (tourists). Local level stakeholders, representing individual tourist service venues and outlets, are the most numerous and the basis for ‘*community-based tourism*’ (CDEMA, 2009c). The Caribbean Disaster Emergency Management Association (CDEMA) notes that “*For purposes of resilience to events* (hazard related), *there is an important connection between the tourism establishments and the communities in which they are located*’, p. 46 (CDEMA, 2009c). At the local level, the Caribbean Tourism Organization (CTO) presents eight-subsectors for the region’s industry: accommodation, food and beverage, transportation, attractions, adventure tourism, events and conferences, travel trade and tourism services (CDEMA, 2009d). Tourism establishments can also be considered as a ‘*cluster’*, comprised of several establishments located near each other, allowing them to collaboratively prepare for and respond to any threats (CDEMA, 2009c; CDEMA, 2013b).

For the island of Barbados, tourism is the key economic driver, though its total industry value has been in decline since 2008, when it was valued at $US 2.1 billion (WEF, 2011). In 2010 the industry was valued at US $1.8 billion and contributed 14.1% of direct and 48.1% of total Gross Domestic Product (WEF, 2011). In 2014, the total industry value was US $1.69 billion, contributing 10.8% to direct GDP and 36.1% to total global GDP (WTTC, 2015a). On average, over 523,000 tourists have visited Barbados each year between 1995 and 2013 (World Bank, 2015). Barbados’ key attractions are its climate and coastal environment, notably its sandy beaches (GOB, 2012; Uyarra et al., 2005). Other attributes include its modern infrastructure and utilities, accessibility (air and cruise), safety, politically stability and low health risks (GOB, 2012; Uyarra et al., 2005). Key source markets for long stay-over arrivals, averaged between 2005 – 2010, are the United Kingdom (37%), US (24%), Canada (10%), the Caribbean (18%) other European countries (5%) and other countries (5%) (GOB, 2012). The principal tourist season runs in the dry season from mid-December to mid-April, accounting for 60-70% of tourism-related business (GOB, 2010b). Figure 6 presents the stretch of shoreline housing tourism facilities along the western (Speighstown to the Bridgetown Cruise Terminal, distance of 19km) and southern coasts (Bridgetown Cruise Terminal to Grantley Adams International Airport, distance of 21km) (Google Maps, 2015). The Barbados Tourism Product Authority (BTPA)

[Tourism Org 4] has 46 tourism facilities (hotels, apartments and guesthouses) registered along the west coast and 96 facilities along the south coast (BTPA, 2015).

Figure 6. Barbados Shoreline and Tourist Facilities along its Western and Southern Coasts



Source: BTPA (2015) and Google Maps (2015).

Barbados has received recognition for its tourism product as in 2013, the island ranked 27th of 140 countries, and highest of five Caribbean countries[31], in the World Economic Forum's '*Travel and Tourism Competitiveness Index'* (TTCI), based on its regulatory framework; business environment and infrastructure; and human, cultural, and natural resources (WEF, 2013). Furthermore, in a regional ranking for the Americas, the island ranked third, after Canada and the United States (WEF, 2013). The 2013 TTCI notes Barbados' positive attitude toward tourists and its government's prioritization and funding towards the sector, as evidenced by destination marketing campaigns and

[31] In decreasing order: Jamaica, Trinidad and Tobago, Dominican Republic and Haiti (WEF, 2013).

timely collection of sector data. To further strengthen the country's travel and tourism competitiveness, the Index recommends Barbados improve its degree of customer satisfaction and continue to protect its natural environment (WEF, 2013).

In 2012, the Barbados' Ministry of Tourism produced a '*White Paper on Tourism'*, which sets the policy direction for the island's Tourism Master Plan from 2011-2021 (GOB, 2012). The document notes the following trends driving the island's tourism industry in the future: increased global competition, demographic shifts, emerging markets, rapidly evolving consumer behaviour, preferences and expectations and the advent of new information and green technologies. Threats to the stability of the island's sector include those posed by the global economic crisis, climate change, natural disasters, health pandemics, currency fluctuations and rising oil and food prices, which are further detailed in sections 5.2 and 5.3 (GOB, 2012).

The '*White Paper'* lists several goals to make Barbados' tourism industry competitive and prepare for any of the noted trends and threats (GOB, 2012). These include diversifying the island's tourism product by becoming a differentiated, year-round destination, with a variety of attributes appealing to several segments of the market, including younger tourists in addition to the repeat customer base of largely mature tourists (GOB, 2012). It would also entail encouraging other products such as ecotourism, sports, community, culinary and cultural heritage tourism (GOB, 2012; UNECLAC, 2014). Further marketing would also occur to travelers from emerging markets such as Brazil, Russia, India and China (BRIC), though no mention is made of the carbon intensity associated with long-haul tourism to the three latter countries (GOB, 2012). The government also plans to continue to develop the sector's luxury segment (GOB, 2012; UNECLAC, 2014).

4.2.4.2 Future Trends

As noted in chapter 2, section 2.5.1, international tourism arrivals are predicted to be 1.8 billion by 2030, with the share of international arrivals to emerging economy destinations surpassing that to advanced economy destinations (UNWTO, 2011). Furthermore, global growth in international tourist arrivals is predicted to continue at a more moderate pace of 3.3% per year during 2010-2030, compared to an average of 3.9% during 1995-2010. In the Caribbean, the rate of growth for tourist arrivals and economic benefits of tourism is not expected to grow significantly in the next two decades (UNWTO, 2011; WTTC, 2015a; WTTC, 2015b). The region's average annual growth in international tourist arrivals, which was 2.4% from 1995-2010, will fall to 2% during 2010-2030, below the predicted global trend (UNWTO, 2011). Moreover, it is estimated that in 2025, tourism will account for 15.4% of the region's total GDP contribution (US $73.6 billion), 14.4% of total employment, 14.0% of total investment and 18.4% of total exports (an almost nil increase for all figures ranging from 0.9 – 1.8% from 2014 figures, as noted in section 4.2.4.1) (WTTC, 2015b). Between 2015 and 2025, long term growth for total GDP for the region is predicted to be 3.3%, a rank of 10th out of the twelve world tourism regions (a drop of two ranks since 2014) (WTTC, 2015b). For Barbados, the total industry value is predicted to be US $2.4 billion in 2025, contributing 12.3% of direct and 41.6% of total GDP, with both GDP figures rising approximately 3.3% per year (increase of 1.5% and 5.5% of 2014 figures as noted in section 4.2.4.1) (WTTC, 2015a). Between 2015 and 2025, long term percent growth for total GDP of the island will be 3.4%, a rank of 8th out of the 10 Caribbean countries considered (an increase of one rank over the ten years) (WTTC, 2015a).

The above tourism figures for the Caribbean and Barbados project a relatively stagnant growth of the sector in the next fifteen years. This can be explained as future international tourist arrivals are forecasted to be more evenly spread across destinations worldwide, with emerging destinations such as South Asia predicted to be the fastest growing sub-region for arrivals (+6.0% a year) (UNWTO, 2011). Nevertheless, Barbados' tourism infrastructure has received a very high rating in the region, due to the island's urban renewal and refurbishment projects to expand and improve hotel quality and capacity and tourist facilities (WTTC, 2014).

4.3 Oistins

The following section presents the community of Oistins and its rationale for selection. It also presents its key tourist attractions and the districts in which the household surveys were conducted.

4.3.1 Community Overview and Rationale for Selection

The tourism destination community of Oistins, situated on the south-coast of Barbados and with the defined boundaries of a town, was selected as a study-site for this research. Oistins is located within the Christ Church Parish and the South Christ Church (SCC) Constituency Council (see Figure 5). The community is a historic and the third most populous town in Barbados with a population of 1037 in 2010 (GOB, 2010c). Oistins is a '*site-specific'* tourism destination community and an example of '*community-based tourism'* (CDEMA, 2009c; UNWTO, 2004a). In addition to falling under the Caribbean Tourism Organization's sub-sectors of accommodation, food and beverage and transportation businesses, Oistins tourism's features can also be categorized as '*attractions'* or as a '*cluster'* of tourist establishments (CDEMA, 2009c; CDEMA, 2009d). Oistins key attractions include two beaches, several hotels and restaurants within and on the outskirts of the community, the Bay Garden Vendors Area and the Oistins Fish-Market, the latter two which neighbour each other. Tourism-related activities are also connected to the consumption of local fisheries, as Oistins hosts the largest fishing community and the second largest fish-market in the island (GOB, 2010a).

Oistins is at risk from an increase in climate-related events, as it supports small (i.e. vendors), medium (i.e. small hotels) and large-scale (i.e. large hotels) tourism related activities, lies low in a basin and its physical resources and infrastructure, including tourism facilities, fish-market and fishing boats, are located very close to the coast (Simpson et al., 2012; The CARIBSAVE Partnership, 2010). Furthermore, Barbados' Ministry of Social Care and Constituency Empowerment identified the community as one the island's most vulnerable to climate-related events as it is located by the sea and has a lot of people, including tourists, congregating in large numbers at the Bay Garden Vendors Area on the weekends. Christ Church Parish has been found to have medium social vulnerability to natural hazards, though the two neighbourhoods across from the Vendors Area and the Fish-Market can be considered highly vulnerable, due to a lower income status, high housing density and a high percentage of older and retired persons (Boruff & Cutter, 2007). Oistins also has physical infrastructure that is vulnerable to climate related-events, including ships that berth off its shore with aviation fuel and a fuel oil storage facility.

Stakeholders consulted (national and local level government, community and tourism representatives) determined Oistins to be an appropriate case-study in Barbados in which to examine tourism-related vulnerability at the community level, as it comprises of livelihoods connected to small, medium and large tourism enterprises. They discussed other possible sites in the island to examine as tourism destination communities, including Holetown and Speighstown on the west-coast, which engage in higher-end or 'luxury' tourism (J. Wilkinson, 2014). Beach sites such as 'Dover' on the south-coast were also considered, which have predominantly large-scale tourism-related activities (i.e. hotels), yet do not have surrounding neighbourhoods that are socioeconomically vulnerable, in which workers or operators of small-scale tourism enterprises might live. Moontown (St. Lucy Parish) on the north coast and Martins Bay (St. John's Parish) on the east coast, also have fish-markets and fish-fries, though they are a lot smaller than Oistins and receive less tourists. When considering the vulnerability of Oistins to climate-related events, stakeholders indicated that other factors besides tourism should also be considered, including socio-economic conditions and the type of tourism people are employed in.

4.3.2 Bay Garden Vendors Area and Fish-Market

Over the past fifty years, the Oistins' Fish-Market has become a key agro-tourism destination community with attractions including the Bay Garden food and craft vendors, the fish-market, the fishermen, the jetty to view the turtles and the fishing vessels, and the boatyard. Out of these, this research focused on the Bay Garden food and craft vendors, the area frequented most by tourists. Fishermen were also interviewed to assess the indirect impacts of climate change on the natural environment, in particular the fisheries harvest, an important resource for the tourism industry. Newer food stalls facing the water and an entertainment stage were built in 2008 by the Barbados Tourism Investment Inc. and managed by the National Conservation Commission (NCC) [Tourism Org 5]. The newer development has facilitated more structured activities for tourists and locals.

The Oistins Bay Garden Vendors Area and Fish-Market are very popular amongst tourists as it is accessible by bus, has a scenic location and access to other businesses, including restaurants and super-markets.   Tourists and locals visit the Vendors Area and the Oistins Fish-Market every night of the week, with the busiest night being the Friday night '*Fish-fry.* In 2003, the Bay Garden Vendors Area and the Oistins Fish Market were the second most popular tourist attraction in Barbados, receiving 28% of all for visitors (CTO, 2003)[32]. Similar visitor statistics to Oistins were recorded between 2001 and 2006 (CTO, 2006). Furthermore, the Friday night *'Fish-fry'* was ranked as the #1 tourist nightlife spot in Barbados in 2008 and #2 tourist nightlife spot in 2006 by Zagat International in a special survey for the Barbados Tourism Product Authority (Hoyos & Corsello, 2006; Hoyos & Corsello, 2008). The Bay Garden Vendors' key features include the low cost of meals and crafts, the culture of dancing and the opportunity to mix with locals. The Ministry of Tourism's '*White Paper'* presents the Oistins Fish Fry as an example of '*community and culinary tourism'*, as it involves the local population in the decision-making and development process and allows tourists to enjoy local

[32] Such precise data was only available for this year (CTO, 2006).

events and food (GOB, 2012). For these reasons, the Ministry wants to replicate this model and is encouraging similar establishments across the island (i.e. Moontown, St. Lucy's Parish) (GOB, 2012).

4.3.2.1 Bay Garden Vendors (Food and Craft)

The Bay Garden Vendors Area is located next to the Oistins Fishing Complex and consists of thirty small food kiosks, an outdoor seating area, a large entertainment stage and an area towards the back facing the water, where twenty craft vendors set up small tables on Friday nights (see Photo 1 and Photo 2). Some of the seating areas are covered by umbrellas. Tourists frequenting the Area on a Friday night (6-9 pm) were estimated to provide up to 75% of weekly business for all of the food and craft vendors interviewed. The Bay Garden Vendors Association (BGVA) is attempting to diversify its activities beyond Friday nights and attract tourists on other nights. The food vendors rent their kiosks from Tourism Organization 5 for a low fee. Popular fish that the Bay Garden food vendors serve to tourists are in the form of large steaks with no bones and include the larger ocean pelagics[33] (i.e. yellow-fin tuna, shark and dolphin, king fish and bill fish (GOB, 2004). The food vendors buy their fish from local fishermen and local fish-vendors. When local pelagic supply is low, and to obtain fish in standard size pre-cut slices, food vendors also buy fish from local processers, where they can also buy imported fish, including shrimp or lobster. The craft vendors sell predominantly to tourists on Friday nights. They do not have permanent booths and sell on tables under tarps and tents (see Photo 2). Tourism Organization 5 is considering creating a more permanent craft vendors area across the main street.

Photo 1. Bay Garden Vendors Food Area

Source: Z. Moghal

[33] Pelagic fish live in the water column of coasts, open oceans, and lakes (NOAA, 2014).

Photo 2. Bay Garden Food and Craft Vendors

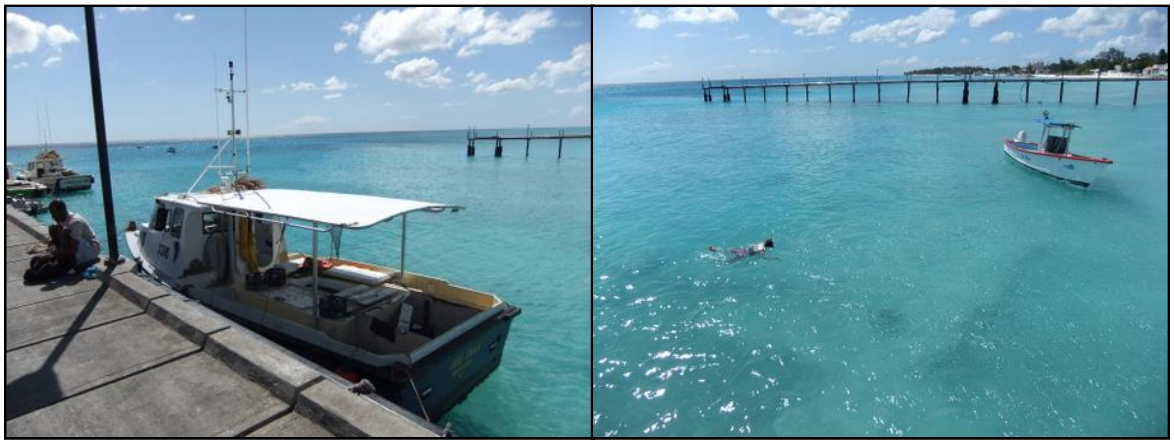
Source: Z. Moghal

4.3.2.2 Fish-Market

The Barbados fisheries sector is dependent on small-scale fisheries consisting of fishermen, fish vendors and fishing boat owners, many of whom are self-employed (GOB, 2004). Fishers in Oistins supply a biological resource important for local and tourist consumption, as Bajan fishers harvest 22.5% of fish consumed in the island. This research examined whether climate variability and change was affecting the supply or fishing ability of fishers and whether this was in turn affected the amount of fish available for food vendors, who thereby sell to tourists and locals.

The fishing industry in Barbados depends on the migratory off-shore pelagics of flying fish and larger ocean pelagics*,* caught from November to July each year, 10km or more off the south or south-east coast of Barbados (GOB, 2004). The larger ocean pelagics represent 22% of total annual landings and are particularly important for the local tourism industry (GOB, 2004; Simpson et al., 2012). The status of ocean pelagics in the Caribbean is uncertain, though it is estimated that some stocks are sufficient to allow for an expansion of the fishery (GOB, 2004). Coastal pelagics, including reef-fish, are also harvested off the coral reefs at all times of the year, though predominantly from July to October within 10-12 km off Oistins' coast. The shallow reef (in-shore) fisheries, which are also important for tourism, have been overfished, particularly on the south and west coasts (GOB, 2004). The deep-slope and bank reef (off-shore) fisheries mainly targets snappers and may be fully exploited in some areas, but not in others (GOB, 2004).

Photo 3. Oistins Jetty (Fishers and Tourists)



Source: Z. Moghal

Oistins is the second largest fish landing site in Barbados and includes a market building, jetty to unload fish, areas to debone and sell fish, cold storage and ice making facilities and vendors stalls (GOB, 2010a). The landing site also has a boat yard to service and repair boats. In the winter of 2011, the Researcher noted seventy boats were actively registered with the Fisheries Division and/or fishing with crews of 2-3 people, approximating 140 – 210 fishermen. After the fish are weighed and a market toll paid, the fishermen can sell their fish to fish-vendors/'*hawkers'* (53%), including the Bay Garden food vendors, fish-processors (30%), '*walk-in'* customers (9%), exporters of large pelagics such as tunas to the American market (6%)[34] and the hospitality sector, including restaurants and hotels (2%) (FAO, 2005; GOB, 2004). The main boats used in Barbados to catch fish are day-boats and ice-boats, with the latter being larger and used to catch ocean pelagics (GOB, 2010a). Ice-boats can travel approximately 150 km off-shore and be on the water for 5-10 days at a time. They have a crew of three people and fishers consulted stated they can cost between \$250,000 – 300,000 BDS[35], plus \$50,000 BDS for equipment. Fishers also noted that a good catch for an ice-boat is to make \$2,000 BDS/ trip in profit.

[34] FAO (2005) notes a lower export figure of 2.5%.

[35] 1 Barbadian Dollar = 0.50 US dollar (XE Currency Convertors, 2013).

4.3.3 Beaches and Other Tourism-Related Enterprises

The community of Oistins has two beaches, Miami and Welches, bordering either side of it. It has also has several hotels, restaurants and other tourism-related services.

4.3.3.1 Beaches

Stakeholders representing water sports operations, clothes vendors, food vendors and lifeguards were interviewed in the two key beaches of Oistins (see Photo 4). Miami Beach (Beach #1) is located approximately 0.5 km east of Oistins. It provides formal recreational activities, by offering lifeguards, change rooms, chair rentals, food and craft vendors. Non-motorized water-sports activities are also permitted. Stakeholders who worked on the beach noted that during the tourist season, predominantly tourists frequent the beach (approximately 80%). The north side of Miami Beach has a lot of rip tide and undercurrent. Welches Beach (Beach #2) is located approximately 0.5 km west of Oistins, used more informally by tourists and locals and has no lifeguards or business activities. To preserve its coastline, the beach underwent improvement in 2006 through groyne construction and beach nourishment valued at US $2.1 million (Griffith & Gibbs, 2009; Mycoo & Chadwick, 2012). The initiative reduced the overtopping of the seawall and flooding of the roadway during storm events and provided an improved beach amenity (CZMU, 2013). Three stakeholders were also interviewed on Beach #3 (Dover Beach), a popular beach located 4 km west of Oistins, as all the respondents in beach #1 and #2 had been interviewed. A clothes vendor, water-sports operator and taxi driver were interviewed on Dover Beach.

Photo 4. Miami Beach and Welches Beach

Source: Z. Moghal

4.3.3.2 Accommodations and Restaurants

Oistins has several large and small hotels, guesthouses, restaurants and other tourism-related businesses located within the community, along and off the coast (see Photo 5). According to Google Maps, Figure 7 presents eighteen hotels situated between Miami Beach and Dover Beach, many of which include restaurants. The Figure does not capture the smaller hotels or guesthouses located in the area (Google Maps, 2015). The '*Intimate Hotels of Barbados'* classifies small hotels as having 75 rooms or less (Harris, 2014). As noted in chapter 3, managers and staff of four large and two small hotels and three individual restaurants were interviewed.

Photo 5. Large Hotel and Small Hotel

Sour

Source: Z. Moghal

Figure 7. Map of Hotels in the Oistins Area

Source: Google Maps (2015)

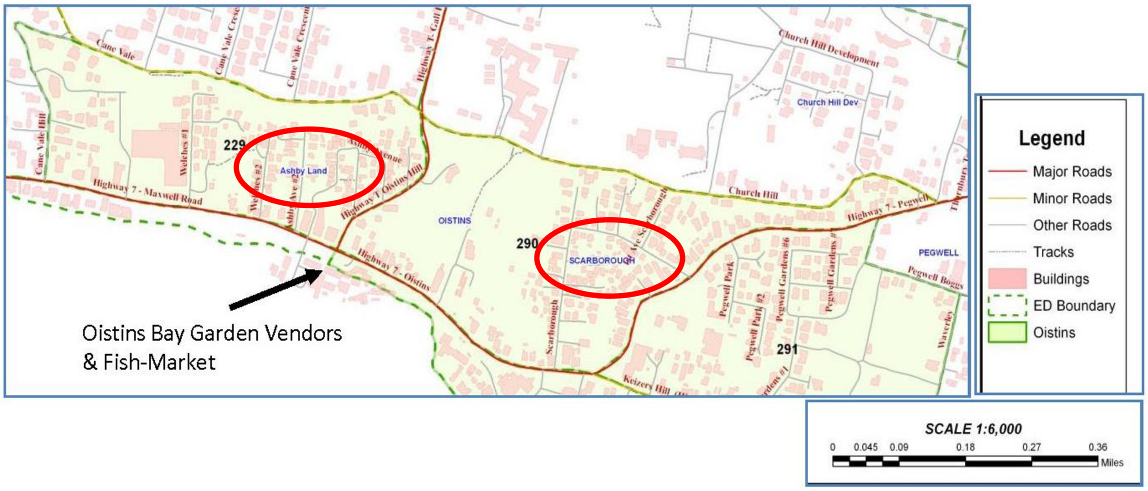
4.3.4 Districts for Household Surveys

As noted in chapter 3, section 3.3.3.1, household-level vulnerability was examined in two of the neighbourhoods in Oistins, directly adjacent to the Bay Garden Vendors Area and the Oistins Fish Market: Ashby Lands and Scarborough (see Figure 8). The neighbourhoods served as the site to assess household level vulnerability to climate change and to determine how connected livelihoods were to tourism related activities. Stakeholders of The CARIBSAVE Partnership Participatory workshop, in August of 2010, identified the two neighbourhoods to be socioeconomically and biophysically vulnerable to extreme climate-related events, due to their proximity to the coast and lower socio-economic status (The CARIBSAVE Partnership, 2010). Other organizations in Barbados also surveyed the districts for similar reasons. The Centre for Resource Management and Environmental Studies, University of West Indies surveyed fifty households in the neighbourhoods in 2008, as Oistins was one of their study sites for the '*Socio-economic monitoring Project by Caribbean fishery authorities'* (Leslie, 2010). The Barbados Red Cross Society also surveyed fifty households in the two districts as part of the '*Building Safer, More Resilient Communities'* Project in Oistins in May of 2010 (The Barbados Advocate, 2011a). Figure 8 portrays the two neighbourhoods and their proximity to the Bay Garden Vendors Area and the Oistins Fish-Market (GOB, 2000).

Photo 6. Neighbourhoods Surveyed

Source: Z. Moghal

Figure 8. Neighbourhoods Surveyed in Oistins



Source: GOB (2000)

4.3.5 Summary and Conclusion

Barbados is a small island developing state, considered to be more developed and have a higher adaptive capacity than many of its neighbouring islands in the Caribbean. Nevertheless, the island remains highly exposed and sensitive to many future impacts of climate change. As the Ministry of Tourism plans to promote community tourism to reduce poverty and expand the island's tourism product, an understanding of destination-scale vulnerabilities remains important. The community of Oistins provides a unique case-study to assess the climate change vulnerability of a tourism destination, including tourism-related livelihoods connected to small and medium sized enterprises.

Chapter four has provided an overview of Barbados' geography, climatic patterns and importance of its tourism sector. It then detailed the community of Oistins and its key tourist attractions and why it was selected to examine in this research. The following chapter critically assesses the vulnerability of Barbados' tourism sector to climate change. It also empirically analyses scenarios for Barbados' tourism sector under future climate change and suggests measures that the island could take to adapt.

Chapter 5 National Tourism Sector Vulnerability Assessment

5.1 Introduction

Small islands developing states are very vulnerable to climate change, as they are often isolated from economic centers, have low adaptive capacity and rely on a few climate-sensitive resource-based activities such as tourism or fisheries (Kelman, 2010; Nurse et al., 2014). Furthermore, as SIDS depend upon the rest of the world for many aspects of their economies, they are also vulnerable to non-climatic global stressors, making it challenging to distinguish the impacts of climatic and non-climatic stressors (Bishop & Payne, 2012; Cramer et al., 2014; Scott et al., 2008). This chapter critically assesses academic and government literature that has examined the vulnerability of Barbados' tourism sector to provide vital context and value for the interpretation of the sub-national indicators and CBVA results to be presented in chapters 6 and 7. The assessment first examines the predicted vulnerabilities of the island's tourism sector via climatic and non-climatic stressors, as presented in this research's conceptual framework, Figure 2, chapter 2 (section 2.6.1). It then empirically analyzes the state of climate change preparedness of Barbados' tourism sector. The chapter also details gaps in the island's efforts to understand vulnerability and adapt, presents future scenarios of the sector under climate change and identifies certain adaptation measures.

5.2 Climate Change Impact Pathways upon Barbados' Tourism Sector

The following section details the four pathways in which climate change could affect tourism in Barbados, based upon the conceptual framework of Scott et al. (2012), Figure 1, chapter 2 (section 2.5.2).

5.2.1 Pathway 1: Direct Impacts of Climate

Barbados' tourism sector would face direct impacts from climate change, including changes in the length and quality of its tourism season and that of its source-markets (GOB, 2001a; Scott et al., 2012). In regards to Barbados' tourism season, the island's mean annual surface temperature is predicted to increase by 3°C by 2100 (T. C. Hall et al., 2013), which added to current average annual temperature (GOB, 2001a), would result in an annual average of 29.8°C late century. National and regional organizations predict that such higher temperatures would be too uncomfortable for tourists and thereby impact upon the islands' tourism demand and destination attractiveness, also leading to a greater use of air conditioning and water, thereby increasing energy consumption and operating costs (CCCCC, 2009b; GOB, 2001a; GOB, 2012). This assumption does not account for recent studies which examined Caribbean tourist behaviour at the micro-scale, including Barbados, and noted the existence of differential climate preferences (Rutty & Scott, 2013; Rutty & Scott, 2014a; Rutty & Scott, 2014b). In particular, tourists from temperate regions have ideal temperatures between 27 and 30°C, while those from tropical regions having an ideal of 30°C (Rutty & Scott, 2013). Beach users were also found to be content with temperatures as high as 32 - 39°C (Rutty & Scott, 2014a). In addition, tourists can obtain differing thermal conditions within a particular coastal resort[36], with outside adaptive ranges between 1-4°C (Rutty & Scott, 2014b). These three studies suggest that a higher annual temperature of almost 30 °C for Barbados by late century, would not likely affect tourists planning to visit the island, who for the most part come from temperature regions to enjoy beach-related activities.

The same insight can be noted for Moore's (2010) assessment of the potential impact of climate change on Caribbean tourism arrivals, including Barbados, based on the use of a Tourism Climate Index (TCI)[37] and a tourism demand model. The study estimated that Barbados tourist arrivals could reduce up to 6% between 2071-2100, from 2004 business as usual (BAU) levels, one of the highest drops in the region (see Table 12) (W. R. Moore, 2010). No specific details were provided as to the TCI change for Barbados, including air temperature. A smaller decline would have been projected by Moore (2010) if he had used the more detailed studies to examine tourist climate preferences in the Caribbean (Rutty & Scott, 2013; Rutty & Scott, 2014a; Rutty & Scott, 2014b), which demonstrate that tourists prefer and can tolerate higher temperatures than projected in the TCI.

In contrast, regional temperature increases in Barbados' key source-markets (i.e. North America, the United Kingdom and other European countries) could cause greater impact to its tourism demand and destination attractiveness, as warmer winters in the source countries could reduce the motivation for northerners to travel south (Bigano, Hamilton, Maddison, & Tol, 2007; CCCCC, 2009b;

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[36] Used the Universal Thermal Climate Index (UCTI) to measure human thermal conditions (i.e. air temperature, wind, radiation and humidity) (Rutty & Scott, 2014b).

[37] Comprised of a weighted average of: 1) monthly means for maximum daily temperature, 2) mean daily temperature, 3) minimum daily temperature, 4) mean daily relative humidity, 5) total precipitation, 6) total hours of sunshine and 7) average wind speed (Mieczkowski, 1985).

J. M. Hamilton, Maddison, & Tol, 2005). More specifically, climatic changes for the United Kingdom are predicted to result in a shift from foreign destinations towards domestic ones, as early as 2025, with the UK's international tourist departures dropping by 1% by 2050 from 1995 levels (see Table 12) (J. M. Hamilton & Tol, 2007). Hamilton et al. (2005) and Hamilton and Tol's (2007) predictions are based on temperature to predict tourism demand and changes in future population and GDP, though face limitations as they do not consider tourist behavior at the micro-scale (Gössling & Hall, 2006c; Scott et al., 2012).

Other direct climatic impacts to Barbados' tourism sector include changes in the magnitude of weather extremes, leading to infrastructure damage, higher seasonal operating costs and business interruptions (GOB, 2001a; Scott et al., 2012). Changes in extreme weather events pertain to tropical storm intensity and rainfall patterns, which could result in increased coastal flooding, where many of Barbados' hotels are established (CCCCC, 2009a; CDEMA, 2009d; GOB, 2001a; UNECLAC, 2011). Over 90% of the island's approximately 6,000 hotel rooms are built on the coast, less than a kilometer from the high-water mark, and storm surge models suggest that over 50% of the rooms could be vulnerable to the impacts of a Category 3 hurricane (Jackson, 2002; UNECLAC, 2011). Predicted impacts include business interruptions and structural damage to buildings, infrastructure and surroundings, making post-event recovery prolonged and costly (CCCCC, 2009a).

Moreover, if hurricane intensity increased, as predicted by Knutson et al. (2010), or was perceived to increase, tourists may seek alternate destinations, as noted by Forster et al. (2012) in her study in nearby Anguilla. Forster et al. (2012) used a choice experiment to examine the influence of hurricane risk on tourist risk perceptions and decisions regarding holiday preferences[38] and found that 40% of respondents had considered the hurricane season when selecting their holiday choice. The study also found that respondents were less likely to select choices where hurricane risk is perceived to increase, and more likely to select choices that provide financial reimbursement for higher risk (Forster et al., 2012). Older tourists and visitors who preferred beach activities were most worried about hurricanes (Forster et al., 2012), also representing the main tourist groups that currently visit Barbados.

[38] 1:100 low chance (i.e. a hurricane expected during 1 week for every 100 weeks), 5:100 medium chance and 10:100 high chance (Forster, Schuhmann, Lake, Watkinson, & Gill, 2012).

Forster et al. (2012) acknowledge that most of Anguilla's tourists visit outside of the hurricane season, yet note that increased damage to tourism resources and infrastructure from increasing hurricane intensities could still have a very large impact on tourist decision-making. Moreover, the influence of hurricane activity on tourists' decisions is also based on the availability of alternative holiday options (Forster et al., 2012). Nevertheless, the study would have benefitted from more specific scenarios, i.e. the probability of return to an island after a hurricane event or the weighting of one destination against another. For these reasons, further studies are needed on the impacts of hurricanes on Caribbean tourism destinations, in particular those that estimate tourism infrastructure damage and assumptions regarding hurricane intensity and occurrence (Scott et al., 2012).

Lastly, higher capital costs due to infrastructure damage from extreme weather could also threaten tourism enterprises, in particular small and medium-sized enterprises (CCCCC, 2009a; Simpson et al., 2010). In addition, enterprises could face higher operating expenses to protect and insure beach front properties from severe erosion and storm surges (ABI, 2009; CCCCC, 2009a; GOB, 2001a). They could also face a loss of insurance coverage in vulnerable areas (CDEMA, 2009d; Scott et al., 2012). Insurance, including any predicted changes in premiums, is further discussed in section 5.2.4. In addition, more funds would be needed to market the destination, as important tourist features, such as beach quality, could be degraded (CCCCC, 2009a).

5.2.2 Pathway 2: Indirect Climate-Induced Environmental Changes

Indirect climate-induced environmental impacts consist of those on natural assets important for Barbados' image as a destination, including environmental conditions that deter tourists (i.e. water scarcity) and those which attract tourists (i.e. beaches and biodiversity). More specifically, countries with high tourist arrivals and limited water resources, such as Barbados, are likely to face water conflicts in the future, with the island facing potential chronic water shortages by 2050 (Black, King, & Clarke, 2009; Gössling et al., 2012). Water scarcity could affect the appearance of the island's landscape and result in competition for the resource between tourism and other sectors (CCCCC, 2009a; CDEMA, 2009d; GOB, 2001a). Even though there is increasing recognition for water conservation in Barbados, its industrial and commercial uses, increased from 20% in 1996 to 44% by 2007, with tourism specific demands from hotels, cruise-ships and golf courses, predicted to account for one-third of the island's water use by 2016 (Emmanuel & Spence, 2009). Furthermore, consumption in the island's hotel sector was unchanged between 1998 and 2008 and demonstrated a much higher use than the general population (770 vs. 240 Liters/ guest-night (L/G-N)) (BWA, 1997; Charara, Cashman, Bonnell, & Gehr, 2011; Singh & Clouden, 1999). This lack of progress in improving efficiency in hotel water use was linked to the fact that current water pricing means that water bills account for less than 5% of yearly expenses (Charara et al., 2011). To foster greater water conservation in the hotel industry, guests should be educated about the need for conservation, awareness should be raised amongst hotel managers and incentives provided to encourage its economic benefits by linking unit water price to total consumption (Charara et al., 2011).

Sea-level rise and its impacts of coastal erosion and inundation could significantly affect Barbados's beaches, damage or motivate the relocation of tourism infrastructure, and impact upon its destination competitiveness (CCCCC, 2009b; CDEMA, 2009d; GOB, 2001a; GOB, 2012; UNECLAC, 2011). The majority of Barbados beaches are approximately 12-15m in width and have very gentle gradients (R. Moore, 2002). A study of the impact of a one-metre sea-level rise to 906 major coastal resorts[39] in 19 Caribbean Community Secretariat (CARICOM)[40] countries, found that of Barbados 75 major coastal resorts, 8% would be partially or fully flooded and between 56% and 67% of properties would face beach erosion from 50m and 100m erosion scenarios (Scott et al., 2012). Furthermore, many resorts would experience losses of beach features and area, before resort property loss from sea-level rise (Scott et al., 2012). Rising sea levels could also lead to 'coastal squeeze', where the coastal boundary cannot migrate inwards due to a fixed boundary such as a sea wall or road (Scott et al., 2012). Such scenarios could lead to increased costs of rebuilding tourist resorts and an annual reduction in national GDP contribution from beach loss (Simpson et al., 2010).

A standardized survey of tourists in Bonaire and Barbados found that 77% would not return to the islands for the same holiday price under the severe climate change scenario where '*beaches largely disappeared'* (Uyarra et al., 2005). Similarly, a standardized visitor survey in Barbados, noted that tourist's probability of return is dependent upon their perceptions of coastal and marine quality, in

[39] Resorts within 100m of the coast and with a minimum of 50 rooms/ 100 beds (Scott, Simpson, & Sim, 2012).
[40] Antigua and Barbuda, Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Haiti, Jamaica, St. Kitts & Nevis, St. Lucia, Montserrat, Suriname, St. Vincent and the Grenadines, Trinidad and Tobago.

particular the amount of litter viewed and the width of beaches, with preferred being 8 - 10 metres (Schuhmann, 2009). More detailed and different results might have been obtained using qualitative interviews to examine tourist perceptions of beach erosion and attempts for restoration, such as that employed by Buzinde et al. (2010) in Mexico.

Climate change is expected to affect marine and terrestrial biodiversity in the Barbados area, leading to a loss of natural attractions and species important for tourism destinations (Nurse et al., 2014). In regards to coral reefs, most reef fish populations in the Caribbean have been depleted and increases in sea temperatures could lead to bleaching, decreasing their quantity and diversity (CCCCC, 2009a; GOB, 2001a; Simpson et al., 2012). Barbados is one of the most reef dependent nations, as it supports fisheries and marine tourism livelihoods, and most exposed to reef threats worldwide (Burke, Reytar, Spalding, & Perry, 2011; Simpson et al., 2012). Coral reefs in the island have been damaged by diving near shore, sewage disposal, alterations to the coastal topography from tourism development, destructive fishing practices and anchoring boats over reefs (GOB, 2002). The most severe bleaching episode occurred in Barbados in 2005, affecting all reef habitats, nearly all coral taxa and 71% of colonies (Oxenford, Roach, & Brathwaite, 2008; UWI, 2008). Warmer sea-surface temperatures could also encourage bacterial blooms, leading to large fish kills about the island's reefs, littering beaches and driving away bathers (GOB, 2001a). Moreover, reduction in reef health, along with deforestation, could add to the vulnerability of the coastline by removing their protection as ecological buffers (CCCCC, 2009a; Mycoo & Chadwick, 2012).

National stakeholders have expressed concern over the future of Barbados' reefs for tourist-related activities (GOB, 2012; UNECLAC, 2011). Nevertheless, studies on a '*sea-sand-sun'* destination such as Barbados, which is not known primarily for diving, have shown that coral bleaching would have limited effects on its tourist numbers (Sealy-Baker, 2011; Uyarra et al., 2005). Uyarra et al. (2005) found that 74% of tourists would to return to Barbados for the same price even if the corals experienced *'severe bleaching and mortality'.* A more recent survey of Caribbean dive tourism operators found that the 2005 bleaching event, and a more restricted 2010 event, had limited impact on their operations, though many dive tourists were cognizant of the bleaching and wanted to learn more about it (Sealy-Baker, 2011). These results denote that there could be a future market for degraded or artificial reefs, but at a reduced price, comprised of beginner and recreational divers, thus having economic implications for local tourism operators even if arrival levels are maintained (Scott et al., 2012).

Any decline in the local fisheries sector from climate change, would impact upon Barbados's tourism sector, as tourists have a high demand for local seafood, in particular larger pelagics (CCCCC, 2009a; GOB, 2004; GOB, 2012; Simpson et al., 2012). Changes in the temperature of fisheries habitat could affect their total production and susceptibility to diseases, their distribution, productivity and yields (FAO, 2008). Warmer waters could also impact upon the migratory patterns of fish and force pelagic species away from the tropics in search of deeper and cooler temperatures (Barange & Perry, 2009). Little is known about the long-term effects of climate variability and change on the Caribbean fisheries population, though adverse impacts are starting to be noted within their marine ecosystems (James, 2008; McConney, Nurse, & James, 2009). For this reason, there is a need to determine which SIDS-specific coastal and marine characteristics are good indicators of climate change (McConney et al., 2009). Moreover, approximately 80% of total fish supply in Barbados is imported from Guyana, Trinidad and South America (FAO, 2005; Government of Guyana, 2003). Reduced local fish catches would increase reliance on already high imports for local and tourist consumption, affect employment and salaries in the fishing industry (Simpson et al., 2012; UNECLAC, 2011). The Barbados Ministry of Tourism advocates consumption of local seafood by tourists to reduce dependency on fish imports and promote self-sufficiency, yet provides no specifics on how this could be done now or in an era of climate change (GOB, 2012).

Climate change could also impact upon other food systems important to locals and tourists in Barbados, resulting in increased prices due to scarcity and increased reliance on external more expensive substitutes (CCCCC, 2009a). Due to little agricultural production, Barbados imports a broad range of food related products, with the Caribbean hotel, restaurant and institutional food service sector accounting for 40% - 45% of agricultural imports (FEAMWU, 2012). Smaller independent hotels and restaurants make greater use of local produce, while the larger and chained hotels source more of their food and beverages from external sources (CCCCC, 2009a; FEAMWU, 2012). Top consumer oriented food imports include snack foods, processed fruits and vegetables, red and poultry meats, dairy products and breakfast cereals (FEAMWU, 2012). No figures were available for the percentage of tourism food that is sourced locally from Barbados, apart from fish (2%) (FAO, 2005; GOB, 2004). The island's Ministry of Tourism advocates that tourism businesses reduce their high food import costs by creating stronger links with the agricultural sector and promoting local culinary and agro-food tourism (GOB, 2012). Moore et al. (2012) note that not many import items could be replaced by locally-produced products, due to Barbados' market size and price competitiveness. Nevertheless, efforts should be made to develop local industries to reduce foreign exchange and increase employment (A. Moore et al., 2012).

5.2.3 Pathway 3: Indirect Climate-Induced Socio-Economic Changes

Climate change could lead to lower global economic growth (Olsson et al., 2014) and reduce the discretionary wealth of tourists, thereby resulting in indirect climate-induced socioeconomic impacts for tourism dependent countries such as Barbados (Scott et al., 2012). Even though no studies have examined such changes for Barbados' tourism sector, the international index '*Climate Vulnerability Monitor'* states that climate change and the carbon-intensive economy caused global economic losses of 1.7% of GDP for the year 2010 (US $700 billion) (Dara and CVF, 2012). Maintaining global warming below 2^{o}C by 2100, relative to pre-industrial levels, will require stringent mitigation efforts leading to a 40-70% reduction in global anthropogenic greenhouse gas emissions by 2050 compared to 2010 levels (Allen et al., 2014). In the absence of such efforts, the IPCC AR5 states that GHG emissions are predicted to grow due to a growing global population and its economic activities (Edenhofer et al., 2014). Baseline scenarios, without supplementary mitigation, could result in global mean surface temperature increases from 3.7 °C - 4.8 °C in 2100**,** against pre-industrial levels (Edenhofer et al., 2014). Such unmitigated climate change could further decrease economic growth, with net average global economic losses of 3.2% of GPD by 2030 (Dara and CVF, 2012; Olsson et al., 2014).

To predict climate induced socio-economic changes for Barbados, it can be useful to examine Barbados' current and future vulnerability to climate change. The '*CVM'* analyses the national level impacts of climate change for certain hazards and economic sectors and scores vulnerability for each country[41] (Dara and CVF, 2012). Barbados is currently categorized as highly vulnerable to climate change, resulting in economic losses of 2.5% of its GDP in 2010*,* with acute vulnerability rankings for its tourism sector and severe rankings for water and heat illnesses (Dara and CVF, 2012). The island is also considered to have the highest rating for adaptive capacity. By 2030, the

[41] Low (L), moderate (M), high (H), severe (S) and acute (A) (Dara and CVF, 2012).

island's climate vulnerability is predicted to become severe, accounting for net average economic losses of 5.2% of its GDP (Dara and CVF, 2012). Certain pertinent future vulnerability rankings that the island received were drought (H), floods and landslides (L), storms (L), biodiversity (L), sea-level rise (M), agriculture (H) and fisheries (L) (Dara and CVF, 2012). Some of the lower rankings, in particular for the determinants of flooding, storms, SLR and fisheries, contradict their higher rankings detailed earlier in pathways #1 and #2 (sections 5.2.1 and 5.2.2) and more detailed sectoral or hazard specific studies (to be presented in section 5.2.5). This points to the challenges in utilizing national level vulnerability indices to portray variation at the local and regional scales and the utility of more detailed sectoral or hazard specific studies, as discussed in chapter 2 (section 2.4.2.2.).

5.2.4 Pathway 4: Impacts Caused by Mitigation and Adaptation Responses in Other Sectors

Mitigation and adaptation responses in other sectors could impact upon the tourism sector in Barbados (GOB, 2012; Scott et al., 2012; UNECLAC, 2011). Pentelow and Scott (2011) examined the inclusion of aviation mitigation policy in the European Union's (EU) Emissions Trading Scheme (ETS) and a similar system in the North American market and their respective effects on tourism arrivals to the Caribbean. The study used price elasticity to examine currently proposed (US $16/ tonne of carbon) (see Table 12), ambitious (US $61/ tonne of carbon) and the most stringent policy (US $200/ tonne of carbon). Only under the most stringent mitigation policy and its deeper emission cuts, was a substantial decrease of 40.1% in arrivals projected to the region (Pentelow & Scott, 2011). Furthermore, the authors found Barbados to be the second most vulnerable country to mitigation policy changes after Bahamas (Pentelow & Scott, 2011). This categorization can be explained by the fact that the island has a high percentage of its tourist market share from long haul destinations, such as the United Kingdom (GOB, 2012).

A mitigation policy of immediate concern to the Caribbean is the United Kingdom's Air Passenger Duty (APD) Tax charged to outbound passengers, with one of its objectives being to reduce the government's GHG emissions (CTO, 2011; GOB, 2012; UNECLAC, 2011). The APD Tax was introduced in 1994 and has had several increases since then. In 2009, four geographical bands were introduced based on the distance to travel from London to the capital city of the country concerned, with the Caribbean falling into the third band: Band C (6440 – 9600 km) (ABTA, 2013). In April of 2014, the tax amounted to US $133/person and US $531 for a British family of four travelling to the Caribbean region (ABTA, 2014). The Caribbean Tourism Organization stated that the high cost of the APD was having a negative impact on UK visitor numbers and lobbied against the tax and for the region to be re-designated in Band B, like Florida and Bermuda (CTO, 2011; UNECLAC, 2011). In 2014, the British Government announced that from April 2015 bands C and D would be abolished and those destinations would be charged at band B rates (ABTA, 2014).

Recent studies have found that the APD has not had demonstrable effects on British outbound tourism to the Caribbean. Seetaram et al. (2014) examined the effect of the tax on UK outbound tourism demand for ten international destinations by estimating income, price, and tax elasticities between 2008 and 2010. The authors found that British outbound travelers were more sensitive to price changes when selecting short-haul destinations such as Spain, but less sensitive to price changes and willing to pay more when choosing long-haul destinations, such as Australia (Seetaram et al., 2014). Scott et al. (2014) also examined whether APD structure or rate increases changed the geography of UK air passenger travel towards closer destinations from 2007-2010. The authors found that UK outbound tourism was not more negatively affected than other outbound European tourism markets that did not have similar taxes to the APD. When examining the effects of the four distance bands, they found that any reduction in UK air travel in 2010 was not largest in the further bands of C and D. Furthermore, similar or lower decreases in arrivals from the UK against other European markets were noted in other Caribbean islands, denoting that there was no consistent larger decrease in tourist arrivals from the UK that could be linked to the APD (Scott et al., 2014). These two studies and others have noted that for the APD or other taxes to influence air travel demand and reduce GHG emissions, they would need to be made a higher proportion of the total trip cost (Gössling, Scott, & Hall, 2013; Scott et al., 2014; Seetaram et al., 2014; Tol, 2007).

Barbados' tourism sector will also need to consider the impacts of any impending mitigation policies, such as the one developed by the International Civil Aviation Organization (ICAO) to half aviation CO_2 emissions by 2050, from 2005 levels (ATAG, 2013). In 2013, the world's governments agreed to develop a single market-based measure (MBM)[42] for international aviation emissions, which would not restrain demand for air travel or increase general revenues (ATAG, 2013). The ICAO is expected to ratify the design of the MBM in 2016 and implement it in 2020 (ATAG, 2013).

[42] Policy mechanisms include carbon offsetting; carbon offsetting with revenue generating component; and a global Emissions Trading Scheme (ATAG, 2013).

The impacts of implementing the MBM was found to be relatively small in regards to increased traffic, profit and costs (ICAO, 2013). More specifically, a MBM scheme in 2036, with a carbon price of US $45/ tonne of CO_2, would result in an approximate additional cost of $4 per seat for a round trip flight from Barbados to New York, Toronto or Brazil and $8 per seat for a round trip flight from Barbados to London (ICAO, 2013)[43].

Adaptation responses in the insurance sector could also significantly impact Barbados' tourism sector through higher premiums and loss of insurance, as noted briefly in *pathway #1* (section 5.2.1) (CCCCC, 2009b; GOB, 2001a). The Association of British Insurers (ABI) stated that by 2080 climate change could increase wind-related insured losses from Gulf of Mexico-Caribbean hurricanes to US $150 billion (ABI, 2005). Furthermore, increased hurricane damages, loss of tourism revenue, and infrastructure damages due to SLR in the region could total US $22 billion a year by 2050 and US $46 billion by 2100[44], with infrastructure damage accounting for 70% of costs in both scenarios (Bueno et al., 2008). In addition, the ABI noted that under high emissions scenarios, insurers' capital requirements could increase by over 90% for the region's hurricanes, and when combined with annual losses from windstorms, could result in premium increases of 80% in the Caribbean (ABI, 2005). A more recent ABI report concluded that climate change impacts noted in their earlier report were conservative and that insurance premiums would double-in many high risk areas (ABI, 2009).

More specifically for Barbados, annual losses from wind, storm surge, and inland flooding totaled 3% of GDP in 2009 and could increase to 4% of GDP by 2030 under a high climate change scenario, with wind accounting for the majority of losses in both scenarios (CCRIF, 2010). Furthermore, Bueno et al. (2008) predict that the cost of Barbados' inaction towards climate change as presented by % of 2004 GDP[45], to be US$ 353 million in 2050 (13.9% of GDP) and US $703 million (27.7% of GPD) by 2100. Simpson et al. (2010) provide further details as to the future impacts and costs of SLR in Barbados in section 5.5.2. Increasing insurance damage costs could mean that private sector insurance coverage would no longer be affordable for tourism operators in Barbados with infrastructure in vulnerable areas (e.g. floodplains or hurricane prone coastlines), in particular smaller operators (Scott et al., 2012; Simpson, Scott, & Trotz, 2011). This could compel

[43] The cost of an MBM scheme in 2036 would be $2 per seat on a 3,000 kilometre single flight and $7-8 per seat for a 10,000 kilometre flight (ICAO, 2013).
[44] In 2007 dollars, percentages based on 2004 GDP (Bueno, Herzfeld, Stanton, & Ackerman, 2008).
[45] US $2.54 Billion (World Bank, 2004).

governments to offer insurance for tourism development or result in the retreat of the operators from these locations (Scott et al., 2012; Simpson et al., 2011). Furthermore, insurance coverage may no longer be accessible in some areas, restricting new investment in high-risk properties and meaning that some operators will not be able to rebuild (Scott et al., 2012).

5.2.5 Vulnerability of the Island's Sector Compared to other Caribbean Countries

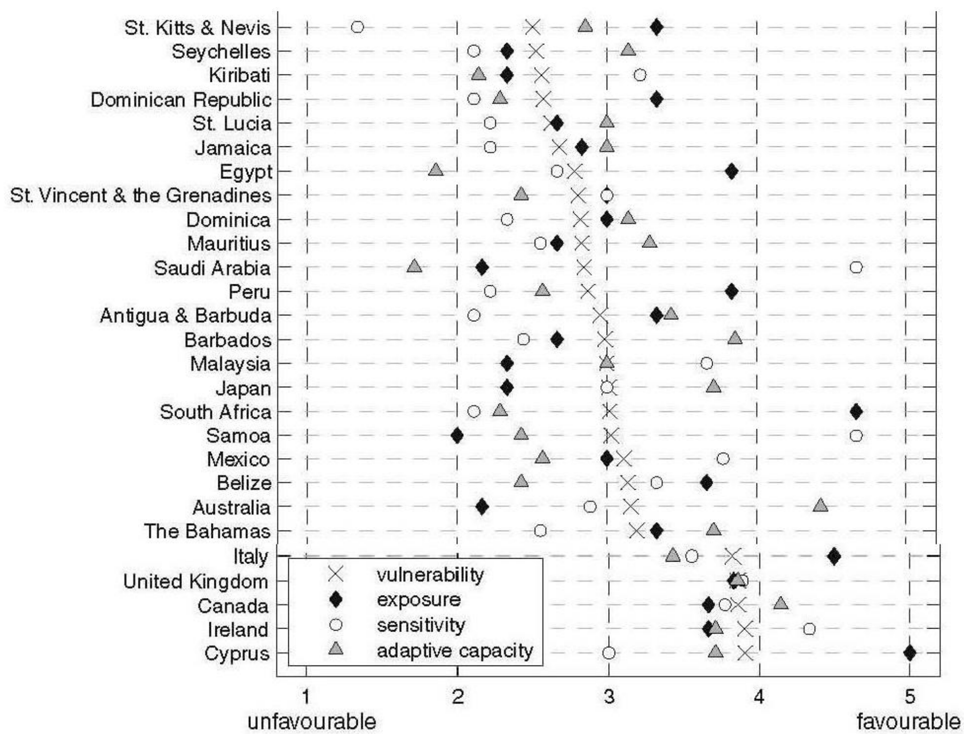
Some scholars have compared the vulnerability of several Caribbean countries' tourism sector to climate change. Perch-Nielsen (2010) examined the vulnerability of 51 countries' beach tourism sector via the application of indicators based on national and international secondary data for exposure (*change in suitability of the climate for the type of tourism present*), sensitivity (*dependence on tourism that relies on current climate*) and adaptive capacity (*sectoral resources available to adapt*). This included examining ten Caribbean small island states and countries[46]. As Figure 9 demonstrates, the countries were found to have had a low to medium vulnerability. This included a range of adaptive capacities and exposures, but all displaying a rather high sensitivity. Barbados's beach tourism sector was found to have a moderate level of vulnerability (3 out of a scale of 5[47]), with only Belize and the Bahamas scoring as less vulnerable. Furthermore, Barbados was found to have the highest level of adaptive capacity (3.8), but also the highest level of exposure (2.6) along with St. Lucia. Its sensitivity (2.4) was approximately on par with three other Caribbean islands (Jamaica, St. Lucia and Dominica), with three islands scoring as more sensitive (St. Kitts and Nevis, Antigua and Barbuda and Dominican Republic) and three islands scoring as less sensitive (Belize, Bahamas and St. Vincent and the Grenadines) (Perch-Nielsen, 2010).

Barbados beach tourism sector's categorization as the third least vulnerable in the region to climate change, after Belize and the Bahamas, was due to the application of several indicators. The indicators included those pertaining to the suitability of climate through the Tourism Climate Index (critiqued earlier and one of four exposure indicators) and sea level rise (three of five sensitivity indicators) linked to proximity of tourism infrastructure and resources to the shoreline, based on older SLR country studies (Hoozemans, Pennekamp, & Marchand, 1992; IPCC, 1990). The study equally weighted the exposure, sensitivity and adaptive capacity indicators, yet also acknowledged

[46] St. Kitts and Nevis, Dominican Republic, St. Lucia, Jamaica, St. Vincent & the Grenadines, Dominica, Antigua & Barbuda, Barbados, Belize and the Bahamas.
[47] 1= unfavourable (most vulnerable), 5 = favourable (least vulnerable).

the limitations of weighting and aggregation and the importance of understanding differential vulnerability based on varying individual priorities (i.e. SLR) (Perch-Nielsen, 2010). A more detailed and recent examination of variables pertaining to SLR, as detailed after Figure 9 below, leads to a different scoring of tourism vulnerability in the Caribbean.

Figure 9. The Relative Vulnerability of Beach Tourism to Climate Change in Certain Countries



List of countries showing the relative vulnerability of beach tourism to climate change. Results for exposure (♦), sensitivity (○), adaptive capacity (△) and all combined (×) are shown for the standard transformation and weighting

Source: Adapted from Perch-Nielsen (2010) (showing 27 of 51 studied countries)

Dasgupta et al. (2007) studied the impact of sea level rise in developing countries using geographic information system software, with inundation scenarios ranging from for 1-5 m and found different results regarding exposure of Caribbean countries. The study included Latin America and the Caribbean, with four Caribbean countries overlapping that in Perch-Nielsen's (2010) study: Dominican Republic, Jamaica, Belize and The Bahamas. Dasgupta et al. (2007) found that worldwide, Bahamas is the most impacted country from SLR, with close to 12% of its total land area affected under a 1m scenario and 60% affected under a 5m scenario. Similarly, a satellite-data study by Scott et al. (2012) on the coastal vulnerability of nineteen Caribbean countries to SLR, including Barbados, found that the tourism resort properties of Belize and Turks and Caicos Islands were at greatest risk to SLR-induced flooding and erosion damage. Perch-Nielsen's (2010) study had scored Bahamas and Belize to be less sensitive and less vulnerable than Barbados, though not based on the geo-location of actual resorts or high resolution satellite data of SLR risk. In addition, as noted in chapter 4 (section 4.2.2.2), the '*Disaster Deficit Index*' identified Barbados as the second most prone country in Latin America and the Caribbean to future extreme disaster risk and to suffer significant losses (Cardona, 2010). These varying and sometimes contrasting/ contradictory results on the vulnerability of Caribbean countries, especially those based on the averaging of indicators, supports the notion that it is also useful to understand vulnerability in a disaggregated form (Adger et al., 2004; Füssel, 2009; Perch-Nielsen, 2010), as discussed in chapter 2 (section 2.4.2.2).

5.3 Non-Climatic Stressors Impacting upon Barbados Tourism Sector

Non-climatic stressors have resulted in socio-economic impacts to Barbados's tourism sector (CCCCC, 2009b; CDEMA, 2009d; GOB, 2001a; GOB, 2012; UNECLAC, 2011). Such stressors include the global economic crisis of 2008/2009, which significantly impacted the island's tourism, financial and construction industries and lead to currency fluctuations and inflation (CIA, 2013; GOB, 2012). The crisis also caused the Barbadian economy to contract by 4% in 2009 and grow below 1% yearly between 2010 and 2013 (UNECLAC, 2014). Barbados' public debt-to-GDP ratio also increased from 56% in 2008 to 98% in 2013 (UNECLAC, 2014). The economic crisis was the principal cause for the decline of total tourist arrivals to Barbados between 2007 and 2010, mainly from British and American visitors (GOB, 2012). Tourist arrivals in the island fell from 572,937 in 2007 to 519,517 in 2010 (a decrease of 9.3%) (GOB, 2012). The largest decrease of arrivals was 6.5% and occurred between 2008 and 2009, higher than the Caribbean decline of 3.6% and the global decline of 5.1% during the same period (GOB, 2012; UNWTO, 2009; WTTC, 2011). The decline worldwide was attributed to the weaker economic positions of international households resulting in more domestic tourism and if international tourism occurred, there was a reduction in the average length of stay and expenditure (GOB, 2012).

The Barbados economy continues to be weak and affected by the economic crisis, in particular poor economic performance in Europe and moderate economic growth in the United States

(UNECLAC, 2013). In 2012, the island's GDP growth remained flat at 0.2%, contracted by 0.1% in 2013 and declined by 0.4% in the first quarter of 2014 (UNECLAC, 2014). The tourism sector, after a slightly positive performance in 2011, saw tourist arrivals reduce by 5.6% between 2012 and 2013, with a further 1% drop year-on-year in the first quarter of 2014 (see Figure 10) (UNECLAC, 2014). During this latter period, there was a shift in the distribution of source markets, as visitors from the United Kingdom and other European countries rose by 8% and 14% and arrivals from the United States and Canada fell by 8% and 10% (UNECLAC, 2014). These changes in arrivals were due to new airlifts from Europe, stronger growth of the European economy in 2013 and reduced airlift out of the United States and within the Caribbean region (UNECLAC, 2014). Total CARICOM arrivals also fell by 7.4% in 2013 (UNECLAC, 2014).

Scott et al. (2014) note that reductions in tourist arrivals to the Caribbean ought to be examined in a wide context, beyond changes via the economic recession or taxes such as the APD. Indices such as the '*Futurebrand Country Brand Index'* (FCBI) present additional criteria to examine a country's advantage in the tourism market (Future Brand, 2015). In 2013, the FBCI ranked Barbados 29 out of 118 countries[48] in categories pertaining to culture, industries, economic vitality and public policy initiatives (Future Brand, 2013). More specifically, tourism attributes were presented for the top 15 countries and included value for money, attractions, resort and lodging, food, shopping, beach (Barbados ranked 7th) and nightlife (Future Brand, 2013). The 2015 Index only ranked 75 countries and did not include Barbados, though commented on traits pertaining to the North American and Caribbean region (Future Brand, 2015). The region's strengths include its natural beauty, range of attractions, visit for holiday, good infrastructure, advanced technology, while weaknesses pertain to food, heritage, art and culture, historical points of interest, and value for money (Future Brand, 2015).

Inflation, including increasing prices for fossil fuels and food, has also adversely impacted upon Barbados' tourism sector and caused volatility in traveller demand (CCCCC, 2009a; GOB, 2012). Inflation has been very high in the island for the past few years and was 8.25% at the beginning of 2009 with a peak of 9.6% at the end of 2011 (UNECLAC, 2013). The rate lowered significantly since then to 4.5% in 2012 and to 1.8% in 2013 (UNECLAC, 2014). Inflation has occurred due to the shift in

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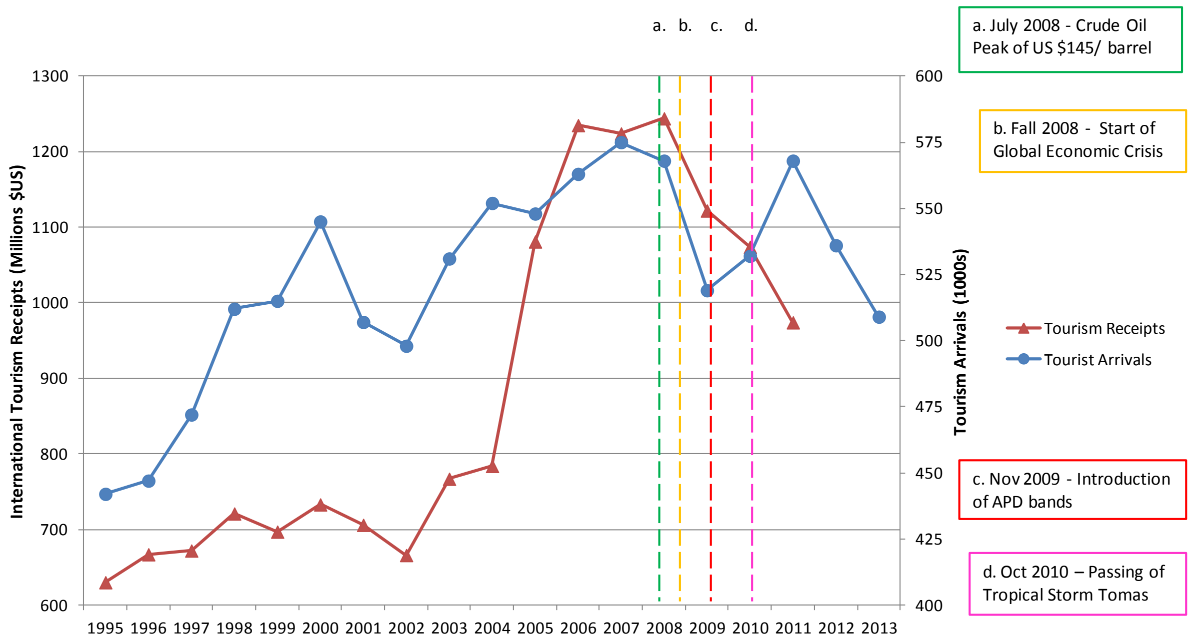
[48] Ranked 36th in 2011 and 32nd in 2010 (Future Brand, 2013).

global production from the advanced industrial economies to the emerging and developing countries, increased production of ethanol and random weather shocks (The Barbados Advocate, 2011b). This is coupled with the fact that over the past few decades Barbados has become increasingly dependent on imported food (FEAMWU, 2012), with the Caribbean's food import staples rising from US $100 million in 1961 to over $2 billion by 2008 (Walters & Jones, 2010). In Barbados, up to US $300 million of food is imported every year, to support local and tourist consumption, from the U.S., Canada, Europe, South and Central America (Best, 2011; FEAMWU, 2012). A declining per capita value of agricultural production in the Caribbean has been found to significantly influence the region's food imports, not increasing tourism arrivals to the region (Walters & Jones, 2010).

Barbados high dependence on fossil fuels and rising oil prices, has meant that the island's fuel import bill rose from 7% of total imports in 1998 to over 25% in 2011 (A. Moore & Jones, 2011). In 2011, fuel for energy and transportation comprised of 25% all imports, followed by food and beverages (17%) and machinery (13%) (A. Moore & Jones, 2011). This heavy dependence on fuel for energy is subject to international fuel prices and has been a major drain on the island's foreign reserves (A. Moore & Jones, 2011). Increasing fuel prices could also increase other tourism-related costs, such as travel to the island and electricity use at resorts (GOB, 2012). To address future volatility in oil or fuel prices, the Barbados' Government aims to promote energy efficiency and conservation and develop renewable energy, as noted in chapter 4, section 4.2.3 (GOB, 2012). The island's Value Added Tax (VAT) also increased by 2.5% to 17.5% in 2010.

Figure 10 presents tourist arrivals and international tourism receipts for Barbados from 1995 to 2013 (data for receipts was not available for 2012-2013) (World Bank, 2012b; World Bank, 2015). Key climatic and non-climate stressors to the island since 2008 are also portrayed: the peak of crude oil prices, the start of the global economic crisis, the introduction of Air Passenger Duty Tax bands and the passing of Tropical Storm Tomas. The Figure demonstrates that tourism receipts and arrivals grew steadily since 1995 and then sharply declined at the end of 2008. Tourist arrivals then increased slightly and since 2012 have been experiencing another steep decline, as explained earlier. Tourism receipts continue to decline. The various stressors portrayed in this Figure indicate that non-climatic stressors can be equally uncertain as future climatic stressors.

Figure 10. Barbados Tourism Figures since 1995 and Key Stressors Faced Since 2008



5.4 The State of National Climate Change Preparedness in Barbados' Tourism Sector

5.4.1 Recognition of Climate Change Vulnerability and the Need for Adaptation

Barbados is cognisant of the fact that its tourism sector is vulnerable to climate change, as evidenced by the following regional and national adaptation initiatives. The Caribbean Disaster Emergency Management has undertaken initiatives to mainstream disaster risk management and climate change adaptation (CCA) at national levels and incorporate both into the tourism sector (CDEMA, 2009a; CDEMA, 2013c). Furthermore, CDEMA identifies climatic and non-climatic stressors impacting upon the region's tourism sector, detailed in section 5.2 and 5.3, for which it developed guidelines to identify risks, map hazards and assess vulnerability at the national level (CDEMA, 2009d). It also developed a *'Strategy and Action Plan'* (SAP) for DRM in the region's tourism sector (CDEMA, 2009b; CDEMA, 2009a) and a '*Guide'* to develop DRM strategies at the national level for the sector (CDEMA, 2009c). The documents initially focused on disaster risk management, so a second phase of the Project revised them to monitor, evaluate and report (ME&R) the results of the '*Regional DRM SAP'* and to address climate change adaptation (CDEMA, 2013b; CDEMA, 2013c). The purpose of the revised initiative was "… *to reduce the vulnerability of the tourism sector to* *natural hazards and climate change through mainstreaming comprehensive disaster management and climate change adaptation",* p. 12 (CDEMA, 2013c). The revised '*Guide's'* national level tools include promoting community level hazard, risk and vulnerability assessment (HRVA) through workshops and promoting tourism site-level HRVA using results from the community HRVA (CDEMA, 2013b). Furthermore, the '*ME&R Framework'* identifies regional and national level indicators to monitor performance of the '*Regional Strategy'* (CDEMA, 2013a).

This research did not consider the guidelines and tools developed by CDEMA, as they were found to be conceptually flawed. Even though the recent documents attempt to address climate change adaptation, they continue to undertake a DRM approach, by focusing on initiatives such as hazard, risk and vulnerability assessment, emergency planning and structural and non-structural measures (further detailed in Table 9, section 5.4.2). The documents provide no details as to steps in the adaptation assessment or planning process or the types of adaptation responses that could be relevant for the tourism sector as detailed by Scott et al. (Scott et al., 2008; Scott et al., 2012). Ten countries, including Barbados, participated in the CDEMA project and expressed interest in receiving assistance to build capacity to develop and implement their national DRM and CCA strategies for the tourism sector (CDEMA, 2014). The project was terminated due to a lack of funds at the end of 2013, so not all of its outcomes were achieved (CDEMA, 2014). The '*DRM and CCA Strategy and ME&R Framework for the Tourism Sector in the Caribbean'* was completed and shared with nine of the ten countries, including Barbados, though not executed (CDEMA, 2013a). The same nine countries received training to develop their national ME&R databases.

More specifically for Barbados, the Caribbean Community Climate Change Center (CCCCC) developed a '*National Adaptation Strategy to address Climate Change in the Tourism Sector in Barbados'*, which involved a synthesis of four technical studies (CCCCC, 2009b) and a strategy and action plan (CCCCC, 2009a). Three of the technical studies were coastal vulnerability studies, with the first investigating inland flooding on Barbados southern and western coasts due to the passage of a 1 in 50 year and a 1 in 100 year hurricane with a 5 mm per year rise in sea-level (Delcan, 1994). The second study built on the first and undertook a biophysical '*Coastal Vulnerability and Risk Assessment of Barbados*' to SLR, using scenarios of 0.2 m SLR by 2020, 0.5 m by 2050 and 0.9-1 m by 2100 (R. Moore, 2002), with the latter being consistent with the IPCC AR5 very high emissions scenario (Alexander et al., 2013). Both studies predicted flooding up to 1 km inland off the main highway for most of the south-coast and a flood zone of up to 300m wide on the west coast (Delcan, 1994; R. Moore, 2002). The third study undertook an '*Intermediate Risk Assessment of St. Peter Township'* on the north-coast and produced storm surge hazard flooding maps for 1 in 50-year, 100-year and 150-year return periods (SWI, 2007). Note-worthy findings of this study were that over 300 structures and 1,000 persons were found to be at risk, including high value resort and heritage properties in Speightstown (SWI, 2007). The study estimated the impact of a 1 in 150 year event to be between US $7 million and $20 million (SWI, 2007).

The fourth technical study was carried out by the CCCCC and assessed the economic vulnerability of the tourism industry to climate change, building on the earlier studies. It considered the impacts of sea level rise on Barbados' hotel supply and found that a rise of 0.5 and 1 metres could impact over 40% of hotels and lead to a revenue loss of approximately US $100 million (CCCCC, 2009b). The resort impact findings are similar to those noted by Scott et al.'s (2012) study of coastal properties in the Caribbean (section 5.2.2), which predicts 56-67% coastal resorts facing beach erosion, yet also predicted significantly higher economic losses by late century, to be noted in section 5.5.2. The fourth study also examined climate change impacts on tourism demand and, by predicting a deterioration in Barbados' TCI along with an improvement in the TCIs of its source markets (i.e. the UK and the US), foresaw arrivals declining between 24 - 40% by 2100 (CCCCC, 2009b). This assertation in this portion of the study faces limitations in its impact predictions of TCI changes in Barbados, as discussed in section 5.2.1, as it does not acknowledge the higher temperature preferences and tolerances of tourists (Rutty & Scott, 2013; Rutty & Scott, 2014a; Rutty & Scott, 2014b). Even though limitations of the second part of this fourth study changes some assumptions about impacts to tourism demand in Barbados, it does not alter the main conclusion of the four reports. The CCCCC's synthesis report (2009b) concluded that the greatest threats to Barbados' tourism industry are to its coast from sea-level rise, leading to coastal erosion, inundation and saltwater intrusion into freshwater aquifers, and changes in rainfall patterns, as also noted in section 5.2. The synthesis document also noted climate change impacts on the island's food production, landscape, biodiversity and communities (CCCCC, 2009b). Even though the '*Strategy'* title emphasizes adaptation, many of its recommendations also pertain to mitigation and it provides examples of how the sector can keep an inventory of its greenhouse gas emissions (CCCCC, 2009a).

The CCCCC's *'Synthesis Report'* and *'Strategy and Action Plan's'* recommendations intended to focus climate change and disaster risk management activities being undertaken by the Government of Barbados and its tourism industry stakeholders, while identifying new activities, opportunities and partnerships to address climate change impacts and promote adaptation and mitigation (CCCCC, 2009a). To do this, the '*Strategy and Action Plan'* identified four goals: 1) comply with existing regulations and policies to reduce the exposure of tourism infrastructure, 2) mainstream new information and technologies to provide future climatic projections, including downscaled climate models for coastal vulnerability 3) initiate the collection of modeling data for physical and structural anticipatory adaptation and 4) coordinate a '*Barbados Tourism Adaptation Strategy'* and industry specific adaptation plans with CDEMA's Comprehensive Disaster Management Strategy and Framework (CDEMA, 2007).

Furthermore, the '*Strategy and Action Plan'* recommended various tools to facilitate adaptation and mitigation for the tourism sector by tourism, environment and disaster management agencies. One policy tool is of particular interest to multi-level action and to this research, is that "…*the scope of these climate change action plans should focus on issues at the sectoral level (e.g. tourism), local area/community level, regional level (e.g. particular parish or stretch of coastline) and the national level",* p. 27 (CCCCC, 2009a). This research undertakes a tourism vulnerability assessment at the destination community level, within the context of a national level understanding of vulnerability. Other tools include implementing a '*Climate Change Act'* to prepare national and sectoral adaptation plans, establishing a '*National Climate Change Unit'* to administer the Act, creating a '*Climate Change Committee'* to formulate policies, a '*Climate Change Task Force'* to coordinate policies and research sector specific needs and establishing an '*Environmental Trust Fund'* to fund adaptation and mitigation initiatives (CCCCC, 2009a).

The CCCCC's *'Strategy and Action Plan'* identified certain activities that the following organizations execute to improve their capacity to implement tourism-related adaptation measures: Ministry of Tourism (i.e. develop sector climate change action plans), Barbados Hotel and Tourism Association (i.e. develop education strategies for members), Ministry of Environment (i.e. finalize and implement a climate change policy), Coastal Zone Management Unit (CZMU) (i.e. generate hazard maps), Planning Dept (i.e. incorporate adaptation strategies), CDEMA (i.e. training in climate change science) and Barbados Building Standards Authority (i.e. enactment of a Barbados Building Act)

(CCCCC, 2009a). The document also provided a detailed plan of action for the Government of Barbados and private sector agencies to move towards climate change adaptation and mitigation in the tourism industry from 2009-2012, with specific activities detailed for 2009-2010 and 2010-2012 (including coastal walks to understand the roles of reefs and beaches, educational activities for the tourism industry and hazard mapping of coastal properties) (CCCCC, 2009a).

Concrete evidence of progress on the recommendations, goals and activities of the CCCCC's *'Strategy and Action Plan*' is non-existent. While the document made specific recommendations as to the roles tourism and other stakeholders could play in the sector adapting to climate change, it did not appear to have much influence amongst the stakeholders consulted in this research, some of which were identified in the *'Strategy'* (i.e. Ministry of Tourism, BHTA, Ministry of Environment and CZMU). During this dissertation's research activities, none of the stakeholders consulted made any reference to the '*Strategy'*. Nevertheless, the findings of this research point to some progress in the document, in particular for goal #4 and certain recommended actions. While no *'Barbados Tourism Adaptation Strategy'* has been developed to date, regional and national level efforts to address DRM, climate change and tourism have been undertaken by CDEMA, as noted earlier. The Researcher also noted some progress for the actions proposed for the Ministry of Tourism, including the codifying of its *'Green Paper on the Sustainable Development of Tourism in Barbados – A policy Framework*' developed in 2001 (GOB, 2001b), a first step in creating the Ministry's '*White Paper on Tourism'* (GOB, 2012). Other actions for the Ministry included the development of tourism sector climate change action plans, which was partially addressed through the development of a draft emergency management plan (EMP) for accommodation, ancillary and transportation services, which at the time of research was not available to the public (noted in Appendix B, Table 33, (*Indicator #18*)).

Lastly, Barbados' Ministry of Tourism's '*White Paper'* notes some linkages between climate change and the island's tourism sector (GOB, 2012). The document presents the impact of climate change as a threat to the tourism sector, in particular the increasing prevalence of natural disasters (primarily hurricanes and extreme flooding), rising sea levels and temperature, coastal erosion, water shortages, droughts and extreme weather (GOB, 2012), as detailed in section 5.2. Under weaknesses of its SWOT analysis, it also notes the absence of a disaster and crisis management plan for the tourism sector (GOB, 2012). Actions to address climate change pertain primarily to mitigation, as evidenced through its '*sustainable and responsible tourism development'* pillar through the reduction of local emissions and the adoption of cleaner technologies (GOB, 2012). The strengthening of coastal infrastructure, implementation of integrated coastal risk management, and the more efficient use of water is also noted, which could be considered disaster risk management measures (GOB, 2012). The document makes one reference to the sector adapting to climate change: adaptation costs pertaining to the replacement of capital infrastructure and loss or degradation of tourist attractions, though provides no specific details (GOB, 2012).

5.4.2 On-Going Tourism-Related Adaptation and Mitigation Initiatives

The following section presents climate change adaptation initiatives undertaken to date or recommended in Barbados that pertain to the tourism sector. Some of the initiatives apply more broadly to other sectors and can also be considered disaster risk management measures, as they address historic and current problems, though are still useful for future climate change adaptation. Other initiatives specifically address adaptation as they consider future climate. Some of the documents also list mitigation[49] options under their adaptation initiatives. Table 9 below summarizes the responses to address climate change in the tourism sector by various stakeholders.

The Government of Barbados has undertaken physical adaptation by redesigning its road network to facilitate better drainage, implementing setbacks for coastal buildings and instigating a building code with special consideration to coastal buildings (UNECLAC, 2011). The Government is also employing beach nourishment and constructing groynes, revetments and breakwaters to enhance the resilience of beaches, such as the Welches Beach Improvement Project (detailed in chapter 4, section 4.3.3.1) and the Boardwalk on the south coast (R. Moore, 2002; Mycoo & Chadwick, 2012; UNECLAC, 2011). UNECLAC (2011) also notes a Project to implement tourism and hotel sector water conservation measures by the Barbados Water Authority, the Environmental Protection Department and the Ministry of Tourism (UNDESA, 2004). There has been no evaluation of the Project's success apart from those generally noted to conserve water in the hotel sector by Charara et al. (2011).

Mycoo and Chadwick (2012) examined the adaptation options undertaken by the Coastal Zone Management Unit of Barbados to address beach erosion from climate change and rising sea levels

[49] Tourism-related energy use and GHG emissions contribute approximately 41% of Barbados' national emissions, as calculated by Simpson et al. (2012), based on UNWTO, Eijgelaar et al. and DEFRA (2010; 2010; 2010).

along the south-west and west coasts. The study found that hard engineering measures and protection approaches, such as seawalls, revetments, groynes and breakwaters, were prioritized, even though they were costlier. Less costly measures considered included beach nourishment, soft measures such as coastal setbacks, which work with natural processes, and retreat approaches such as managed realignment. Retreat and relocation options were considered contentious due to limited space and economic and political costs. The authors found that adaptation measures can be based on a range of hard and soft options and can be implemented individually or in combination, depending on the circumstances through initiatives such as integrated coastal zone management (Mycoo & Chadwick, 2012). A further study by Mycoo (2013), which examined sustainable tourism and climate change adaptation policies to address sea level rise, noted that policy adjustments are needed on building construction, water resources management, sewage treatment, coastal zone management, physical planning and land management. Both studies noted that the success of any adaptation measure depends on adequate financing and enhancing the implementation, monitoring and enforcement capacity of Barbados' regulatory agencies (Mycoo & Chadwick, 2012; Mycoo, 2013).

UNECLAC (2011) undertook an economic analysis of the benefits and costs of ten adaptation and mitigation options for the tourism sector in Barbados using a methodology developed by Moore (2011). The cost-benefit analysis was carried out for a 20-year period (years not specified), calculating the net present value, the cost-benefit ratio and the payback period. The five options which had cost-benefit ratios above 1 in decreasing order: (1) improved reef monitoring systems to provide early warnings of bleaching events; (2) establishment of artificial reefs; (3) creation of national adaptation plans (for levee, sea wall and boardwalk); (4) revised policies to finance carbon neutral tourism (detailed below); and (5) increased recommended design wind speeds for new tourism-related structures (UNECLAC, 2011).

Even though *'carbon neutral tourism'* is not an adaptation measure, it is insightful to examine its mitigation potential for the tourism sector in Barbados, as it could reduce emissions from aviation, its largest sub-sector of emissions (59%) (Simpson et al., 2012)[50]. To promote '*carbon neutral tourism'*, destinations need to measure emissions from domestic and international tourists,

[50] Other tourism-related emissions in Barbados arise from accommodation account (13%) and cruise ships (12%), as calculated by Simpson et al. (2012) based on UNWTO, Eijgelaar et al. and DEFRA (2010; 2010; 2010).

including air travel; decarbonize by reducing energy use and carbon intensity; and off-set emissions (Gössling, 2009; Gössling, Scott, & Hall, 2015). This means that it is imperative for national tourism policies to acknowledge the carbon intensity of their tourism markets (Gössling et al., 2015). The Caribbean is starting to understand climate finance and emissions from its local accommodation and transportation sub-sectors. A "*Caribbean Carbon Neutral Tourism Program*" (CCNTP) was piloted in the Bahamas, Belize, Guyana and Trinidad and Tobago from 2009-2012 by the Caribbean Community Climate Change Centre, with the aim to extrapolate findings to countries with more complex tourism products (i.e. Barbados). The Program focused on direct sources of emissions (i.e. accommodations, land, water and domestic air transportation) and defined the tourism sector as the accommodation sub-sector and associated in-country tourism related transportation (CCCCC, 2012b). The '*Caribbean Hotel Energy Efficiency Action Program'*, from 2009 to 2010, focused on the improved use of energy in the accommodation sub-sector, in particular small and medium sized hotels (CHTA, 2010). The CCNTP Program focused on the transportation sub-sector.

The first component of CCNTP assessed the carbon footprint of the local transportation sub-sector and evaluated approaches to reduce it (CCCCC, 2012b). Approaches included building stakeholder capacity in carbon accounting and low carbon tourism/economies; operational practices (i.e. resource pooling) to reduce GHGs and conserve fuel; the use and production of biofuel; technology options (i.e. fuel efficient vehicles); and broader measures such as integrated land use and transportation planning (CCCCC, 2012b). The second component identified financial mechanisms to establish carbon neutrality for the Caribbean tourism sector (CCCCC, 2012a). Primary sources of climate financing were found to be from international investors or a combination of national/international sources, with the majority focused on mitigation (i.e. energy efficiency, renewable energy, carbon offsetting, and sustainable destination planning) and momentum building towards adaptation-related activities. Barriers in the mobilization of financing included a lack of capital and technical knowledge (CCCCC, 2012a). Recommended next steps were to develop low carbon and resilient development strategies for tourism in each country. The third component of CCNTP, if implemented, is to develop a strategic framework for accessing available climate change financing and a business plan for the tourism sector to attract funding for a path towards carbon neutrality.

The CCNTP Program did not address emissions from national and regional aviation emissions as recommended by Gössling et al. (2009; 2015) and others. Such emissions could be reduced by marketing towards environmentally-aware tourists and nearer source markets, which would also lower Caribbean exposure to the climate policies of customary long-haul markets and fuel price volatility (Gössling et al., 2015; UNECLAC, 2011). As noted in Chapter 4 (section 4.2.4.1), Barbados receives 52% of its tourists from the nearer source-markets of the United States (i.e. New York City a distance of 3367 km), Canada (i.e. Toronto a distance of 3886 km) and the Caribbean (i.e. Sao Paulo, Brazil a distance of 4318 km) (GOB, 2012). More distant markets include 42% of tourists from the United Kingdom (i.e. London a distance of 6762 km) and other European countries (GOB, 2012). To promote '*carbon-neutral tourism'* countries could engage in strategic market development by '*demarketing'* from longer haul markets and focusing on nearby (including newer) markets, thus enabling a reduction in energy and emission intensities (Gössling et al., 2015).

Other measures for Barbados to adapt to climate change include the government developing a climate change adaptation policy, enhancing public and private sector awareness; advocating that insurance companies develop equitable strategies to assess risks; developing early warning systems and EMPs; and diversifying the tourism product (as noted in chapter 4, section 4.2.4.1) and considering alternatives for the sector as a whole (R. Moore, 2002). Proposed initiatives to diversify the island's economy include increasing other exports, such as light manufacturing, developing the local agricultural industry, and providing financial services to Latin American markets (BSL, 2013; Callaghan, 2015; Cox, 2015).

Table 9 summarizes the proposed and undertaken responses noted by the five key national and regional studies to address climate change (CCCCC, 2009b; CDEMA, 2009d; GOB, 2001a; GOB, 2012; UNECLAC, 2011), categorized as adaptation, disaster risk management or mitigation. Some are sector specific and some are generic. The responses were not evaluated for feasibility.

Table 9. Responses to Address Climate Change for Barbados' Tourism Sector

Adaptation
• **GOB** (2001a): In-land tourism development and development of a '*National Adaptation Strategy to Address Climate Change in the Tourism Sector'* (ref to CCCCC initiative (CCCCC, 2009a)). • **CCCCC** (2009b): Coastal vulnerability impact assessment, data collection for anticipatory physical and structural adaptation (i.e. storm surge, coastal erosion and flood zone mapping; hazard maps; inventory of critical infrastructure and land values; and a drainage study for storm water management and beach maintenance); coordination of a '*Barbados Tourism Adaptation Strategy'*. • **UNECLAC** (2011): Notes Government of Barbados has undertaken physical adaptation (i.e. setbacks for coastal buildings, redesigned road networks to facilitate drainage; coastal building code; beach nourishment and protection; and water conservation measures in the hotel sector). UNECLAC analyzed improved and artificial reefs and creation of national adaptation plans for levee, sea wall and boardwalk. • **White Paper** (2012): Adaptation costs pertaining to the replacement of capital infrastructure and loss or degradation of tourist attractions, with no details. *Indirectly:* Increased consumption of local agricultural products and seafood by the tourism sector.
Disaster Risk Management
• **CDEMA** (2009d): Hazard, risk and vulnerability assessment, emergency planning and structural (i.e. flood levies) and non-structural measures (i.e. land use planning) for DRM in the tourism sector. • **White Paper** (2012): Strengthening of coastal infrastructure, implementation of integrated coastal risk management and more efficient use of water.
Mitigation
• **GOB** (2001a): Promotion of renewable energy and energy efficiency and conservation, including the tourism sector. • **CCCCC** (2009b): Establishing an inventory of greenhouse gases. • **UNECLAC** (2011): Revised policies to finance carbon neutral tourism and increased wind-speeds for new tourism-related structures. • **White Paper** (2012): Reduction of local tourism emissions and the adoption of cleaner technologies.

5.5 Assessment of Barbados' Tourism Sector Vulnerability to Climate Change

5.5.1 Gaps in Efforts to Understand Vulnerability and to Adapt

The island of Barbados has undertaken commendable efforts to identify climate change impacts and vulnerabilities and adaptation measures for its tourism sector, though knowledge gaps remain. Table 10 below summarizes the vulnerability of the island's sector based on the climatic and non-climatic stressors identified by the five key studies, regional: CDEMA '*Standard for Conducting Hazard Mapping, Vulnerability Assessment and Economic Valuation for Risk Assessment for the Tourism Sector*' (2009d), and national: Government of Barbados '*First National Communication to the UNFCCC'* (2001a), CCCCC '*National Adaptation Strategy to Address Climate Change in the*

Tourism Sector' (2009b), UNECLAC '*An Assessment of the Economic Impact of Climate Change on the Tourism Sector in Barbados*' (2011) and the Ministry of Tourism's '*White Paper'* (2012). The number of studies for each stressor is tallied and presented in highest order. The Table also presents the timing of the predicted impact, its magnitude and confidence level, to be discussed in section 5.5.2.

Table 10 indicates that changes in storm intensity and rainfall patterns was the most common impact identified under *pathway #1*, with sea-level rise for *pathway #*2. No impacts were identified for *pathway #3* and mitigation and adaptation responses were identified under *pathway #4,* pertaining to the transportation and insurance sectors respectively. Heavy consumption and cost of imported food was the most commonly identified non-climatic stressor. The findings pertaining to the understanding of tourism climate change vulnerability between the various stakeholders will be discussed in chapter 8 (section 8.3.2.2) and compared to those perceived by local level stakeholders, to ascertain any commonalities and gaps.

Table 10. Vulnerabilities of Barbados' Tourism Sector to Climatic and Non-Climatic Stressors

	# of Studies (out of 5)	**Timing of Impact (Early, Mid, Late Century)**	**Magnitude (Low, Medium, High**	**Confidence Level (Low, Medium High)**
Climatic Stressors				
Pathway 1 – *Direct Impacts of Climate on the Tourism Sector*				
Changes in storm intensity and rainfall patterns.	4	2050	H	M
Higher temperatures leading to greater energy and water use and higher operating costs.	3	2100	L	M
Warmer winters in key source-markets and in Barbados, leading to less tourist arrivals.	3	2100	M	M
Higher capital costs to protect beach front properties and to market destination.	3	2030	H	H
Pathway 2 – *Indirect Climate-Induced Environmental Changes*				
Increased SLR, impacting upon beaches and relocation of infrastructure, leading to higher capital costs.	5	2100	H	H
Coral bleaching affecting diving.	4	2030	L	M
Water scarcity.	3	2050	H	H
Reduced fisheries biodiversity.	2	2050	M	M
Impacts upon local food production.	1	2030	M	M

Pathway 3 – *Indirect Climate-Induced Socio-Economic Changes*				
Indirect climate induced socioeconomic changes.	0	2050	H	M
Pathway 4 – *Impacts Caused by Mitigation and Adaptation Responses in Other Sectors*				
Aviation mitigation responses.	2	2030	M	M
Higher insurance costs.	2	2030	H	H
Non-Climatic Stressors				
Heavy consumption and cost of imported energy and food.	4	Impacting currently		
Economic dependence on tourism.	3			
Volatile oil prices, leading to increased airfare and operating costs (inflation).	2			
Valuable coastal infrastructure.	2			
High population density.	2			
Prolonged global financial crisis.	1			
Rising food prices (inflation).	1			
Currency fluctuations.	1			

In regards to tourism and climate change adaptation, initiatives have been undertaken regionally and nationally, though are not comprehensive, lack consistency in their implementation, do not provide specific recommendations and are at times contradictory. More specifically, regional initiatives by the Caribbean Disaster Emergency Management Association, while acknowledging tourism sector adaptation, maintain a disaster risk management focus. Other regional studies predict climate change impacts to Caribbean countries (W. R. Moore, 2010), using methodologies (i.e. Tourism Climate Index) which have been recently critiqued (Rutty & Scott, 2013; Rutty & Scott, 2014a; Rutty & Scott, 2014b). The '*Caribbean Carbon Neutral Tourism Program'*, recently undertaken in the region, makes a good first attempt to reduce the carbon intensity of the local tourism sector (CCCCC, 2012a; CCCCC, 2012b), yet fails to address aviation, the largest source of sectoral emissions (Scott et al., 2008; Scott et al., 2010).

Nationally, the Caribbean Community Climate Change Centre produced a '*Strategy and Action Plan'* detailing many worthwhile goals, tools and actions for the island's tourism sector to adapt to climatic and non-climatic stressors, though evidence of implementation is non-existent (CCCCC, 2009a; CCCCC, 2009b). Furthermore, UNECLAC noted physical adaptation options implemented for the sector, yet provided inconsistent terminology in their costing, where they also included mitigation to promote carbon neutral tourism, for which no further implementation details were provided (UNECLAC, 2011). In addition, the Barbados' Ministry of Tourism's '*White Paper'* notes the threat of climatic and non-climatic stressors, but only explicitly addresses mitigation. The Ministry notes that it plans to reduce local GHG emissions from the tourism sector, yet does not consider the strong contradiction of marketing the sector to long-haul destinations such as Russia, India and China (GOB, 2012). Furthermore, the '*White Paper'* advocates the increased consumption of local agricultural products and seafood by the sector, but provides no specifics on how this could be done. Lastly, community level vulnerability assessment tools are promoted by CDEMA, but remain DRM focused and have not yet been implemented (CDEMA, 2013b).

By examining the literature in the Caribbean and Barbados to date, and further to the tourism and climate change literature gaps identified in chapter 2, it can be noted that additional studies are needed to examine the vulnerability and adaptation of the Caribbean tourism sector to climatic and non-climatic stressors at the regional, national and community levels (Nurse et al., 2014; Simpson, Gössling, & Scott, 2008; Simpson et al., 2010). This includes comparative studies and those that examine the impacts and vulnerabilities of tourism stakeholders at the destination community level, including those whose livelihoods are most connected to the sector and those who live nearby (Becken, 2013; Kaján & Saarinen, 2013; Nurse et al., 2014; Scott et al., 2012). This need is also identified by CDEMA in their '*Guide for the Development of National DRM and CCA Strategies*', which promotes community level and tourism site-level vulnerability assessments (CDEMA, 2013b). Furthermore, as the Ministry of Tourism endorses the development of '*community tourism'* to diversify the island's tourism product, an understanding of destination vulnerabilities would be important (GOB, 2012).

5.5.2 The Future of the Tourism Sector under Climate Change

Based on the review of national and regional literature, climate change to date has not resulted in any significant impacts to the tourism sector in Barbados, in terms of tourist arrivals. Under current emission scenarios, the impacts of climate change to Barbados and its tourism sector are predicted to be most severe by the end of the 21st century, in particular sea-level rise and acute water shortages. As indicated in Table 10, greater certainty (level of confidence) exists in the extent of indirect impacts from 1-2 m of sea level rise on the island's tourism sector, which could lead to the majority of its coastal resorts facing beach erosion, including losses of beach features and area and eventually resorts (CCCCC, 2009b; R. Moore, 2002; Scott et al., 2012). Furthermore, the general economic impacts of SLR in Barbados (as detailed in chapter 4, section 4.2.2.3) could be super-ceeded by losses to tourism through costs of rebuilding and annual losses to national GDP through loss of beaches amenities (Simpson et al., 2010). Losses are predicted to be between US $850 million to 860 million annually in 2080, with total capital GDP loss predicted to be between 7.3% - 42.8% in 2080 for the mid (1m) and high range (2m) SLR scenarios (Simpson et al., 2010). These figures present a comprehensive prediction of SLR damages and costs for Barbados, though do not account for the economic impacts of climate-related hazards (i.e. storm surge) and changes in temperature and precipitation (Simpson et al., 2010). Potential impacts on coral reefs and fisheries and indirect impacts on society are also not considered (Simpson et al., 2010).

Table 10 also indicates that temperatures in Barbados are forecast to increase up to 3˚C late-century (T. C. Hall et al., 2013), which are not predicted to be an issue for tourists, who visit predominantly from temperature regions for beach-related activities (Rutty & Scott, 2013; Rutty & Scott, 2013). Uncertainty remains in how the direct impacts of lower precipitation and higher wind speeds would affect the tourism sector by 2100 (T. C. Hall et al., 2013; Simpson et al., 2012). Mid to late century, some certainty exists in tourists being less likely to visit destinations where they perceive tropical storm risk to increase (Forster et al., 2012), which is predicted to amplify 2-11% in average intensity (Knutson et al., 2010). Mid-century, high certainty also exists in the island facing chronic water shortages, which could limit the growth of the heavy using tourism industry (Black et al., 2009; Gössling et al., 2012). Fisheries biodiversity would also be affected more significantly during this period (FAO, 2008; McConney et al., 2009).

More immediately, Barbados would need to consider the impacts of increased costs and loss of insurance (ABI, 2009). The island would also need to examine the impacts of continued bleaching of its coral reefs, including whether there would be a market for degraded or artificial reefs, and any impacts upon local food production (CCCCC, 2009b; Scott et al., 2012). It also remains to be seen how effective the ICAO mitigation policy will be in reducing international aviation emissions and whether additional costs for travellers will remain low. Caribbean countries could benefit from the policy if they were to receive assistance to reduce their emissions (Climate Summit, 2014).

Table 11 presents the range of predicted economic impacts of climate change on the Caribbean, Barbados and its tourism sector, which will all increase mid to late century.

Table 11. Future Economic Impacts of Climate Change on the Caribbean, Barbados and its Tourism Sector

	2030	2050	2080	2100
Caribbean				
Wind-related insured losses from Gulf of Mexico-Caribbean hurricanes (ABI, 2005).			US $150,000 M / yr	
Increased hurricane damages, loss of **tourism** revenue and infrastructure damage to SLR (Bueno et al., 2008).		US $22,000 M/ yr		US $46,000 M/ yr
Barbados				
Climate change caused economic losses (Dara and CVF, 2012)	5.2% of GDP			
Cost of inaction towards climate change (Bueno et al., 2008)		13.9% of GDP or US $353 M/ yr		27.7% of GDP or US $703 M/ yr
Annual losses from wind, storm surge and inland flooding (CCRIF, 2010)	4% of GDP			
1m SLR to general economy (Simpson et al., 2010)			US $187,000 M or $4,000 – 6,000 M/ yr	
1 m SLR to t**ourism** (CCCCC, 2009b; Simpson et al., 2010).			Impact approx 60% of hotels, loss of US $850 M/yr, 7.3% GDP loss	Impact 40% of hotels, loss of US $100 M/ yr

Note: M = Million

Scott and Gössling,S. (2015) suggest that the tourism sector could benefit from future scenario building to examine any predicted social, technical, economic, environmental and political impacts. Scenarios can present alternative future portrayals for a tourism destination, by testing the ‘business as usual’ claims and identifying mechanisms to transform the sector towards a low carbon economy (Scott & Gössling, 2015). Barbados’ tourism sector should therefore plan for slower long-term growth due to the predicted impacts of climatic and non-climatic stressors, noted in sections 5.2 and 5.3, and other stressors noted in chapter 2 (section 2.5.3), pertaining to aging populations in industrialized countries, increasing travel safety, health pandemics and increased environmental awareness (Scott et al., 2008; Scott et al., 2012).

Table 12 below portrays mid-century predicted growth in Barbados tourist arrivals based on four documented scenarios, with the first [Scenario A] being ‘*business as usual*’. The three other scenarios affect arrivals based on mitigation policy [Scenario B] (*pathway #4*) and changes in source market [Scenario C] and destination temperatures [Scenario D] (*pathway #1*). Scenario A depicts the UNWTO ‘*business as usual*’ prediction of 2% annual tourism growth for the Caribbean between

2010 and 2030, using average annual arrival figures between 1995-2013 (523,000) as a baseline (UNWTO, 2011; World Bank, 2015). If the same growth rate was to continue to mid-century, by 2030 BAU annual arrivals are expected to reach 732,000 and by 2050, 1.09 million. Scenario B demonstrates the impact of EU mitigation aviation ETS policy ($16/tonne of CO_2)[51] decreasing BAU arrivals in Barbados by 1.8% (from 2013 levels), resulting in 719,000 arrivals in 2030 and 1.07 million arrivals in 2050 (Pentelow & Scott, 2011). Scenario C then portrays a 0.2% decline in UK tourist departures in 2013, due to changing climate in their country, leading to a -1% decline by 2050 (J. M. Hamilton & Tol, 2007). This projection is then inferred to all Barbados BAU tourist arrivals and results in 728,000 arrivals by 2030 and 1.08 million arrivals by 2050 (J. M. Hamilton & Tol, 2007). Scenario D projects a 6% decline in BAU arrivals by 2071-2100, due to a changing climate in Barbados, which if inferred from 2013 BAU arrivals would result in 689,000 arrivals by 2030 and 1.02 million arrivals by 2050 (W. R. Moore, 2010). For this latter scenario, it is important to remember the limitations of inferring TCI changes in Barbados as noted earlier in section 5.2.1.

Table 12. Barbados Future Tourist Arrivals under Different Growth Scenarios

Scenario	2030	2050
A: BAU (+ 2% growth)	732,000	1.09 million
B: BAU – 1.8%	719,000	1.07 million
C: BAU – 1% by 2050	728,000	1.08 million
D: BAU – 6% by 2070	689,000	1.02 million

Table 12 demonstrates that near to mid-century tourist arrivals in Scenarios B, C and D are not expected to change significantly from the BAU Scenario A. Furthermore, Scenario A indicates that Barbados would need to accommodate a doubling of tourists by 2050, so a question of sustainability arises due to the availability of resources (i.e. water) and capacity to house the increased number of tourists. Scott and Gössling (2015) importantly note that UNWTO growth projections do not demonstrate how any increased tourist arrivals could be accommodated sustainably, as it does not account for projected increases in CO_2 emissions (Scott et al., 2008) and the doubling of water consumption over the next 40 years (2010-2050) (Gössling, Hall, & Scott, 2015). As noted earlier,

[51] Similar to other carbon prices in California (US $11/ tonne CO_2), United Kingdom (US $16 carbon price floor/ tonne of CO_2) and British Columbia (US $28/ tonne of CO_2) (World Bank, 2014).

Barbados is expected to face chronic water shortage mid-century. Furthermore, the island could potentially house a doubling of tourists by 2050 with a minor expansion of current accommodation capacity, as the average occupancy rate from 2004 to 2010 was 58% (CTO, 2010), and several abandoned hotels exist on the island. Nevertheless, mid to late century, the impacts of climate change will become more severe and could lead to over half of the island's accommodation properties experiencing beach erosion due to sea level rise (Scott et al., 2012). Such a scenario could therefore return any increased hotel capacity to current occupancy numbers, just over fifty percent, and would therefore not be able to accommodate a doubling of tourists. All three Scenarios have important implications for the future sustainability of Barbados' tourism industry under climate change, suggesting that the island will need to re-consider its current vision and reliance on the sector, as detailed in the next section.

5.5.3 Suggested Measures to Adapt

The '*New Climate Economy Report'* suggests that countries have the ability to grow economically and lower their climate change risk by undertaking structural and technological changes and investing in economic efficiency, land use productivity and energy systems (GCEE, 2014). While the Report does not mention the tourism sector specifically, its general themes could be applied to sectoral adaptation and mitigation initiatives in Barbados. In any current to mid-century tourism growth scenario, the island will face an increased number of tourists along with increased water scarcity, a declining availability of accommodations, and the degradation of coastal tourism infrastructure and assets due to SLR. Barbados is therefore presented with an opportunity to alter and adapt its tourism industry, thereby reducing its vulnerability and maintaining insurability. Certain measures are available for the island to adapt, which would also allow it to maintain its key tourist attractions and ratings (i.e. beach brand, natural beauty and infrastructure (Future Brand, 2013; Future Brand, 2015; WEF, 2013)).

Specific adaptation measures include Barbados marketing its sector to nearby source-markets in the Americas, while also lowering exposure to climate policies of its long-haul markets and fuel price volatility. It could also entail the island transformatively adapting its tourism industry, by reconsidering where to continue developing and if so, doing so in climate resilient places. If the island continued to foster the tourism sector, it could more heavily emphasize its luxury market located primarily on the west coast, which offers a higher economic yield per customer, thus compensating for a projected decrease in accommodation capacity. Moreover, in light of degrading coast-lines in the southern and western coasts, this would entail the west coast receiving the majority of funds and efforts to protect its shoreline and coastal infrastructure (i.e. beach nourishment). Tourism areas on the south coast and in-land could continue to develop their niche ecological or cultural attractions, which do not provide pristine coastal features. Furthermore, decreasing the number of tourists who visit the island would also place less pressure on other declining resources important to the sector (i.e. water). Nevertheless, greater efforts would still need to be made to conserve water in the sector, in addition to considering the costs of building a second desalinization plant. On a broader scale, any long-term adaptation planning should consider the comparative and competitive advantages amongst Barbados and other Caribbean destinations in regards to climate change impacts upon their relative attractiveness (Forster et al., 2012).

5.6 Summary and Conclusion

Over the next fifty years, Barbados tourism sector is predicted to face a range of climatic and non-climatic impacts. Studies have examined tourism climate change vulnerability at the Caribbean or national level, with only a few addressing adaptation and if so not comprehensively, and none examining destination-community level vulnerability. Moreover, mid-century scenario planning for the sector predicts increasing tourism arrivals to the island, along with decreasing water availability and accommodation capacity, the latter due to increased degradation of infrastructure and features due to SLR. Barbados could transformatively adapt its tourism sector by reconsidering the composition, emphasis and location of its tourism infrastructure and attractions.

Building on case-study material presented in chapter four, this chapter has presented a critical and empirical assessment of the current and future vulnerability of Barbados' tourism sector to climate change, to provide context and value in the interpretation of the indicators and CBVA results. The next two chapters present the research's methodological results and examine whether they provide any new insights into the vulnerability of the tourism destination community of Oistins.

Chapter 6

Indicators and Resulting Vulnerability of Oistins

6.1 Introduction

The following chapter presents the empirical results of the indicator-based research and separately presents the findings of the tourism destination community and household level indicators, based on a similar format. For both sets, it commences by detailing the conceptually relevant indicators, then details the indicators developed and selected as implementable and operationally feasible and the application of any for which data currently exists. The chapter then presents the empirical vulnerability assessment of the destination community of Oistins based on data collected via the destination community and household level indicators. Strengths and limitations of utilizing the indicator approach noted through the course of this research are then discussed. The broader implications of the utility of the indicator findings in assessing the vulnerability of the destination community are examined in chapter 8.

6.2 Destination Community Level Indicators

The following section presents the indicators developed and applied at the tourism destination community scale. It first outlines the conceptually relevant indicators that were presented to stakeholders and modified based on discussion. It then details the refined list of indicators that stakeholders developed and chose as implementable and operationally feasible to apply. Data from any applicable destination-level indicators is then used to assess the vulnerability of the destination community of Oistins.

6.2.1 Conceptually Relevant List

As detailed in chapter 3, 37 conceptually relevant indicators were presented to the focus groups and key informants to assess the climate change vulnerability of a tourism destination community in Barbados. The types of determinants examined and the particular indicators are presented in Table 13. Table 32 (Appendix B) provides further details for each indicator, including their rational and relationship to vulnerability, limitations, suggested modifications from the focus groups and key informants, the score from the focus groups, any modified indicators, the units for data collection and time frames for data collection and/or original data source.

Stakeholders were asked to rank each indicator most appropriate for the tourism destination community and to provide details as to their potential applicability, based on the criteria presented in chapter 3, Table 5 (relevance, feasibility, credibility, clarity and comparability). Stakeholders chose to emphasize the first two, as they thought that indicators found to be relevant or feasible at the destination community scale could then be made credible, clear and comparable. Relevance pertains to whether "*the indicator responds to the specific issue and provides information that will aid in its management"* and feasibility to "*Is it useful, practical and affordable to collect and analyze data at the Destination Level?"*, p. 40 (UNWTO, 2004a). Furthermore, as noted in chapter 3, once stakeholders discussed their findings at the end of each focus group, there was often a rescoring of some of the indicators. This did not always result in formal new scores, but lead to a general consensus of which indicators were most relevant and feasible to apply at the destination community scale. For these reasons, the initial scores provided by stakeholders are not presented in Table 13.

The eleven exposure indicators in Table 13 demonstrate the direct and indirect biophysical impacts of climate change to the climate suitability or assets of the tourism destination community. The first eight indicators present direct impacts from changes in extreme-climate related events and long-term changes in air temperature and precipitation (suggested as a proxy for extreme events). The last three indicators pertain to the indirect impacts of biodiversity loss. The twenty-six indicators for the socio-economic determinants of sensitivity (9) and adaptive capacity (17) are hazard generic and provide insight as to the processes (contexts), nature and root causes of vulnerability. The sensitivity indicators demonstrate the social, economic and biophysical characteristics of the destination community, which affect its susceptibility to climate-related events. The adaptive capacity indicators present the social, economic and biophysical characteristics of the destination community, which affect its ability to adapt to climate-related events. Any indicators pertaining to sustainable livelihoods capitals, as detailed in chapter 2, Table 1, are also identified for the sensitivity and adaptive capacity indicators.

Table 13.Conceptually Relevant List of Tourism Destination Community Indicators

Determinant	Indicator
EXPOSURE – Change in the suitability of the climate and assets for the destination community (11 indicators)	
Direct Impacts Increase in *extreme climate-related events* relevant to tourism, which can lead to intense rainfall, floods, storm surges and/or landslides.	**1.** Frequency of hazard events in the past 30 years (Change in max 5-day precipitation total).
	2. Intensity of the worst hazard event in the past 30 years (Change in fraction of total precipitation).
	3. Probability of possible hazard events (chances/ year).
	4. Expected intensity of possible hazard events.
Direct Impacts *Long-term changes* in air temperature and precipitation.	5. Mean standard deviation of the daily average maximum temperature by month.
	6. Mean standard deviation of the daily average minimum temperature by month.
	7. Mean standard deviation of average precipitation by month.
	8. Mean climate: suitability of the climate for the type of tourism present (Ex: Change in modified Tourism Climate Index).
Indirect Impacts Biodiversity loss - Strength of climate change that might affect flora and fauna.	9. Biodiversity [Most socially and economically valuable species for tourism]. Change in mean fish harvest in the past 30 years– In shore and off-shore reef fisheries.
	10. Biodiversity [Most socially and economically valuable species for tourism] - Change in mean fish harvest in the past 30 of years – Large pelagic species.
	11. Changes in coastal ecosystems of the destination (i.e. coral reef beds).
SENSITIVITY – Social, economic and biophysical characteristics of the destination community, which affects its susceptibility to climate-related events (9 indicators)	
Economic Sensitivity Economic Diversification	12. Destination community's economic sector mix for employment (% related to tourism).
	13. Destination community's share of total tourist arrivals for recreation.
Value of tourism infrastructure [PHYSICAL CAPITAL]	14. Percentage of tourist infrastructure located in vulnerable zones.
	15. Value of [or number of] destination community's tourism infrastructure in coastal zone below estimated maximum storm surge levels or equivalent.
Robustness of tourism infrastructure and resources.	16. Population annually affected by meteorological extreme events.
Environmental management [NATURAL CAPITAL]	17. Tourism dependent on species that are considered vulnerable to climate change.
Sea Level Rise Proximity of tourism infrastructure and resources to the maximum shoreline [PHYSICAL CAPITAL]	18. Length of low lying coastal zone with more than 10 persons/ km^2.
	19. Number of people additionally inundated once a year given a sea-level rise of 50cm.
	20. Beach area to be nourished in order to maintain important tourist areas.
ADAPTIVE CAPACITY – Social, economic and biophysical characteristic of the destination community, which affect its ability to adapt to climate-related events (17 indicators)	
POLITICAL CAPITAL	21. National standards exist for construction of new tourism infrastructure to be set-back from the shoreline.
Societal capacity	22. Existence of an Emergency Management Committee (EMC) with Parish level.

Public participation [SOCIAL & POLITICAL CAPITAL]	Representatives.
Management & Institutional capacity • Emergency Plans • Risk map [POLITICAL CAPITAL]	23. Availability and circulation of Emergency Management Plans (EMPs) at Parish level (ex. existence of EMPs for tourist zones/ % of tourist areas included). 24. Availability and circulation of risk maps at Parish level.
Economic Capacity Economic resources available to adapt [FINANCIAL CAPITAL]	25. Ranking of destination and/or attraction by tourists. 26. GDP generated by the local tourism industry. 27. Local GDP per capita (USD), purchasing power parity (total locally generated GDP).
Insurance market	28. Availability of insurance for buildings.
Local emergency funds	29. Local emergency funds as percent of local budget.
Access to national emergency funds	30. Release period of national emergency funds.
Access to international emergency funds	31. Access to international emergency funds by Destination.
Mitigation loans	32. Availability of loans for Disaster Risk Reduction measures [or amount].
Reconstruction loans	33. Availability of reconstruction credits for Destination.
Public works	34. Magnitude of local public works programs at Destination.
Physical Planning & Engineering Preventive structures [PHYSICAL CAPITAL]	35. Percent of Tourist area and infrastructure with sea defenses (or similar).
Environmental Management Erosion management [NATURAL CAPITAL]	36. Effective erosion protection measures in place in vulnerable areas (e.g. sea defenses). 37. Percentage of Beaches where erosion monitored at least annually.

As noted in chapter 3, for each successive focus group, the list of conceptually relevant indicators was modified to reflect comments from the previous focus groups and follow-ups with key informants, with comments from earlier groups shared with latter groups. These discussions led to some additional conceptually relevant indicators being developed, with other indicators being scored very low (i.e. below 8) and removed, as suggested by the stakeholders. As detailed below, stakeholders recommended adding two exposure and one adaptive capacity indicator to the conceptually relevant list. Four sensitivity and eight adaptive capacity indicators were removed or merged with other indicators. Table 32 provides further details as to which stakeholders made the particular recommendations.

Exposure:

- *Biodiversity - Change in mean fish harvest in the past 30 years (Reef fisheries)* (Ind. #9)
  - Added as feasible to examine as reef fisheries are located close to the destination community.
- *Biodiversity - Change in mean fish harvest in the past 30 of years (Pelagic species)* (Ind. #10)
  - Even though pelagics species are not distinct to a particular community, as they are very important to the local tourism and fisheries economy, it could be feasible to extract national data to examine livelihood impacts at the destination community scale.

Sensitivity:

- '*Percentage of tourist infrastructure located in vulnerable zones'* (Ind.#14)
  - Considered by merging into '*Value of destination's tourism infrastructure in coastal zone below estimated maximum storm surge levels or equivalent'* (#15).
- '*Length of low lying coastal zone with more than 10 persons/ km^2'* (Ind. #18).
  - Removed as too difficult and not feasible to apply at the destination community scale.
- '*Number of people additionally inundated once a year given a sea-level rise of 50cm*' (Ind. #19).
  - Removed as too difficult and not feasible to apply at the destination community scale.
- '*Beach area to be nourished in order to maintain important tourist areas'* (Ind. #20).
  - Removed as not feasible to apply at the destination community scale. Also not relevant as there should not be an exclusive focus on tourism in maintaining beach areas.

Adaptive Capacity:

- '*National standards exist for construction of new tourism infrastructure to be set-back from the shoreline [or tourism organizations that follow codes*]' (Ind. #21).
  - Removed as a key informant, who dealt with standards, found it to be offensive as he considered Barbados to be an island with appropriate building standards and thus felt it was not necessary to ask such a question. It could therefore be inferred that Barbados would score high on such an indicator, though its scoring criteria would need to be developed. The removal of the indicator, in this case, does not imply that it would not be relevant or feasible to other destination communities.
- '*Ranking of destination and/or attraction by tourists'* (Ind. #25)
  - Researcher added, as this type of information was available for the destination community. Similar relevance rationale to *'GDP created by the local tourism industry'* (Ind. #26).
- '*Availability of insurance for buildings'* (Ind. #28)
  - Broadened to '*Availability of insurance for tourism related employment and infrastructure for impacts due to weather availability*'.

- '*Local emergency funds as percent of local budget'* (#29), '*Release period of national emergency funds*' (#30), '*Access to international emergency funds by Destination'* (#31), '*Availability of loans for Disaster Risk Reduction measures'* (#32), '*Availability of reconstruction credits for destination'* (#33), and '*Magnitude of local public works programs at the Destination'* (#34).
  - Removed as scored very low by all the participants, particularly for feasibility, credibility, clarity and comparison.
- '*Percent of Tourist area and infrastructure with sea defenses'* (Ind. #35).
  - Removed as such specific information does not exist for tourism destination communities. The information could be easily obtained by walking on the beaches and examining Google Earth imagery, though local stakeholders did not note or suggest this.

6.2.2 Refined List

Table 14 presents the 25 refined indicators that stakeholders developed and selected as implementable and operationally feasible to apply at the tourism destination community-scale, with the 10 bolded ones applicable at the time of research. The second column portrays whether indicator data is being collected and if so, the data type, how often and at what scale. The third column presents any suggested indicator scoring criteria and if data is not being collected at the destination scale, it also depicts future applicability and organizations that could collect such information. The majority of indicators are based on numerical analyses or emperical quantiative data, with a few adaptive capacity indicators based on normative and descriptive criteria (#17,18,19,23,24,25). Table 33 (Appendix B) presents further details for each indicator as to its relevance and comparability amongst tourism destinations, its current and potential applicability, type of data available, how often it is collected, any identified thresholds and specific results for Oistins.

As noted in chapter 2, section 2.4.2.1, the application of local level indicators needs to occur within a defined boundary *"… when systems can be narrowly defined…"* p. 206 (Hinkel, 2011). Determining the most *'easily implementable*' was difficult due to the challenge of defining the tourism destination community of Oistins (i.e. the entire tourism community of Oistins, whose boundaries are not very distinct, or a more precise tourism boundary such as the Oistins Bay Garden Vendors Area). Upon consulting stakeholders it was ascertained that any applicable destination community-scale-indicator data was more readily available for the site-specific tourism attraction of the Oistins Bay Garden Vendors Area and the Fish Market. The advantages and disadvantages of obtaining data at a micro destination community scale are discussed in chapter 8.

Data for ten of the indicators noted in bold in Table 14 were being applied or could be in the near-future at the destination community level, two for exposure (#9,#11), one for sensitivity (#13) and seven for adaptive capacity (#17, 18, 19, 20, 23, 24, 25). The exposure indicators were found to be conceptually relevant by stakeholders, though analysis of the majority of data occurs at the national or regional level. More specifically, for the direct impacts of climate change (extreme events, temperature and precipitation data), stakeholders did not find it relevant, feasible or comparible to downscale regional or national data and analyze it at the destination community scale, where there is too much variation. Nevertheless, stakeholders suggested that data might exist and be relevant, feasible and comparible to analyze for some of the biodiversity indicators to demonstrate the indirect impacts of climate change (#9 and 11).

For the indicators pertaining to sensitivity and adaptive capacity, stakeholders noted that some have been or are being applied, though not all for consistent time periods (#13, 17, 20, 24, 25). Some of the indicators could be applied in the near-future at the destination community level, if respected decision-makers had the need, resources and/or capacity (#18, 19, 23). According to categories presented by the IPCC AR5 (Field et al., 2014), adaptive responses suggested by the destination community indicators relate to vulnerability reduction through disaster risk management (i.e. building codes) and ecosystem management (i.e. maintaining coasts). They also relate to incremental adaptation, via institutional economic responses (i.e. insurance), policies (i.e. disaster planning) and physical measures (i.e. fisheries co-management). These responses will be discussed further in chapter 8 (8.2.1) and

Table 23.

Table 14. Refined List of Tourism Destination Community Indicators

Indicator	**Data being currently collected? If so, by whom, how often, what scale and what type?**	**Scoring Criteria AND/OR If not collected at Destination Scale, future applicability and possible organization(s) to collect.**
EXPOSURE: Change in the suitability of the climate for the destination community [11 Indicators]		

Indicator	Data being <u>currently</u> collected? If so, by whom, how often, what scale and what type?	Scoring Criteria AND/OR If not collected at Destination Scale, <u>future</u> applicability and possible organization(s) to collect.
1. *Frequency* of extreme climate events in the past 30 years (number of tropical storms that develop into Category 1 hurricanes)	• Not applicable at the destination community scale. • Caribbean Institute for Meteorology and Hydrology (CIMH) has a monitoring site on the west coast (St. James Parish) for wind-speed, rainfall and relative humidity. Best climate data and most historical. Analysis occurs regionally (Caribbean) or sub-regionally. • National Oceanic & Atmospheric Administration (NOAA) – Collects data on storms and hurricanes at the regional level.	• Could extract GCM data for Barbados. • Could be easier to apply if stayed with conceptually relevant indicator, which focused on '*extreme precipitation events'.* Barbados Meteorological Service (BMS) continuously monitors this and has readily available data in digital, tabular form. Analysis would be at the national-level.
2. *Intensity* of the worst extreme event in the past 30 years (number of homes severely destroyed by a Category 1 hurricane)	• Not applicable at the destination community scale. • Same points as #1.	• Could extract GCM data for Barbados. • More applicable if stayed with conceptually relevant indicator, which focused on '*extreme precipitation events*'. BMS monitors this and has readily available data. Analysis would be at the national-level.
3. *Probability of extreme future* events (chances/ year) – (number of tropical storms that develop into Category 1 hurricanes)	• Not applicable at the destination community scale. • NOAA makes projections at the regional level.	• Analysis of future trends occurs at the regional level.
4. *Expected intensity of extreme future* events - (# of homes severely destroyed by a Category 1 hurricane)		
5. Mean standard deviation of the daily average maximum temperature by month	• Not applicable at the destination community scale. • BMS collects data at two sites near Oistins, but analysis occurs at the national and regional levels.	• Analysis of trends occurs at the national and regional levels.
6. Mean standard deviation of the daily average minimum temperature by month		
7. Mean standard deviation of average precipitation by month		
8. Mean climate: suitability of the climate for the type of tourism present (Ex: Change in modified TCI)	• Not collected by any local organization.	• TCI could be calculated, though would be relevant and feasible to examine nationally. Would also need to account for other factors influencing tourist climate preferences.
9. Biodiversity: Change in mean *reef fish* (coastal pelagic) harvest in the past 30-years - Shallow-reef (*in-shore)* and Deep-slope and bank reef (*off-shore)* fisheries.	• Not collected at the destination community scale, though could be as fisheries are close to the coast.	• Scoring criteria would need to be developed. Fisheries Div could collect mean size, mean weight, catch/ trip, as only need a few boats to examine changes in catch/ per unit of effort. Could define it to the Oistins area. • Could also rely on local fisher knowledge for changes in catch and movement.
10. Biodiversity: Change in mean fish off-shore *pelagic* harvest in the past 30-years.	• Not feasible to collect at the destination community scale as pelagics are not distinct to a particular community. Shared stock and resource assessment for migratory large pelagic occurs on a	• Fisheries Division has trends for pelagics. May have extracted national-level data for dolphin. Analysis would not be at destination community level, but could extract.

Indicator	Data being <u>currently</u> collected? If so, by whom, how often, what scale and what type?	Scoring Criteria AND/OR If not collected at Destination Scale, <u>future</u> applicability and possible organization(s) to collect.
	regional or international basis.	• Could rely on local fisher knowledge for changes in catch or movement.
11. Biodiversity: **Changes in coastal ecosystems of the destination (i.e. % of live coral cover)**	• Yes. Govt Org 2 monitors health of 46 reef sites around Barbados on a 5-year basis. Most of the work is done by CERMES. • Near-shore reefs monitored closest to Welches and Miami beaches are '*Welcome Inn'* and '*Windsurfer'* patch reef monitoring sites.	Stakeholders suggested a coral reef cover indicator, which could score as: • 1 = cover of 30% or more • 2 = cover of 15-20% or more • 3 = cover of 10% or less
SENSITIVITY - Social, economic and biophysical characteristics of the destination community, which affect its susceptibility to climate related-events [5 indicators]		
12. Destination's Economic sector mix for employment (% related to tourism)	• Too difficult to collect at the destination community scale.	• Possibly by Statistical Department, Ministry of Finance and Economic Affairs or Ministry of Tourism [FG3].
13. Destination's share of total tourist arrivals for recreation	• Yes, though data not collected consistently. • CTO (Tourism Org 6) contracted by Ministry of Tourism (Tourism Org 2) collected exit survey stats on '*places of interest visited during stay by country of residence'* from 2001-2006. Oistins Fish-Fry was found to be second most popular attraction island-wide (CTO, 2006) • Nothing specific on share of tourist arrivals to Oistins hotels or restaurants.	• Scoring criteria would need to be developed. CTO/ MofT could continue to collect number of visitors to Oistins Fish Fry. • Stakeholders could consider measuring share of tourist arrivals via accommodation vs. visits to attractions, as tourists visit more than one attraction. Questions remain of relevance or feasibility due to dense nature of Barbados.
14. Value of [or number of] destination community's tourism infrastructure located in coastal zone below Category 4 storm surge levels [PHYSICAL CAPITAL]	• Not applied at the destination community scale. Govt Org 2 has projections for Category 4 storm surges, though models for the whole island.	• Could extrapolate destination level data from Govt Org 2 modeling or obtain figures on infrastructure from Land Valuation Department, if deemed relevant.
15. Tourism dependent on species that are considered vulnerable to climate change (i.e. consumption of particular fish species or viewing of coral reefs) [NATURAL CAPITAL]	• Not applied at the destination community scale and no clear data source. • Coral reef viewing does not occur in Oistins. • Hard for stakeholders to distinguish which fish species are more vulnerable to climate change, due to lack of studies.	
16. Destination community related employment and infrastructure annually affected by meteorological extreme events.	• Not applicable at the destination community scale, as only national figures available.	• Indicator #23, '*availability of insurance*', might be easier to apply. • If applied conceptually relevant indicator '*population annually affected'* could get info from Damage Assessment to households after a disaster (HH Indicator #1, Table 16).
ADAPTIVE CAPACITY - Social, economic and biophysical characteristics of the destination community which affect its ability to adapt to climate related-events [9 indicators]		
17. Existence of functioning Emergency Management Committee (i.e. local District Emergency Office (DEO) with public representatives at destination Level) [SOCIAL & POLITICAL CAPITAL]	• Yes, as a District Emergency Organization [Emerg Mgmt Org 1] exists for the SCC Parish, which includes Oistins, though not with an exclusive tourism focus. National Dept of Emergency Management [Emergency Management Org 2] is aware of the DEO's activities.	Could score as: • *Is there an EMC? No =1, Yes = 2? If Yes, has it developed an EMP and/or Risk Map? = 3, Has the EMP or Risk map been implemented in the past year = 4, Implemented in 5 years+ = 5*

Indicator	**Data being <u>currently</u> collected? If so, by whom, how often, what scale and what type?**	**Scoring Criteria AND/OR If not collected at Destination Scale, <u>future</u> applicability and possible organization(s) to collect.**
18. Availability and circulation of *Emergency Management Plans* or *Disaster Risk Management Strategies* for destination [SOCIAL & POLITICAL CAPITAL]	• EMPs exist at different scales in the community (i.e. community or national) with different sectoral focuses (i.e. tourism, fisheries or community). There is a need for coordination. • The local DEO would like to create an integrated EMP for Oistins, including the BGVA and other tourism facilities. Information exists, though a Plan hasn't been created due to time and capacity constraints.	• Could be if there is coordination amongst local stakeholders and a desire to create a tourism destination community-specific plan. • Could score as: • *Has a Coordinated EMP for the Tourism Destination been developed? No =**1**, Yes = **2**? If Yes, in what form? Draft = **3**, Approved = **4**, Implemented and tested within last year = **5**, Implemented, tested and revised within 5 years + = **6***
19. Availability and circulation of Risk (Hazard) Maps for the destination community, that have been operationalized in the past 10 years [SOCIAL & POLITICAL CAPITAL]	• DEO would like to create integrated Risk Maps for the entire destination community of Oistins, starting at the household level. Presently, the local DEO lacks time, capacity and resources to create them.	• Could be if there is coordination amongst local stakeholders and a desire to create destination community-specific maps. • Could score as: • *Has a Coordinated Risk Map for the entire Tourism Destination been developed? No =**1,** Yes = **2**? If Yes, in what form? Draft **= 3,** Approved = **4**, Implemented and tested within last year by circulating to households and community groups = **5,** Implemented and tested within 5 years + = **6***
20. Ranking of tourism destination and/or attraction [FINANCIAL CAPITAL]	• Yes, though not consistently applied and not sure if will be in the future. • '*Zagat Awards',* through '*Best of Barbados*' survey, ranked Oistins Friday night fish-fry as #1 nightlife attraction in 2008 and #2 in 2006. Survey was funded by the Barbados Tourism Authority [Tourism Org 4] and ranked by Zagat members.	• Zagat survey only carried out for two years. • Scoring criteria would need to be further developed. CTO BTPA/ Zagat could continue to carry out the survey on a yearly basis. BTPA agreed that it is useful to periodically rank attractions.
21. Share of annual GDP generated by the destination's tourism industry [FINANCIAL CAPITAL]	• Not collected at the destination community scale and no clear data source.	• Tourism stakeholders in Oistins pay income taxes and Value Added Tax, through which could look at GDP contribution. • Defining a distinct tourism boundary around Oistins presents a challenge.
22. Total locally (destination level) generated GDP <u>OR</u> Total available local budget in US $ [FINANCIAL CAPITAL]	• Not collected at the destination community scale and no clear data source.	• Local groups, such as the Bay Garden Vendors Association, Oistins User Committee, or Constituency Council could collect data on the local GDP contribution of their key stakeholders.
23. Availability of insurance for tourism related employment [i.e. vendors, fisher-folk, lifeguards] and infrastructure (i.e. food stalls, restaurants, boats), for impacts due to weather variability [FINANCIAL CAPITAL]	• *Infrastructure insurance* can be provided for infrastructure loss due to weather variability, if individuals pay into it. • National Insurance Scheme (NIS) can provide *employment insurance* for off-season employment if individuals pay into it. NIS does not provide benefits due to less work due to weather variability. • Even if individuals have employment and infrastructure insurance, information is not consistently collected at the destination community level.	• Information on whether an individual has employment or infrastructure insurance could be collected consistently if coordination amongst local stakeholders. • Benefits for loss of work due to weather variability could be provided by sector specific organizations. • Could score as: • *Is insurance available to address impacts due to weather variability for employment and infrastructure? **No = 1, Yes = 2**, If so, amt? Price/ amount?*
24. Effective erosion protection	• Yes, as Govt Org 2 quarterly profiles the physical	• Stakeholders need to further develop, by

Indicator	Data being <u>currently</u> collected? If so, by whom, how often, what scale and what type?	Scoring Criteria AND/OR If not collected at Destination Scale, <u>future</u> applicability and possible organization(s) to collect.
measures in place in vulnerable areas (e.g. sea defenses) [NATURAL CAPITAL]	dimensions of 200 beaches, with 70 selected for detailed monitoring. Erosion protection measures are put in place in vulnerable areas, as needed. Two of the detailed sites are Welches and Miami beaches (Beach #1 and #2) in Oistins.	identifying additional effective erosion protective measures. • Could score as: • *Have effective erosion protection measures (e.g. sea defenses) been implemented in vulnerable areas of the tourist destination? No = 1, Yes = 2? If Yes, what types?*
25. Beaches monitored on a regular basis (i.e. changes in beach width or physical dimensions) [NATURAL CAPITAL]	• Yes, as Govt Org 2 profiles physical dimensions of 200 beaches, with 70 selected for detailed monitoring. Monitor sites where the coastal processes are the same (Oistins = Sector 2). • Two of the detailed sites are Welches and Miami beaches (Beach #1 and #2) in Oistins. Every quarter, take lines to calculate beach width, volume and height.	Could score as: • *Are the physical dimensions of the beaches in the destination monitored on a regular basis? No* ***= 1,*** *Yes* ***= 2,*** *Yearly =* ***3****, Quarterly =* ***4***

6.2.3 Results of any Applicable Indicators

As noted in Table 14, at the time of research, 10 destination-level indicators were being applied or could have been in the near-future at the destination community level in Oistins. The findings from the eight indicators that were being applied are noted below, though not all were being applied consistently. This includes one exposure indicator for an indirect impact of climate change (#11), one sensitivity indicator (#13) and six indicators sites for adaptive capacity (#17,18,19, 20, 24, and 25). The suitability of the indicators in their assement of the vulnerability of the destinaiton community of Oistins is discussed in chapter 8, section 8.3.1.

Three of the indicators pertain to the biophysical traits of beaches #1 and #2 (#11, 24 and 25). The exposure indicator (#11) pertains to changes in the destination's coastal assets and the adaptive capacity indicators (#24 and 25) pertain to the biophysical characteristics of the destination community which affect its ability to adapt to climate related events.

- Beaches #1 (Miami) and #2 (Welches) are monitored regularly by Government Org 2 to assess any changes in coastal ecosystems, in particular coral reef health (#11). Furthermore, erosion protection measures have been put in place in vulnerable areas, as needed (#24), and the beaches are monitored on a regular basis for changes in width or physical dimensions (#25). Tourism Org 5 also undertakes beach risk analysis, stability mapping, rating, evaluation and carrying capacity analyses along with Govt Org 2. As noted in chapter 4, Beach #2 underwent through a beach improvement in 2006.

The sensitivity indicator pertains to the destination community's share of total tourist arrivals for recreation, though data for this has not been collected consistently (#13).

- The Caribbean Tourism Org [Tour Org 6] was contracted by the Ministry of Tourism [Tour Org2] to collect statistics on '*places of interest (attractions) visited during stay by country of residence*' from 2001-2006. During this time period, the Oistins Fish-Market ranked as the second most popular attraction in Barbados (CTO, 2006). The indicator only applied to visitors to the Friday night Fish-Fry and no information has been collected on the share of tourist arrivals to Oistins hotels or restaurants.

The other four indicators pertain to adaptive capacity and relate to the social and economic characteristics of the destination community which affect its ability to adapt to climate related events. Three of them pertain to Emergency Planning and Risk Management (#17, 18 and 19) and one to tourism ranking (#20).

- At the time of research, a local Emergency Management Committee [Em Mgmt Org 1] existed for the larger community of Oistins, but not with an exclusive focus on tourism (#17). No specific Emergency Management Plan had been developed for the tourism based activities of Oistins, though different EMP initiatives exist at different scales and cross-cutting sectors of the island (#18). In particular, A '*National Tourism EMP'* had been drafted by the Ministry of Tourism [Tourism Org 2], BHTA [Tourism Org 3] and BTPA [Tourism Org 4] and is applicable to accommodation, ancillary and transportation services, though at the time of research was not available for review. Furthermore, the Police had developed a generic EMP for Oistins, the Oistins Users Committee [Fisheries Org 5], representing fisher-folk, fish vendors and boat owners, had drafted a '*rapid response plan*' for fish-market stakeholders and the OSMBO [Fisheries Org 3] had developed an EMP for small boat owners. The Bay Garden Vendors [Tour Org 1] still needed to develop a draft EMP and would need assistance from the South Christ Church District Emergency Organization (DEO) [Emergency Mgmt Org 1]. The various EMPs could be coordinated depending on what sector and spatial scale stakeholders decided to operate from. The SCC DEO would like to create an EMP for Oistins, including its tourism facilities. The information exists, though a Plan hasn't been created by the organization due to time and capacity constraints. The DEOs operate as the local volunteer arms of the national Department of Emergency Management (DEM) [Emergency Mgmt Org 2] and work with communities and organizations to reduce the impacts of disasters, including climate-related hazards of hurricanes and floods (DEM, 2008). Apart from specific disaster incidents, there are no formal reporting requirements from the DEO to the DEM.

- No specific risk maps had been developed for the tourism based activities of Oistins, though could be if there was coordination amongst local stakeholders and a desire to create tourism destination community maps (#19). The SCC District Emergency Office would like to create an integrated risk map for Oistins, starting at the household level, though lacks the time, capacity and resources. The '*National Adaptation Strategy to Address Climate Change in the Tourism Sector in Barbados'* notes that the preparation of risk/hazard maps can be costly due to the hiring of personnel in Geographic Information Systems, social surveys, and land valuation and the necessary investment for software and hardware to support the research and to store the data (CCCCC, 2009a).
- The Oistins '*Friday-night fish-fry'*, one of the community's key tourism attractions, has been ranked regarding its tourism services, but not consistently (#20). The '*Zagat awards'* ranked the Oistins '*Fish-Fry'* as the #1 nightlife attraction in 2008 and #2 nightlife attraction in 2006. The Barbados Tourism Product Authority, which funded the survey, thinks it would be useful to continue to periodically rank its attractions.

In summary, the application of the above destination-community indicators provided some insights into the vulnerability of the tourism-destination community of Oistins. The community's tourism sector is experiencing indirect impacts of climate change, faces economic sensitivity to any climate-related events and demonstrates some capacity to adapt to these events. In particular, the community understands the importance of its coral reefs in maintaining biological diversity and its coastal ecosystem and continues to monitor their health, even though they are not key tourist attractions in Oistins. Furthermore, the community could experience greater sensitivity to climate change due to its high share of tourist arrivals (sensitivity indicator #13), though its high ranking of attractions by tourists (adaptive capacity indicator #20), could also encourage further resources to develop the industry and build its adaptive capacity. As noted in Table 32 (Appendix B) tourism-related sensitivy and adaptive capacity indicators can have contradicting rationales, and this is further discussed in section 6.4.2. In addition, the community's beaches are considered key coastal features in Barbados and are monitored regularly, enabling greater capacity to adapt to changing climate-related events. Lastly, initiatives to plan for emergencies and map risks exist within the community, the tourism sector and the island as a whole, but at different spatial scales and lack coordination at the tourism destination community level.

6.3 Household Level Indicators

The following section pertains to the indicators developed and applied at the household level for the tourism destination community of Oistins. As noted in chapters 2 and 3, household level indicators can investigate how household characteristics are linked with vulnerability. Such indicators were developed to examine whether they can assist with the identification of vulnerable stakeholders in the destination community and to examine how the determinants of vulnerability (exposure, sensitivity and adaptive capacity) are related at the destination community and household levels. The section commences by providing general characteristics of the two neighbourhoods adjacent to the Oistins Bay Garden Vendors Area and the Fish-Market, based on the results of the household surveys. It then presents the conceptually relevant list of household indicators, followed by the refined list of household indicators. Household survey results pertaining to the applicable vulnerability indicators are then detailed.

6.3.1 General Characteristics of the Two Neighbourhoods

As noted in chapters 3 and 4, the Barbados Statistical Department idenfied four enumeration districts within the community of Oistins, with a total population of 1200 in the year 2000 (GOB, 2000). Household surveys were conducted in the two districts of Ashby Lands and Scarborough, as they are neighbouring, have very similar attributes and are directly across from the Bay Garden Vendors Area and the Oistins Fish-Market. In 2000, the two districts comprise of 270 households with a total population of 719, which resulted in a significant sample size of 71. Upon analysis of the survey results, the following are some general characteristics of residents living in the two neighbourhoods.

Of the 71 Households Heads interviewed:

- 85% (60) live with others and 15% (11) live alone.
- 27% (19) are retired [2 are younger than 65], of which:
  - 58% (11) are women and 4 live alone.
  - 42% (8) are men [many retired fishermen] and 4 live alone.
- 8.5% (6) are unemployed, of which all are women, though live with other family members and are still considered the household head.
- Of the 85% (60) household heads who lived with other family members, the largest number of additional family members per household was 15.
- There were 187 additional people residing in the households surveyed, which combined with the Household Heads (survey respondents), equaled a total number of 258 individuals considered in the survey. Out of these 187 additional household members, there were:
  - 115 adults [61% of total population] over 15, of which
    - 99 completed secondary school or more (86%)
    - 16 completed only primary school (14%)
  - 72 children under 14 (39% of total population)

In regards to livelihood and employment, forty-four households (62%) had household heads and other household members employed in income generating activities. Out of these, twenty-nine households (66% cumulative) had household heads and other household members engaged in tourism-related livelihoods pertaining to accommodation and hotel, food and restaurant services and fisheries (further detailed in section 6.3.4). Other types of employment included administration, financial services, construction, domestic work, education, sales and services, health services, government, information technology, trades, private sector or self-employed. If household members were not working, they were retired, home-makers, care-givers, students or unemployed.

6.3.2 Conceptually Relevant List

As noted in chapter 3, 31 conceptually relevant indicators were presented to the household level focus group and key informants to assess differential vulnerability at the household level. The type of determinant examined and particular indicators are presented in Table 15. Table 34 (Appendix C) provides further details for each indicator, including its rational and relationship to vulnerability, its limitations, suggested modifications, average focus group score, the resulting indicator and the unit of analysis. Time is fixed in the current point of time. As detailed in chapter 3, stakeholders were asked to select and score the most appropriate indicators to examine household level determinants for tourism destination communities and to provide details as to their potential applicability. It was noted that any data collected to apply the indicators could be analyzed at the household, destination community, regional (district) or national levels. Twenty-four of the indicators were developed based on the academic literature, five indicators were developed from the original The CARIBSAVE Partnership household survey and two were developed by the Researcher building on sources in the literature to suit the particular context.

Climate-related events were defined in plain language terms and included strong winds, which can be attributed to tropical storms, flooding, high waves (for storm surges), water shortage (for drought) and landslides. Three of the four household level indicators for exposure are hazard specific and demonstrate the direct and indirect biophysical impacts of climate change. The twenty-seven indicators for the socioeconomic determinants of sensitivity and adaptive capacity are hazard generic as they provide insight as to the processes (contexts), nature and root causes of vulnerability at the household level. Only a few of the household level indicators had specific links to tourism or livelihoods (#4, 18, 19 and 31).

Table 15. Conceptually Relevant List of Household Level Indicators

Determinant	**Original Indicator and Analysis Level[52]**
EXPOSURE of the household to extreme climate-related events and long-term changes in climate [4 indicators]	
Direct Impacts • Increase in extreme climate-related events. • *Perceived long-term changes* in air temperature and precipitation.	1. Average number of storm, flood and storm events in the past 10 years (range: 0–7) - C or R
	2. % of households that note long-term changes in air-temperature and precipitation in the past 10 years - C or R
Indirect Impacts • Perceived degree and nature of impact.	3. % of households with an injury as a result of the most severe climate-related event in the past 10 years- R
	4. % of households that experienced climate-related impacts to livelihoods [tourism related] – C or R
SENSITIVITY - Health, food and water characteristics that determine household sensitivity [15 indicators]	

[52] H = Household, C = Community, R = Region/ District, N = National

Determinant	Original Indicator and Analysis Level[52]
Community Risk Awareness	5. % of households with perceived risk from a particular hazard – C
Demographic Structure (*Socio-demographic profile)*	6. % of households where dependent members exceed 4 = populations under 15 or over 65 [Economic and social dependency ratio] – H, N, R
	7. % of households headed by women - R
	8. % of households headed by seniors (over age of 65) or retired persons – H
Health	9. % of households with a member with a physical disability – H
	10. % of households with a member suffering from a chronic illness (i.e. asthma, hypertension, diabetes, heart disease) – H, R
	11. Households where a family member had to miss work or school in the past month due to illness - R
Food	**12.** % of households that do not have adequate food through the year - R
Water	13. Households that do not have a running water supply in the house - R
	14. Households reporting water conflicts - R
Financial	15. Average *Receive: Give* Ratio – Ratio of number of types of help received by HH in the past month to number of types given - R
	16. Average *Borrow: Lend* Money ratio - Ratio of HHs borrowing $ to lending $ in the past month - R
Housing Quality	17. % of Households that have homes [roof and floor] made from lower quality materials (i.e. wood) - H
Livelihood	18. % of Households dependent on a tourism-related *[direct and indirect]* as a primary source of income - R
	19. % of households with at least one family member working in a different community - R
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources (assets) that determine a household's capacity to adapt [12 indicators]	
Evaluation of Community Leadership [POLITICAL CAPITAL]	20. Trust in govt institution to manage impacts and risks associated with a hazard - C
	21. Satisfaction with local management efforts of climate-related events in community to date - C
Disaster Risk Management	22. % of households that received a warning about any pending climate-related events - R
	23. % of households benefitting from *more than one* DRM Effort - H
Human Capacity [HUMAN CAPITAL]	24. Knowledge within the sector on climate change, its potential impacts and possible actions [via proxy, % of household heads and members (over 15) who've completed secondary school] - R
Social Networks Interconnectivity in higher level processes [SOCIAL CAPITAL]	25. Range and scope of social capital contacts - H
	26. % of households with membership in social groups - H
PHYSICAL CAPITAL	27. % of households that own their home and/or other physical resources – H
NATURAL CAPITAL	28. % of households with access to a family farm or household garden (vegetable vs. herb) – H
FINANCIAL CAPITAL	29. % of households that have a variety of insurance [i.e. health, house (strong winds, flooding, high waves and fire), private, national insurance (government pension)] – H, R
	30. % of households with accessibility to a variety of funds – H
Livelihood	31. % of households taking more than one action (change to livelihood activities) in response to a climate-related event – H

Based upon consultation with the focus group, key informants and The CARIBSAVE Partnership, the following five indicators were removed or modified from the conceptually relevant list detailed in Table 15 (two for sensitivity and three for adaptive capacity).

Sensitivity:

- '*Household where a family member had to miss work or school in the past month due to illnesses*' (#11).
  - Focus group members thought this would be challenging information to collect regularly and consistently.
- *'Number of Households that provides support'* (#16).
  - Focus group asked to remove as thought that if a household provides financial support outside of the household, they are more financially sound and less sensitive.

Adaptive Capacity:

- '*Trust in government institution to manage impacts and risks associated with a hazard'* (#20) and '*Satisfaction with local management efforts of climate-related events in community to date'* (#21).
  - The CARIBSAVE Partnership asked to remove, as they thought community organizations might find them too politically sensitive to ask. Instead, the organization suggested '*whether management of climate-related events could be improved*'.
- *'% of Households with membership in social groups'* (#26).
  - The focus group thought this was irrelevant, as often lower income communities do not belong to many social groups, besides the Church. Membership in the Church would not necessarily result in support in the case of an extreme climate-related event. Stakeholders thought a firmer and more specific relationship with family or friends would be appropriate.
- *'Percent of households that own their home and/or other physical resources'* (#27).
  - Focus group participants thought that owning a home is not relevant to adaptive capacity and that the type or structure of the home is more useful (i.e. Indicator #17).

6.3.3 Refined List

Table 16 presents the 26 refined list of indicators that stakeholders developed and selected as implementable and operationally feasible to apply at the household level. The Table details the modified indicators (not all were applied in the surveys as the indicators were further refined after survey execution), whether household data was being collected and future applicability if it was not being collected. Table 35 (Appendix C) presents further details for each indicator as to their potential and current applicability, actual question posed in the survey, survey results, other relevant data and any identified thresholds. In summary, due to the defined boundaries of the households in the two neighbourhoods, it is fairly easy to apply all of the household level indicators through the execution of a survey, by local or national government, community groups and non-government organizations. The challenge is to determine what is currently being collected or feasible to apply in the long-term by organizations that regularly survey the neighbourhoods (i.e. community or government groups).

Upon consultation of stakeholders, it was noted that household data was being collected for 11 of the 26 indicators in Oistins by various organizations, though the temporal and spatial scales of data collection differed for each (noted in bold in Table 16). The four indicators for exposure were not being collected by any organization at the household-level as they were not part of any of their mandates. Stakeholders suggested that a non-government organization specifically engaged in climate change adaptation planning could collect such information. Furthermore, no information regarding climate change impacts on tourism-related livelihoods (#4, 26), or household members travelling to diffect communities for tourism-related work (#17), was collected at the household level. Information pertaining to the type of livelihoods, including those that are tourism related (#16), is analyzed at the national level by the Barbados Statistics Department, Ministry of Labour and Caribbean Tourism Organization.

Even though the household level indicators did not present a lot of tourism specific information, they can highlight other characteristics of a household, which could influence the vulnerability and adaptive capacity of stakeholders within a tourism destination community (i.e. socio-economic conditions, physical and natural assets, social networks and perceived risk). In this context, it was ascertained that the Statistics Department collects household-level data on a 10-year basis for seven of the sensitivity indicators (#6,7,8,9,12,14,15) and two of the adaptive capacity indicators (#21,23). The indicators pertain to households headed by women, seniors, or individuals with a disability, to financial resources, to water supply, to materials of homes, to education levels and to resource access. Statistical data is collected as part of the national census at the neighbourhood/ enumeration district level, but analyzed at the Parish level, which is useful to look at general trends, though not specific enough to say which households. If need be, specific information could be pulled out by individual enumeration districts, to identify trends for a particular tourism-destination community. Statistical census questions are consistent accross the Caribbean allowing for comparability accross the region.

Furthermore, as part of their community profiling, the South Christ Church District Emergency Office and the Oistins Police Department collect information in the two neighbourhoods, but are not as systematic or coordinated as the Statistical Department. Two of their indicators overlap with the information collected by the Statistics Department (#8 and 9) and two of the indicators are additional (#10 and 22). All of the information collected pertains to elders, in particular those with disabilities, illnesses or who live alone (#8,9,10, 22). The DEO collects this information on behalf of the National Assistance Board's (NAB) '*Vulnerable Person's* list. The NAB is made up of several organizations and defines vulnerable peoples as those "*… with disabilities and the elderly living alone, who have no support mechanisms, i.e. family, friends or support groups who can ensure their safety in the event of a disaster or major emergency or whose existing homes are proven to be unable to withstand the impact of a disaster or a major emergency due to a state of disrepair or location in a vulnerable area... Example in an area that is prone to flooding"* (GOB, 2011).

In addition, via the '*Community Profile'* that the DEO is slowly conducting of Oistins, the organization discusses sensitivity and adaptive capacity indicators #5, 13, 15, 23 and 24 with households, but does not systematically note the information pertaining to perceived risk, water conflicts, home materials, resource access or insurance. As of April 2011, the DEO had visited several households in the community to identify vulnerable people, as per the National Assistance Board definition. The conversation with residents then broadened, as the DEO also collects information on risk preparation, including flood prone areas or the location of artisans and volunteers who can help in the event of an emergency. Ideally, the DEO would like each household to have a plan identifying individual risks. The DEO plans to visit more households in the near future, though is limited by time, capacity and staffing.

The SCC Constituency Council [Govt Org 1] represents a range of community organizations and was also interested in collecting community information, though as it was recently established had not yet established its survey protocol or scope of data collection. The Council was particularly interested in some of the information that could be obtained through the DEO's '*Community Profile'* [Indicators #5, 15, 23 and 24], with the addition of knowledge of climate change and its particular impacts [Indicator #21]. All stakeholders noted that vulnerable people should be continued to be identified at the community level for emergency planning and adaptation efforts and that general at risk groups should be identified nationally.

Adaptive responses brought forth by the household indicators, as noted in Table 16 and further to criteria presented by the IPCC AR5 (Field et al., 2014), relate to vulnerability reduction through human development (i.e. education), poverty alleviation (i.e. insurance schemes), livelihood (i.e. livelihood diversification) and disaster risk management (i.e. early warning systems). These responses will be discussed further in chapter 8 (8.2.1) and

Table 23. Table 17, section 6.3.4, presents the survey results of the applicable household indicators and provides some data correlation with those households dependent on tourism-related livelihoods.

Table 16. Refined List of Household Level Indicators

Indicator	**Data being currently collected? If so, by whom, how often, what scale and what type?**	**Future Applicability? If so, possible organization(s) to collect**
EXPOSURE of the Household to extreme climate-related events and long-term changes in climate [4 Indicators]		
1. Average number of tropical systems, including hurricanes, (leading to intense rainfall, floods, storm surges or landslides) OR periods of drought in the past 10 years, leading to physical impacts on the households.	• Damage Assessment Officers collect data after any major disaster. No stats collected on *how often* a household is impacted. • DEO collects info on *susceptibility* to extreme events at the community level. Irrelevant for their work.	• Perhaps for an international project, to determine which destinations would benefit from adaptation planning.
2. % of Households that note long-term changes in air-temperature and precipitation in the past 10 years.	• DEO does not collect. Not sure if relevant as how accurate would the projections be due to recall bias and consideration of other stressors?	• Perhaps for an international project.
3. % of Households with an injury as a result of the most extreme climate-related event in the past 10 years.	• DEO does not collect and does not think relevant.	• Perhaps for an international project.
4. % of Households that experienced climate-related impacts to tourism-related livelihood.	• DEO does not collect, as not part of their mandate.	• Perhaps for an international project.
SENSITIVITY – Current health, food and water characteristics that determine household sensitivity [13 Indicators]		
5. % of households with perceived risk from a particular hazard	• DEO encourages people to identify their risks, though does not systematically note. Most people are	• Constituency Council thinks this would be useful, to increase awareness of community agencies and services.

Indicator	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect
	fairly aware.	
6. % of households solely headed by women, where dependent members exceed 4 = populations under 14 or over 65.	• Stats collects via census at the Parish level (size of HH, main activity and family type). • DEO does not examine.	• DEO thinks this is useful and that NAB's '*vulnerable persons*' definition should include single parent led families with high dependency ratios and no defined support. NAB has agreed to this.
7. % of Households headed solely by women [single or widowed], with a certain income level and/ or no support.	• Stats collects via census (household head by sex and parish). Focuses on income activity but not income level. Stats '*Continuous Household Labour Force Survey*' samples quarterly in EDs to examine labour force and employment by earnings and sex, but not whether household heads are women.	• DEO recommends collecting this in conjunction with Indicator #22 (social contacts). Thinks NAB's '*vulnerable persons*' list should include single parent led families with high dependency ratios and no defined support. NAB has agreed to this.
8. % of households headed by seniors (over age of 65) or retired persons, who live alone.	• Stats census collects population by age and household head, though not specific to Parish and whether they live alone. • Oistins Police Dept maintains seniors list and visits them monthly to track health situation and social networks. Collect next of kin info, so in case of an emergency, can contact them on the senior's behalf. Seniors with no support are placed on NAB's '*vulnerable persons'* list. • DEO collects similar information on behalf of NAB.	• Police and DEO recently realized overlap and plan to coordinate/ discuss. Information not collected for statistical purposes.
9. % of households heads with a cognitive or physical disability that live alone and with no support.	• Stats census collects by sex, age and type of disability. Don't note whether live alone. Part of NAB '*vulnerable persons'* definition, in particular if disability impairs mobility and individual lives alone with no support. • Oistins Police collect monthly. • DEO also collects on behalf of NAB. Though both focus on elders.	• DEO plans to collect household information beyond elders.
10. Households where the household head or one of its members suffer from a chronic illness (i.e. asthma, hypertension, diabetes, heart disease)	• Police collect in relation to elderly, especially if living alone. • NAB, via DEO, has a list of certain illness that they check on (i.e. diabetes, heart conditions).	
11. % of households that do not have adequate food throughout the year.	• Not currently collected. • Stats '*Continuous Household Labour Force Survey*' looks at employment by earnings and sex for the whole	• Should be asked by an organization that has developed rapport with the community. Welfare Dept might know if a family is having difficulty, if they

Indicator	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect
	population. • DEO does not collect as does not think relevant and not part of their mandate.	come forward themselves. In most areas where people are in need, the community organizations would know.
12. % of households that do not have a running water supply in the house	• Statistics census looks at type of water supply by Parish.	
13. % of households reporting water conflicts	• DEO does not collect, though would note if came across info. • DEO suggested Constituency Council, which does not currently collect.	• Constituency Council has not put their survey protocol in place.
14. % of households that receive financial support	• Could extract data from Statistical Dept '*Household budget Survey'.*	
15. % of households that have homes made of materials vulnerable to damage from high wind and hurricanes.	• Stats census examines dwelling units by Parish, Occupancy Status and Materials of Outer Walls and Materials or Roof. • Organizations affiliated with NAB target homes that are known to have issues or come after a damage event. • DEOs can note, but does not ask systematically.	• Constituency Council thinks information would be very useful. • Future indicator could be *'% of Households in poor condition and/or in a sensitive location'* [need criteria checklist] or *'% housing rental'*, which indicates where contents are least likely to be insured.
16. % of households dependent on a tourism-related activity as a primary source of income	• Not currently collected. • Stats census collects '*economic activity stats'* at national level. Tourism not distinguished as a sector. Stats '*Continuous Household Labour Force Survey'* presents national employment figures by '*accommodation and food services*' [doesn't include other tourism related activities]. • Ministry of Labour presents this as % of people employed in sector *nationally.* CTO also collects info on satellite accounting at national level.	• When examining GDP, Stats has a section on spending of tourists, but it would be good to focus on income coming out from tourism. How is the amount being spent by tourists being converted into income for locals? Possibility to look into future, perhaps in collaboration with the Caribbean Tourism Organization. Focus would remain national.
17. % of households with at least one family member working in a different community for tourism-related work.	• No parties collect and found irrelevant for a small island like Barbados. Yet the island is densely developed and has a lot of rush hour traffic. So if an individual has to travel far from their home to work, it could take a while.	• No parties plan to collect.
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources (assets) that determine a household's capacity to adapt [9 indicators]		
18. % of households that thinks management of climate-related events could be improved in their neighbourhood. [POLITICAL CAPITAL]	• DEO does not ask, as this is not part of their mandate.	• Perhaps for an external organization or international project engaged in adaptation planning.
19. % of households that received a warning about any pending climate-related events.	• DEO found this irrelevant and does not ask, as government warns for extreme events, which most people receive via media, friends or family.	• No parties plan to collect.
20. % of households benefitting from	• DEO found this irrelevant, as even if	• No parties plan to collect.

Indicator	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect
more than one DRM Effort (i.e. relief supplies, evacuation or Information)	run information/ training exercises, not a lot of people participate.	
21. Knowledge within the sector on climate change, its potential impacts and possible actions [via % of household heads and members (over 15) who've completed secondary school]. [HUMAN CAPITAL]	• Stats Census collects via population aged 15 years and over not attending school full-time by highest level of educational institution. • DEO does not test household knowledge about climate change and found irrelevant, as even if one has knowledge, would one use it?	• Constituency Council thinks this would be useful as could lead to a discussion of response/ survival techniques.
22. Range and scope of social capital contacts [*Range from*: friends and family, leadership within neighbourhood [BONDED CAPITAL], formal governance structures, and/or contacts beyond the geographical limits of the neighbourhood [NETWORKED CAPITAL] [SOCIAL CAPITAL]	• DEO and Police note whether household heads are elderly, have a de-habilitating illness and/or are single parent families with high dependency ratios [*latter only DEO notes*]. If so, ask whether they have family or friends for support. If not, put on DEO/ NAB list. • For others, DEO does not systematically note, comes out in conversation.	
23. % of households with access to one or more natural resources (i.e. household garden, livestock and/or fisheries). [NATURAL CAPITAL]	• On 2010 Census, Agric Dept placed a question on gardening/ farms. • To date, DEO identifying vulnerable people. Mapping physical resources for the immediate aftermath of a disaster is next step. If DEO was responsible for a feeding program, existence of agricultural resources would be useful.	• Constituency Council thinks this would be useful to examine post-disaster period and determine how independent a family can be.
24. % of households that have a variety of insurance [i.e. health, house (strong winds, flooding, high waves and fire), private, employment, pension]. [FINANCIAL CAPITAL]	• DEO asks whether home is insured and if not, encourages households to get it. Does not systematically note which households have it or not.	• Constituency Council thinks this information is very useful.
25. % of households with accessibility to a variety of funds [FINANCIAL CAPITAL]	• DEO doesn't collect.	
26. % of households taking *more than one* action (change to livelihood activities) in response to a climate-related event.	• DEO does not ask, as not part of their mandate.	• No defined organization. Might be useful to examine range of actions with age, as for younger people it is easier to engage in new livelihoods.

6.3.4 Results of any Applicable Indicators

Household level indicators were developed and applied to examine how household characteristics are associated with vulnerability and whether they could assist with the identification of vulnerable stakeholders within the tourism destination community. As noted in Table 16, at the time of research, data was being collected for 11 of the 26 household level indicators in Oistins by various organizations, though the temporal and spatial scales of collection differed for each. Table 17 below presents the statistical results of the household surveys for the eleven applicable indicators (8 for sensitivity and 3 for adaptive capacity), though particulars as to which organization collects the data are noted in Table 16.

Survey results pertaining to the four indicators detailing tourism-related livelihoods are also presented, even though their data is not being collected by any organization at the household level (#4, 16, 17 and 26). Furthermore, data for indicator #16 (% of households dependent on a tourism-related activity) is correlated with the indicators pertaining to single women run households, illnessses, financial support, housing material and education levels (Indicators #6, 10, 14, 15 and 21). Such a correlation was made based upon the number of responses and the fact that the determinants of these latter indicators have been noted to more significantly influence the vulnerability of households.

It is important to note that the purpose of this exercise was to determine what indicators were relevant and feasible to develop and apply at the household scale and whether they could offer any additional insight into tourism-related vulnerability. One cannot make statistically significant comments from the results of the survey, as there are no other communities to compare the data to and no data thresholds were established. Nevertheless, some general comments can be made from looking at the data. Complete survey results pertaining to each household level indicator are presented in Table 35 (Appendix C).

Table 17. Results of Oistins Household Surveys

Refined Indicator (number indicated in bold)	Results from Household (HH) Surveys in Oistins
EXPOSURE of the household to extreme climate-related events and long-term changes in climate	
• % of Households that experienced climate-related impacts to **tourism**-related livelihoods (income generating activities) **[#4]**	21% (15 HHs[53]) LHs impacted by, [12 Post-Tomas]: • 19.7% (14 HHs) – strong winds • 7% (5 HHs) – flooding • 1.4% (1 HH) – high-waves • 1.4% (1 HH) – water shortage Impacts to livelihood were closed down tourism infrastructure (i.e. hotel, restaurant, recreational activity or fish-market); ability to carry out or get to livelihood; and impacts to tourists.
SENSITIVITY – Health, food and water characteristics that determine household sensitivity	

[53] HH = Household head

Refined Indicator (number indicated in bold)	Results from Household (HH) Surveys in Oistins
• **% of households solely headed by women**, where dependent members exceed 4 = populations under the age of 14 or over 65 [Economic and social dependency ratio] **[#6]**	42.3% (30 HHs) headed by women who are single or widowed and have dependents, of which: • 3 had *4 or more* family members under the age of 15 (10%) • 2 had *4 or more* family members that are students [could be over 15] (6% cum)
• % of Households headed solely by women [single or widowed], with a certain income level and/ or no support **[#7]**	34 HHs [48%] headed by women, of which: • 42.3% (30) had other family members living with them [i.e. children, siblings] • 5.6% (4) lived by themselves • 41.2% (14) received support • *Income*: 11 (32%) could support themselves for 1-6 months, 19 (56%) don't know. • *Income breakdown*: 14 (41.2%) < $1000, 5 (14.7%) between $1000-2000, 13 (38.2%) > $2500, 1 (2.9%) don't know, 1 (2.9%) varies.
• % of households headed by seniors (over age of 65) or retired persons, who live alone **[#8]**.	23% (16 HHs) were seniors • 9 women & 7 men *Out of this* • 6 HHs (8.5%) lived alone [3 women and 3 men]
• % of households heads with a cognitive or physical disability that live alone and with no support **[#9]**.	9.9% (7 HHs) with a member with a physical disability • Of which over half, 4 HHs (11.8%) headed by single/ widowed women, with dependents - *Could include themselves*
• HHs where the household head or one of its members suffer from a chronic illness **[#10]**	42.3% (30 HHs) with Chronic Illnesses • Out of which, almost half headed by single women (14 HHs, 47%). • Asthma and Hypertension were the most common illnesses.
• % of households that do not have a running water supply in the house **[#12]**	• 2.8% (2 HHs) – Did not have piped (running) water inside the house.
• % of households that *receive* financial support **[#14]**	39.4% (28) HHs received financial support: • 26 HHs (36.6%) as grant, 2 HHs (2.8%) as monetary gift [*could receive from more than one source].* • From: 1 HH (1.4%) spouse, 11 (15.5%) relative, 19 (26.8%) from govt [out of latter 9 HHs receive as seniors' pension, 4 of which lived alone.
• % of households that have homes made of materials vulnerable to damage from high wind and hurricanes **[#15]**.	• 69% (49 HHs) wood • 25.4% (18 HHs) cement • 5.6% (4 HHs) bricks
• % of households *(heads and other household members)* dependent on a **tourism**-related activity as a primary source of income **[#16]**	62% (44 HHs) involved in an income generating activity, • 40.8% (29 HHs) where tourism-related activity was a primary income source for *HH and/or other household members.* Key activities included: • Accommodation (37.9%, 11 individuals); • Food industry (41.4%, 12 individuals); and • Fishing related (44.8%, 13 individuals). **Out of the 29 households engaged in tourism-related activities:** • 13 HH (45%) were headed by women, who were single or widowed and had dependents (linked to ind #6) • 17 HHs (59%) had chronic illnesses (linked to ind #10) • 11 HHs (38%) received financial support (linked to ind #14) • 22 HHs (76%) had homes made from wood (linked to ind #15) • 19 HHs (76%) completed secondary school (linked to ind #21)
• % of households with at least one family member working in a different community for **tourism**-related work [**#17**].	40.8% (29HHs) involved in tourism-related activity • 17% (12 HHs) travelled to a different community. *Closer* - Dover, Maxwell. *Further* - St. Michaels (Bridgetown) or St. James (Holetown)

Refined Indicator (number indicated in bold)	Results from Household (HH) Surveys in Oistins
ADAPTIVE CAPACITY – Resources and Assets that determine a household's capacity to adapt	
• Knowledge within the sector on climate change, its potential impacts and possible actions [via % of HH and members who've completed secondary school] **[# 21]**.	• 62.3% (42 HHs) completed secondary school or more • Additional 115 adults over the age of 15 in the 71 households, of which 99 completed secondary school or more (86% cumulative).
• Range and scope of social capital contacts [*from*: friends and family, leadership within neighbourhood [BONDED CAPITAL], formal governance structures, and/or contacts beyond the geographical limits of the neighbourhood [NETWORKED CAPITAL] **[# 22]**	BONDED CAPITAL: • 69% (49HHs) – family and friends • 7% (5 HHs) – "….." + traditional government NETWORKED CAPITAL: • 4.2% (3 HHs) – "….." + formal government structures • 33.8% (24 HHs) – "……" + beyond neighbourhood
• % of households with access to one or more natural resources (i.e. household garden, livestock and/or fisheries) **[# 23]**.	• 14.4% (10 HHs) – veggie garden • 5.6% (4 HHs) – herb garden • 8.5% (6 HHs) – livestock • 32% (23 HHs) - fisheries as subsistence or livelihood
• % of households taking *more than one* action (change to **livelihood** activities) in response to a climate-related event [**#26**]	• 8 HHs (11%) took at least one action • 6 HHs (8%) took *one or more* actions • 5 HHs took action Post Tomas Key actions included reducing household expenses, offering labour to others, improved infrastructure or efficiency of the house (most common) or buying insurance.

The results of the household surveys, detailed in Table 17, note that almost half of households (41%) had heads and/or other members engaged in tourism-related livelihoods. When including the total adult population of 186 considered in the survey, this amounted to forty adults (22% of all adults considered in all of the households). The majority of employment pertained to workers in small, medium or large enterprises in the accommodation (management/ operation, housekeeper or groundskeeper), food (restaurant or food stall – management/ operation, waitress or cook) and fishing industries (fishermen, fish-vendor, fish-processor or fish-cleaner). A few members also worked as tour operators, property developers and in the transportation businesses. Out of these 29 households, 12 (41%) had members travel to another community outside of Oistins for work. This included travelling to nearby locations in Dover or Maxwell (15-20 minutes by road) or further to Bridgetown and Holetown (up to an hour or more by road).

From the survey results, it appears that over half of the individuals who engaged in tourism-related livelihoods and who resided in the neighbouring communities had their livelihood activities connected to the destination community of Oistins. Furthermore, some insights as to the vulnerability of households dependent on tourism-related livelihoods can be gained by correlating certain indicators, such as gender, illnesses, finances, housing and education levels, but no significant observations can be made due to the small sample size. Caribbean women are considered to be more sensitive to climate change, particularly if they are the sole household heads, have a high dependency ratio and low income levels (Castello, 2008; Dulal et al., 2009; Dunn, 2008; Vassell, 2008). Furthermore, as detailed in Table 16, information pertaining to the type of livelihoods households engaged in (Indicator #16), was deemed relevant by stakeholders to collect at the national level. More detailed climate-related impacts pertaining to tourism-related livelihoods (Indicator #4) could be collected at the local level by an international project. No parties were designated to collect data for the other tourism-related indicators (#17) and (#26).

In regards to exposure and sensitivity pertaining to climate-related events, 38% of households were interviewed before Tropical Storm Tomas hit the island in October of 2010 (surveys #1-27) and 62% were interviewed afterwards (surveys #28 – 71). As the storm was the first to cause significant economic and physical damage to the island since Hurricane Janet of 1955, this split in sampling showed slight differences in whether households and/or their livelihoods were impacted by climate-related events or whether they thought their home was at risk from future events. Focus groups participants noted that one has to be careful when carrying out surveys after storms, because people may be expecting financial aid and answers might not be as honest. Table 18 presents the two exposure and one sensitivity indicators pertaining to impacts upon the home, livelihood and perceived risk (as numbered in Table 16). Parties were not collecting data for these indicators at the time of research.

Table 18. Exposure and Sensitivity Impacts to Households Pre and Post Tropical Storm Tomas

Indicator [indicator # in bold]	Results from Household Surveys in Oistins	More specifics from Surveys in Oistins OR any Identified Thresholds
• Average number of tropical systems, including hurricanes, (leading to intense rainfall, floods, storm surges or landslides) OR periods of drought in the past 10 years, leading to physical impacts on the households **(#1).**	25% of households (18 HHs, with 13 HHs Post Tomas) impacted: • Tropical storms/ hurricanes (i.e. Tomas) = 1 time • Strong winds = 1-5 times • Flooding = 1-4 times	Mostly low level impacts [18 HHs]. Types: • *Tropical storms/ hurricanes/ strong winds* = damage to house [4 HHs], damage to infrastructure around the house [8 HHs], damage to crops or gardens [2 HHs] • *Flooding* = damage to house [2 HHs], damage to infrastructure around the house [1 HH], increased water around the house [2 HHs].
• % of Households that experienced climate-related impacts to tourism-related livelihoods (income generating	21% (15 HHs, with 12 HHs Post-Tomas) of livelihoods impacted by: • 19.7% (14HHs) – strong winds	• Impacts to livelihood included closed down tourism infrastructure (i.e. hotel, restaurant, recreational activity, fish-market); ability to carry out or get to

Indicator [indicator # in bold]	Results from Household Surveys in Oistins	More specifics from Surveys in Oistins OR any Identified Thresholds
activities) **(#4).**	• 7% (5HHs) – flooding • 1.4% (1HH) – high-waves • 1.4% (1HH) – water shortage	livelihood; and impacts to tourists. Most impacts lasted between 2-3 days.
• % of households with perceived risk from a particular hazard **(#5).**	69% (49 HHs, with 28 HHs Post-Tomas) felt at risk from the following: [25 HHs to more than one], • 69% (49HHs) – strong winds • 26.8% (19HHs) – flooding • 18.3% (13 HHs) – high-waves • 5.6% (4HHs) - landslides	

In summary, the results of the household surveys generally demonstrate that the two neighbourhoods have had low exposure to extreme climate-related events (i.e. tropical storms) and high exposure to long-term changes in climate (i.e. increased temperatures, higher rainfall and flooding). Furthermore, the household characteristics of the two neighbourhoods point to a medium sensitivity, demonstrated by a low quality of housing materials (i.e. wood), yet good access to food and water and not a complete dependence upon tourism related livelihoods. The household resources (assets) of the neighbourhoods indicate a medium adaptive capacity, as exhibited by a high dependency ratio and minimal social networks, but with a high level of education. The other types of livelihoods that the households engaged in were in noted in section 6.3.1 and included administration, sales, construction or government type work, which are not as climate sensitive as tourism and fisheries.

6.4 Reflections on Development and Application of Indicators

The following section reflects on the process of developing and applying indicators to assess the vulnerability of a tourism destination community in a small island developing state. In particular, it discusses the general strengths and limitations that were noted with the approach in carrying out this research, pursuant to the strengths and limitations of indicators detailed in chapter 2 (section 2.4.2). Chapter 8 (section 8.3) further discusses how useful any of the applicable indicators were in assessing the vulnerability of the destination community of Oistins and whether they advanced the understanding of climate change vulnerability at this scale. It is insightful to note that the vulnerabilities revelead by the destination-community indicators were somewhat consistenct with those identified by the national-level assessment of Barbados's tourism sector in chapter 5. The destination-community indicators identified climate-related impacts due identified under *pathway #1* (i.e. changing temps leading to less tourists travelling south and changes in strom instensity and rainfall leading to impacts on tourism infrastructure) and *pathway #2* (i.e. increased incidence of SLR, reduced fisheries biodiversity and coral bleaching). Similarly, the vulnerabilities identified with the household level indicators, which were broader than the tourism sector, pertained to *pathway #1* (changes in storm intensity leading to flooding, property damage) and *pathway #2* (reduced fisheries biodiversity, impacts upon local food production and water scarcity).

6.4.1 Strengths

Vulnerability and adaptive capacity indicators can facilitate '*rapid vulnerability assessments'* by collecting readily available information on key determinants and providing a simple and reliable basis for assessing change (Ebi et al., 2004; Rosenzweig & Wilbanks, 2010). Moreover, indicators can summarize relevant information; make the determinant of interest visible; and quantify, measure and communicate relevant information (Malone & La Rovere, 2004). Based on these and other strengths noted in the literature, the following advantages were noted for the indicators that were being applied or could have been in the near future at the destination community (D) and household (H) level in Oistins.

The indicators were able to bring forth specific issues pertaining to the determinant of interest (ex. destination community's share of tourist arrivals, D:#13). With appropriate data collection and instruments, they could collect longer term and more systematic data, including that for exposure to climate-related hazards, which is important for climate-modeling purposes (i.e. change in mean reef fish harvest, D:#9). They could work within clear boundaries in which to collect and analyze information. As many of the tourism destination community indicators cross-cut with other sectors, many of the indicators could also be used beyond the context of the tourism sector (i.e. beaches monitored on a regular basis, D:#25).

Furthermore, the indicators could allow for the collection of different types of information. Table 19 presents the types of information brought forth by the refined destination community and household level indicators, presented in Table 14 and Table 16, even though not all were able to be applied. Apart from the exposure indicators, all of the indicators can be considered hazard generic, as they provide insights on the dynamic factors and processes influencing the destination community and households. Such indicators can also be categorized as '*theory-driven'* indicators, as they signify *patterns of change*. As detailed in Table 19 with specific examples, the indicators can be further classified to provide numerical analyses, empirical quantitative data and/or normative and descriptive criteria to assess and monitor the community's vulnerability. Proxy measures were also used to approximate some information. Some indicators can be used to develop future scenarios and to determine thresholds. They can also be used as benchmarks to evaluate or monitor whether the particular goal of adaptation planning at the destination community has or will be met. Lastly, some of the indicators can portray specific climate-related impacts.

Table 19. Types of Information Presented by the Indicators

Type of Indicator	**Refined Destination or Household Indicator**
Numerical analyses, empirical quantitative data (i.e. destination's share of tourist arrivals, D:#13)	**D**: # 9,11,13,29,23,24,25 **H**: #6,7,8,9,10,12,14,15,21,23
Normative and descriptive criteria (i.e. existence of functioning emergency management committee, D:#17)	**D**: #17,18,19, **H**: #22
Proxy (i.e. knowledge within the sector on climate change (based on education levels), H: #21)	**D**: none, **H**: #21
Thresholds (i.e. changes in the coastal ecosystem of the destination, D:#11)	**D**: #9,11, **H:** Could be all, though haven't defined.
Benchmarks to evaluate/ monitor whether the adaptation planning goal has been met (i.e. availability of insurance for tourism-related employment, D:#23)	**D**: #17,18,19,23,24,25 **H**: all of sensitivity, #23
Impact Identification (i.e. number of households with an injury as a result of an extreme climate-related event in the past 10 years, H:#3)	**D:** #1,2,3,4,5,6,7,8,9 **H**: #1,2,3,4

6.4.2 Limitations

To minimize challenges associated with developing and applying indicators, this research addressed their subjective nature and uncertainty in their development by using transparent methods as recommended by Perch-Nielsen (2010) and Vincent (2007b). This included attempting to develop indicators that were specific to scale of the system, captured the process-based (contextual)-identified driving forces and were sensitive enough to demonstrate differentiation. Discussion on long-term collection and monitoring also occurred. Nevertheless, in addition to defining the boundary for the tourism destination community, other limitations remained in developing and applying the indicators. These included data availability, challenges in data collection due to duplication and consistency issues, determining the indicator's direction and deciding whether or not a change improves the status of the determinant, and differing stakeholder opinions.

As noted earlier, it was difficult to obtain data for many of the tourism destination community indicators, due to the lack of information at such a small scale. In addition, after the indicators were developed and when discussing their application, challenges arose in ascertaining which stakeholders currently collected data (or could do so in the future) and any overlap in jurisdiction and time for data collection. This was particularly noted for the household level indicators and as Table 16 demonstrates, data for some of the indicators was collected for different time periods by different stakeholders. In particular, the Statistics Department, the District Emergency Office and the local Police all collect data pertaining to the elderly for indicators #8 and #9. Furthermore, the Statistical Department collects data as part of their 10-year census and the two community groups collect the information more sporadically. Such an overlap was not observed regarding the destination community-level indicators, as the majority of the indicators were not applicable to a defined boundary.

Furthermore, when developing the indicators, the directions for some of the tourism-specific sensitivity and adaptive capacity indicators were also found to be contradictory. In the conceptually relevant list of destination-community indicators presented in Table 13, decreasing sensitivity to climate change involves reducing reliance on tourism and diversifying the economy [*Indicator #12*: Destination's Economic Sector mix for Employment (including tourism) and *Indicator #13*: Destination's share of total tourist arrivals for recreation] (Bollin & Hidajit, 2006; Parkins & MacKendrick, 2007; Perch-Nielsen, 2010). The rationales for both indicators are that the higher the dependence on tourism, the greater the sensitivity as tourists visiting for leisure are the most sensitive to changes in climate versus those visiting for businesses or to see friends and family. This is in contradiction to the two indicators for adaptive capacity which give importance to the tourism industry and seek to further develop it [*Indicator #26*: GDP generated by the local tourism industry and *Indicator #35*: % of Tourist area and infrastructure with sea defenses (or similar)[54]] (Perch-Nielsen, 2010; UNWTO, 2004a). The rational for these two indicators reflect the importance of the

[54] Removed in '*refined list of destination-level indicators'* –Table 14 and Table A2.

tourism sector, as the higher the importance of tourism, the more resources might be allotted to build the sector's adaptive capacity. For these reasons, contradictory rationales are presented as the former set of indicators suggest that the destination should rely less on tourism, while the latter set reflect the importance of the sector and encourage a greater reliance upon it.

The same contradiction was observed for a household level indicator presented under sensitivity in the conceptually relevant list in Table 15 [*Indicator #18:* % of households dependent on a tourism-related activity as a primary source of income] (Hahn et al., 2009). Its rationale was that the higher the dependence on tourism, the greater the sensitivity, though only if households were not dependent upon other climate sensitive livelihoods such as agriculture. This conflicting viewpoint on the sector was observed island wide in Barbados, as many stakeholders want to encourage more tourism (GOB, 2012). At the same time, in light of the lingering effects of the economic recession and projections for future tourism moderate growth, stakeholders will also need to consider developing other economic industries (UNECLAC, 2014; UNWTO, 2011).

In addition, tourism destination communities are not often homogenous, as they are comprised of different groups with diverse perspectives on tourism, climate change and adaptation needs (Kaján & Saarinen, 2013; Saarinen, 2006). Even though the purpose of the indicators was to focus on tourism, as detailed in chapter 3, a range of stakeholders representing sectors with important cross-cutting sectors were also consulted: emergency/disaster management, coastal zone management, economics, meteorology and fisheries. These diverse perspectives became apparent as not all of the stakeholders, in particular those representing coastal zone management and fisheries, agreed with the tourism focus of some of the indicators. In the conceptually relevant destination-community indicators presented in Table 13, this included *Indicator #20* [Beach area to be nourished in order to maintain important tourist areas]. Such stakeholders thought it would be too difficult to obtain specific information at the destination-community level for the tourism sector and that such an indicator should apply to all areas in a small island like Barbados. Such differences of opinion also occurred for the household indicators, in particular between the District Emergency Office and Constituency Council, as noted in Table 16 [*Indicator #21*: Knowledge within the sector on climate change]. The former organization thought that knowledge of climate change would not result in action to reduce impacts, while the latter organization though it could lead to a discussion of responses.

Moreover, there was some delicacy in the development (refinement) of the indicators. Some indicators were initially scored low by focus group participants, but scored higher after the group discussion [i.e. *Indicator #21:* Existence of an Emergency Management Plan, Table 13]. Stakeholders also asked that certain indicators be removed as they were found to be offensive to Barbados' development status, though they though could have been useful to score or apply in other destination communities [i.e. *indicator #35*: national standards exist for construction of new tourism infrastructure to be set-back from the shoreline, Table 13]. Other indicators that were removed from the conceptually relevant list could have been developed if stakeholders had the capacity, will and need [i.e. *indicator #35:* % of 'tourist infrastructure with sea defenses, Table 13]. As Table 32 (Appendix B) demonstrates, the scoring and ranking results of the indicators differed by each stakeholder. In addition, due to time stakeholders were not able to weigh all of the indicators, but an arbitrary weighting was provided by selecting three indicators to provide more information in the '*indicator development worksheet'.* The above issues point to the fact that while it is useful to have collaborative discussions amongst stakeholders, one can end up with different results and value of input based on who is participating (Cannon, 2008).

6.5 Summary and Conclusion

This chapter has provided this research's empirical results pertaining to the development and application of the tourism destination community and household level indicators. In summary, it was found that the destination community indicators were most applicable if a defined boundary was determined to collect relevant data, though even then data was lacking for the majority of indicators**.** Household level indicators provided useful information on socioeconomic determinants to understand stakeholder dependence on tourism-related livelihoods; though systematic analysis was found more worthwhile at the parish and national levels. The following chapter discusses the CBVA results. Chapter 8 will further discuss the above points and the utility of the indicator and CBVA approaches in understanding tourism vulnerability at the destination community scale.

Chapter 7

CBVA and Resulting Vulnerability of Oistins

7.1 Introduction

This chapter presents the results of the forty-eight Community-Based Vulnerability Assessment interviews carried out with stakeholders in Oistins between February and April of 2011. The purpose of the assessment was to interview those stakeholders whose livelihoods were most dependent on the destination community's tourism related activities. As noted in chapter 3, individuals representing five groups of stakeholders were interviewed. These included the Bay Garden Vendors Area (food and craft vendors), the Oistins Fish-Market (fishers), those engaged in beach-related activities at its two beaches (water sports, clothes and food vendors, lifeguards), staff and managers of large and small accommodations and restaurants and key institutional informants representing tourism development, fisheries, local government and local emergency management.

The chapter commences by outlining the key stakeholder groups consulted in the tourism destination community of Oistins. It then details interviewee perceptions as to the current exposure-sensitivities impacting the community due to climatic and non-climatic stressors, within the context of recorded trends noted in chapters 4 and 5. Coping strategies, resources and support to address multiple stressors are then detailed, along with any limits or constraints. The chapter then presents any perceived future exposure-sensitivities to impact upon the community. It also details adaptive strategies, required resources and support to address future changes and any limits or constraints. The chapter then presents the empirical assessment of the destination community of Oistins based on data collected via the CBVA. The broader implications of the CBVA findings, within the context of the national vulnerability assessment presented in chapter 5, are examined in chapter 8.

7.2 Overview of Stakeholders

Further to the information regarding the community of Oistins presented in chapter 4 (section 4.3), this section provides further details as to the groups of stakeholders consulted via the CBVA interviews, including their type of tourist activity, personal traits and place of residence.

7.2.1 Bay Garden Food and Craft Vendors

Bay Garden food and craft vendors stated they earned up to 75% of their weekly earnings on the Friday night '*Fish-Fry'*, with a good night of earning for food vendors being $2000 BDS/ night and for craft vendors being $500 BDS/night. Part of the Bay Garden's attraction is its outdoor eating and vending space and proximity to the water. For these reasons, thirteen individuals were interviewed between February and March of 2011 who worked as small-scale food (8) and craft (5) vendors in the Bay Garden Vendors Area of the Oistins Fish-Market. The median age of all participants was 51 years of age. Seven of the food vendors were female and one was male, with their education being at the primary or secondary school level. The majority of the food vendors resided in Christ Church Parish, with two living in the Scarborough enumeration district, in which the household interviews were conducted. Furthermore, five of the vendors obtained their fish from relatives and friends who were fishermen or vendors at the fish-market, in addition to buying fish from the processors. In regards to the craft vendors, three of the vendors were female and two were male, with their education being at the college or university level. Two of the craft vendors resided in Christ Church, with the other three residing in St. Andrews, St. Johns or St. Michael Parishes. The 14th interviewee was a key institutional informant (Tourism Org 5) from whom the vendors rented space and required an operating license (university educated, male and in his 50s). This latter interviewee's organization also represented beach vendors and lifeguards, as detailed in '*Beach-Related Activities*'.

7.2.2 Fishers

Nine fishermen were interviewed between February and March of 2011 who fished primarily out of the Oistins Fishing Complex. The interviews took place in the peak fishing season for large pelagics, harvested primarily via ice-boats. All of the fishers were men, with the median age being 47 and education ranging from primary, secondary to college level. The majority of fishers resided in Christ Church Parish, with one residing in the neighbouring St. Philips Parish. Four of the fishers owned or captained ice boats; four were crew on the ice-boats and one fished part-time. Five of the fishers also reef-fished in the summer. Six of the fishers sold their fish to Bay Garden Food Vendors, in addition to fish-processors and fish-market vendors. Two additional interviewees served as key institutional informants and were interviewed in the fall of 2010 and spring of 2011. One of them managed the Fish-Market (Fisheries Org 1) and the other was an Academic specializing in fisheries (Academic #2). One was male and one was female, with both having a university education.

Small-scale fisheries in the Caribbean are generally open access, allowing fishers to have high geographic mobility and operate from different landing sites (James, 2008). Barbados has yet to settle its marine boundaries with neighbouring states and many fishers fish in the waters of Tobago, where stock has been observed to be abundant, though this has been met with opposition by the Government of Trinidad and Tobago (Cumberbatch & Hinds, 2013; GOB, 2004). Generally, ice-boats fish for large pelagics 320km off-shore from Barbados. Depending on migration patterns, fishers can fish southeast, southwest (towards Trinidad and Tobago) and northwards passing Grenada towards St. Vincent and the Grenadines and St. Lucia. At the time of the interviews, the pelagics were caught mostly at the southeast corner of Barbados, approximately 322 km above Tobago and east of Barbados. Fishers can also make money from selling reef-fish, even though the reef-fishing season is shorter. Most of the reef fishing occurs 6 - 16 km off the coast of Barbados. Fishers from Oistins reef-fish off the south point in the Christ Church and St. Phillip Parishes and along the east coast towards Bathsheba.

7.2.3 Beach Related Activities

Between March and April of 2011, ten individuals who engaged in beach-related activities on Beach #1 and #2 of Oistins and Beach #3 west of Oistins were interviewed. Three of the stakeholders sold food or clothes on beaches #1 and #3, three worked as lifeguards on beach #1 and four worked as water sports operators on beaches #1, 2 and 3. Three of the stakeholders operating out of beach #1 did not have any formal shelter and were highly exposed to variable weather conditions such as rain, wind and heat (two vendors and water sports operator). All of the vendors and one of the lifeguards were female, while the rest of the six interviewees were male. The median age was 43 and the majority of participants had completed secondary school, with one completing primary and one completing a university education. The majority of interviewees resided in Christ Church Parish, with one residing in the Scarborough enumeration district, and two residing in the neighbouring St. Philips Parish and one in St. Michaels Parish. Of the seven small businesses, six were independent and one operated out of a large all inclusive hotel [Tourism Org 7 (water sports operator #1)]. A key institutional informant [Tourism Org 5] was also interviewed, as six of the stakeholders either worked for or required a license from the organization to rent space or operate their business (lifeguards (3), clothes vendors (2) and water-sports operator (1)).

7.2.4 Accommodations and Restaurants

Ten individuals were interviewed between February and April of 2011 who were involved in accommodation and restaurant businesses in the Oistins area. Seven of the stakeholders were managers, owners or staff of small (3) and large hotels/restaurants (4) west of Oistins, with the two largest hotels located right on the coast [Tourism Hotel Org 1 and 2]. Two managed restaurants in the town of Oistins, with one located directly on beach #2. The tenth was a taxi-driver who operated out of beach #3. One of the hotel staff and two of the hotel managers and owners were female, with the rest of the seven interviewees being male. The median age was 53 with education ranging from primary, secondary to university level. The majority of respondents lived in Christ Church Parish. The stakeholders' exposure to any variable weather conditions, in particular strong winds, increased rain or heat, varied based on the features and size of their business, including their proximity to the coast.

7.2.5 Institutional

Six key institutional informants were interviewed representing tourism development, local government, local emergency management and fisheries. Three of the interviewees were female and three male, with all having university education. The key informants representing local government and local emergency management had been previously consulted to develop the destination and household level indicators. Any of their comments pertaining to local contextual issues were incorporated into the CBVA findings and were also noted in the sections pertaining to indicators.

7.3 Current Stressors

This section presents stakeholder perceptions as to the current exposure-sensitivities impacting the tourism destination community of Oistins due to climatic and non-climatic stressors. It then details coping strategies and types of resources and institutional support available to cope with the multiple stressors, followed by any limits or constraints to cope.

7.3.1 Climatic Exposure-Sensitivities

Stakeholders were asked about their perceived changes in the weather or natural environment in the past 10 years (2001-2011) and whether any of the changes had made it difficult for them to carry out their livelihood activities. Table 20 summarizes major impacts that stakeholders perceived from climatic stressors in the past 10-years, based on themes presented in Appendix D and tourism and climate change pathways noted in chapter 2 (Figure 1), and compares them to recorded climate trends. Figure 11 and Figure 12 below present climate data for Barbados from 2000-2012, with further details provided in Appendix A, Table 30 (BMS, 2014a; BMS, 2014b; BMS, 2014c). It is not possible to discern significant climatic trends from the short-term data, though as the CBVA interviews examined stakeholders perceptions of climate variability within a ten-year period, it is insightful to ascertain whether their perceptions coincide with any recent trends in climate variability. Furthermore, even though stakeholders were asked to recollect trends for the past 10 years, most only noted recent trends (2008-2011), many of which correlated with maximum trends for each of the climate variables. In summary, all stakeholders perceived direct and indirect changes in weather and the environment; in particular increased temperatures, rains and winds, a tropical storm, drought and biodiversity loss. These changes lead to twenty-two stakeholders (45%) experiencing varying impacts to their tourism-related livelihoods, via higher operating costs, business interruptions and infrastructure damage. Fourteen stakeholders (30%) noted more significant impacts. Further details are provided below.

Table 20. Perceived Climatic Stressors and any Resulting Impacts vs. Recorded Climate Trends

Perceived Impacts	Perceived Climate Variability and any Significant Impacts (2001-2011)	Recorded Climate Trends in Barbados from 2000-2012
Pathway 1: Direct Impacts of Climate on the Tourism Sector	• Increased **summer heat,** lead to greater reliance on air conditioning and higher operating costs for three smaller and mid-size accommodations/ restaurants. • Increased **rains** and **winds**, in particular in the winter of 2011, lead to four crews losing 1-2 weeks of fishing/ month. • T**ropical Storm Tomas** caused some infrastructure damage in October 2010 (destroyed a craft vendor's pottery shop, sank 3 day fishing boats, loss of revenue for two restaurants for 3-4 days, one experienced slow business for a month). • **Other stressors** of '*eutrophication'* and green-water affected visibility of two reef-fishers and made one jet-ski operator weary of going in the water.	• Variable temperature trends, with highest average monthly mean daily maximum daily and daily minimum noted in 2010. • Number of rain days highest in 2011. Low in 2009, but even lower before 2004. Rainfall amount highest in 2010, second highest in 2011. Low in 2009, but even lower before 2004. • Wind speed variable, though highest in 2009. • Tropical Storm Tomas caused the highest economic damage to Barbados.
Pathway 2: Indirect Climate Induced Environmental Changes	• All mentioned varying **water availability**, in particular due to the drought in fall 2009/winter 2010. No personal impacts. • Five fishers noted **biodiversity** loss to reef-fisheries.	• Rain days and rainfall amount were low in 2009, though even lower before 2004. • Shallow reef-fisheries have been over-fished on the south-coast (GOB, 2004). Off-shore fisheries may have been fully exploited in some areas (GOB, 2004).
Pathway 3: Indirect Climate-Induced Socio-Economic Changes	• None noted at the time due to climate variability or change.	
Pathway 4: Impacts caused by Mitigation and Adaptation Responses in Other Sectors	• **British Air Passenger Duty Tax** had lead to fewer tourists visiting the island and less spending when they do visit, impacting livelihoods of tourism stakeholders. • Increasing insurance costs.	• APD has not had any effects on UK outbound tourism between 2007-2010 (Scott et al., 2014; Seetaram et al., 2014). Tourism spending is down (World Bank, 2012b). • No significant impacts yet.

Approximately forty percent of stakeholders noted that temperatures have increased, particularly in the summer, which correlates with recent and long-term climate trends. Higher temperatures have led to higher air-conditioning (i.e. electricity) use and operating costs for three smaller and mid-size accommodations/ restaurants. Figure 11 indicates that the daily maximum and minimum temperatures varied during the twelve year period, with average monthly mean maximum daily temperature being 30.32^{o}C and average monthly mean minimum daily temperature being 24.55^{o}C

(BMS, 2014a). The highest trends for both were noted in 2010 with a daily maximum temperature peak of 30.98°C (increase of 0.57°C from the average) and a daily minimum temperature peak of 25.31°C (increase of 0.76°C from the average). This trend is consistent with observations of the Caribbean's daily minimum surface air temperature increasing more than the daily maximum temperature from 1961 to 2010 and that the frequency of warm days, warm nights and extreme high temperatures has increased, particularly in the past twenty-five years (1986-2010) (Stephenson et al., 2014). A smaller group of stakeholders, approximately 20%, noted that air temperatures have been cooler, particularly at night, even though cool days and nights have been noted to decrease over the past fifty years, particularly during the past twenty-five-years (Stephenson et al., 2014). Four fishers also noted that water temperatures have become cooler and resulted in pelagics migrating to warmer waters, thus resulting in lower local fish catches and meaning that fishers have had to fish further. There is no evidence supporting this claim.

> *"I have noticed that it is getting hotter in the summer… The summer electricity bill went up due to increased use of air-conditioning by guests. Now the bill is increasing due to higher utility costs*". (Tourism Hotel Org 4, SH 41).

Heavier and increased rainfalls were perceived to have increased by the majority of stakeholders, over 70%, which somewhat correlates with recent and long-term climate trends. The major impact from increased and heavier rains was to the number of days fishers were able to take their boats to sea, with four pelagic fishing crews noting they lost 1-2 weeks of fishing/ month in the 2010-2011 season, thus resulting in less fish catch and income. Minor negative impacts included flooding near the Bay Garden food and craft stalls (infrastructure damage) and the positive impact of more business for two sheltered vendors and the taxi driver. Figure 12 presents the average number of monthly rain days during the 12 year period, which during the time frame averaged to 12.17 rain days per month (BMS, 2014c). The highest number of monthly rain days was noted in 2011 at 15.75 days (an increase of 3.58 days from the average). This was a gradual increase from a lower period of 11.58 days in 2009, which many stakeholders noted as a drought year, though was not as low as the amount of rain days from 2001-2003 (from 10.33 to 11.25 days). Furthermore, the average monthly rainfall for the twelve-year period was 223.73 mm, with a peak of 300 mm in 2010 (increase of 76.27 mm from the average) and a second highest amount of 284.00 mm in 2011. The lowest amount of rainfall received was from 2000-2002 (106.6 - 80.4 mm), which gradually increased then lowered again in 2009 to 233 mm (considered a drought year by many stakeholders), before peaking in 2010. These variations in precipitation link to the claim of almost half the stakeholders that the weather has become more variable, in particular through increased discrepancy in rainfall patterns, with increased dryness one year and increased rainfall the next. Less reliable long-term trends in precipitation changes have been observed in the Caribbean, though small positive trends have been noted in the region's annual total precipitation, daily intensity rainfall, maximum number of consecutive dry days and heavy rainfall events from 1986–2010 (Stephenson et al., 2014).

> "*Our seasons have changed and the rainy season is going later into the fall. The summers can be drier and the rain is coming later*". (Beach Related Activities, Water Sports Operator 3, SH 34).

Almost half the stakeholders noted that winds have become stronger in the past few years, resulting in stronger and higher swells (waves), which correlate with recent and long-term climate trends. Fishers faced the major impact from stronger winds and the same as noted under increased/ heavier rains, that being impacts to the number of days pelagic fishers were able to take their boats to sea, thus reducing the supply of local fish and meaning that higher prices were paid for imported fish by three fish vendors. Other minor impacts included the displays of food and craft vendors being blown away and an increased number of '*red flags*' being posted by lifeguards, discouraging tourist swimming and water-sport activities. Three beach-related activity stakeholders noted that stronger waves were causing more coastal erosion and creating caves, with three additional stakeholders observing increased '*man-o-war*' jellyfish, which are not commonly found on beaches and can be linked to eutrophication. Figure 11 presents the average monthly mean wind speed for the twelve-year period, which varied and averaged to 12.20 knots per month (BMS, 2014b). The highest speed was recorded in 2009 at 13.58 knots, an increase of 1.38 knots from the average. The speed lowered by 2011 to 10.83 knots, with other low periods noted from 2004-2005 (10.92-10.83 knots). Simpson et al. (2012) note that from 1960-2006, mean monthly marine surface wind speeds in Barbados increased by 0.86 kt per decade annually around the island.

Approximately forty percent of stakeholders experienced impacts from recent extreme climate events, in particular Tropical Strom Tomas, which caused the highest economic damage to Barbados (CDEMA, 2010; EM-DAT, 2010). Seven stakeholders (15%) experienced direct impacts to their livelihoods or personal effects from the storm, including the destruction of a craft vendors pottery shop, the sinking of three day boats for fishers, the loss of revenue for two restaurants for 3-4 days and the significant business slow-down for one restaurant due to utility outages. Other more minor impacts included sand deposition near the vendor stalls and the Oistins jetty, damage to the Oistins fuel pump, knocking down of trees and damage to tourist infrastructure (i.e. destruction of tables, signs and beach canopies). Chapter 4 (section 4.2.2.2) presented further details on the impacts of Tropical Storm Tomas in Barbados.

In terms of indirect climate induced environmental changes, all stakeholders noted varying water availability, including the fall 2009/ winter drought of 2010, though this did not directly impact upon them (BMS, 2014c). Furthermore, five fishers noted the reef fisheries population has been declining for several years, which has been documented with shallow reef-fisheries being over-fished on the south-coast and the possible exploitation of off-shore fisheries in some areas (GOB, 2004). It remains challenging to distinguish whether the impacts to reef-fisheries are distinctly due to climate variability or other environmental and social stressors such as over-fishing, water contamination, reduced reef vegetation, coral bleaching, sand build up on the reefs and the bacterial '*fish-kill'* of 1999 (GOB, 2004; PAHO, 2000). In addition, some stakeholders observed increased 'eutrophication' in the past two years, which made it difficult for fishers to reef-fish or jet-ski operators apprehensive of engaging in water-sports activities. Highly eutrophic conditions have begun to affect West Indian reefs, including those in Barbados, as anthropogenic pollutants are released close to the reefs and disturb the natural reef environment (Holmes, 2000; Runnalls & Coleman, 2003).

Moreover, stakeholders were asked about any perceived impacts of the British Air Passenger Duty Tax mitigation policy, which was highly talked about in the national press and feared by national and regional tourism stakeholders (Bryan, 2011; CTO, 2011; UNECLAC, 2011). Eight stakeholders were familiar with the Tax and predicted that its current tax and any future increases would result in fewer tourists and their families visiting the island. As noted in chapter 5 (section 5.2.4), recent literature disproves of this fact (Scott et al., 2014; Seetaram et al., 2014).

As noted in Table 20, almost half of the stakeholders perceived impacts from recent climate-variability to their tourism-related livelihoods. Nevertheless, all stakeholders noted that tourists had not minded or complained about the variable weather. The perceived hotter or cooler days, increased rain and rough waves due to increased winds was not severe enough to stop tourists in Barbados from going to the beach to sun-bathe or to swim or visiting the fish-market. Some tourists even enjoyed swimming and surfing in the rough sea and waves. Stakeholders assumed that tourists did not mind the increased heat as they were visiting from colder climates, and even if the weather is perceived to be cooler to locals, it is still considered warm for tourists. Furthermore, during Tropical Storm Tomas, the larger hotels noted that tourists, who were kept inside until the all-clear was given, liked watching the storm. These findings are similar to those noted in chapter 5 (section 5.2.1) regarding the thermal comfort of tourists in the Caribbean, where comfort perceptions were found to significantly differ between beach users and non-beach users (Rutty & Scott, 2014a). Furthermore, thermal conditions and adaptive ranges of tourists can vary at the scale of a coastal resort, as tourists can obtain comfortable conditions within a particular resort by changing location (i.e. from beach, garden or pool) (Rutty & Scott, 2014b).

Figure 11. Temperature and Wind Speed Data for Barbados (2000-2012)

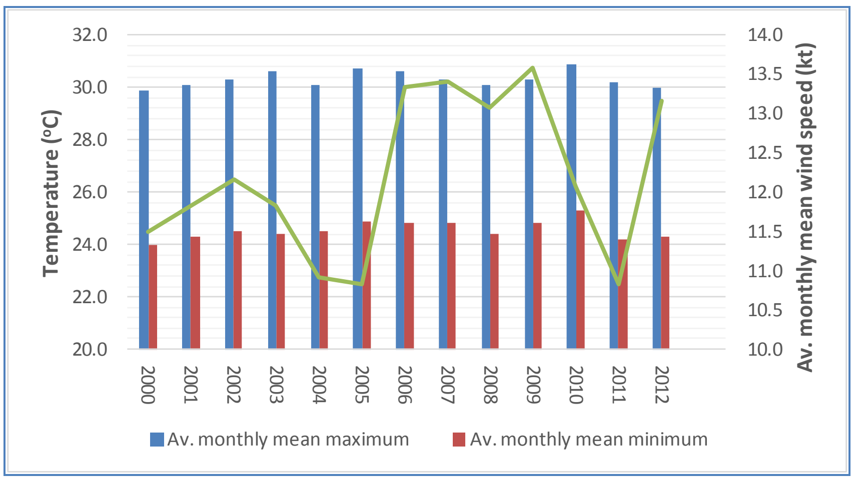
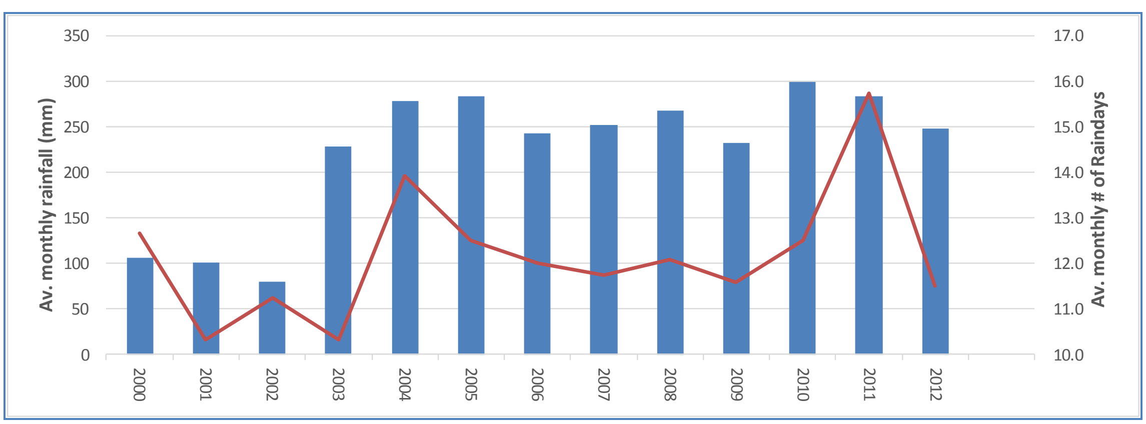


Figure 12. Rainfall Data for Barbados (2000-2012)



7.3.2 Non-Climatic Exposure-Sensitivities

As noted in chapter 2, unmitigated climate change could result in reduced global gross domestic product, reducing the discretionary wealth available to tourists and having negative implications for tourism dependent nations (Scott et al., 2012; Stern, 2007). Global GDP and the discretionary wealth of tourists were lower in the 2010-2011 periods, though not due to climate change but due to the global economic crisis of 2008 (UNWTO, 2009; UNWTO, 2011). This research examined whether the CBVA and indicator approaches enabled the investigation of the interaction of climatic drivers with non-climatic drivers in a particular destination and whether any similarities/overlaps existed in coping and adaptive strategies (Handmer et al., 2012; Scott, 2008; Scott et al., 2012). For this reason, stakeholders were also asked about perceived changes in any social or economic stressors in the past 10 years and whether this had impacted upon their livelihoods. Table 21 below summarizes perceived impacts that stakeholders noted from non-climatic stressors in the past 10-years and compares them to recorded trends.

Table 21. Perceived Non-Climatic Stressors any Resulting Impacts vs. Recorded Trends

Perceived Impact by Pathway	**Perceived Non-Climatic Stressors and any Resulting Impacts**	**Recorded Trends from 2000-2012**
Pathway 1: Direct Impacts of Non-Climatic stressors on the Tourism Sector	• **Economic recession** lead to decreased number and spending of tourists visiting the island, particularly during 2008-2010. • **Economic recession** and **inflation** have led to business interruptions, higher operating costs, and decreased revenue from tourism-related business. • These conditions have impacted all the stakeholders, with the livelihoods of some more affected than others.	• Economic recession lead to tourist arrivals in the island decreasing 9.3% from 2007 to 2010, with largest decrease of 6.5% between 2008 and 2009. Caused Barbadian economy to contract by 4% in 2009 and grow below 1% yearly between 2010 and 2012. National public debt to GDP ratio increased from 56% in 2008 to 83% in 2012. • Inflation was 8.25% at the beginning of 2009, lowered to 3.5% at the beginning of 2010, then peaked at 9.6% at the end of 2011.
Pathway 3: Indirect Non-climate-Induced Socio-Economic Changes	• **Crime** had led to business interruptions, higher operating costs, decreased revenue and infrastructure damage. • The prolonged effects of the economic recession of 2008 has reduced global GDP and impacted upon the wealth of tourists. Impacted all stakeholders.	• Crime was the fourth top ten social issue affecting Barbados in 2010.

Multiple non-climatic stressors facing the destination community of Oistins and island as a whole included the economic crisis leading to decreased tourism revenues from lower tourist arrivals and spending and increasing cost of living due to inflation and a higher value added tax. In particular, the majority (65%) of vendors, beach-related activities and accommodations and restaurants perceived the economic crisis to have led to a decrease in the number of tourists visiting the island. The 2008-2009 tourist season was noted to be hardest hit, with 2010-2011 numbers seeming to be higher. The hotels noticed a decrease of tourists in the 2008-2009 and 2009-2010 seasons, with mid to smaller sized ones noticing a decline up to 30% and larger ones a decline of 15%. Tourism-related businesses operating out of large hotels noted they were not as affected, due to repeat business and their reputation. This perception correlates with the tourism figures depicted in chapter 5 (Figure 10), which note that tourism arrivals reduced dramatically in 2008, then rebounded slowly, with another reduction in 2012 (World Bank, 2015). Over a third of these stakeholders also noted that tourists that were visiting seemed to be spending less (i.e. taking the private bus vs. taxi) or not staying as long, which is also confirmed by Figure 10, where tourism receipts have been down since 2008 (World Bank, 2012b). Stakeholders noted that reductions in both figures have impacted the government's ability to generate revenue and for small businesses to remain economically viable.

> *"The economic situation is affecting the number and spending of tourists... Most people are asking for bargains. I have seen this happening for the past two years".* (Bay Garden Craft Vendor 2, SH10).

Furthermore, inflation was perceived to affect all stakeholders, with the majority (88%) noting increased prices for fuel, food (including fish processor prices), tourism-related supplies and fishing equipment, coupled with an increase in the island's '*Value Added Tax*'. One restaurant owner also noted crime as a stressor, as they experienced two break-ins in the past seven years, with glass table tops being stolen. Nation News (2010) in their 2010 '*Year in Review*', noted the top ten social issues for Barbadians, of which the following are relevant to this research in order of importance: 1) the cost of living, 3) the state of the economy, 4) crime, 5) decreased spending of tourists, 6) drought and 7) drop of market prices for local products (in particular sugar).

7.3.3 Coping Strategies and Resources/ Support Available

Caribbean people have always coped with social, economic and environmental changes, due to a strong sense of community, local and traditional ecological knowledge and previous experience of dealing with such changes (James, 2008; Kelman, 2007; Lazrus, 2012). Stakeholders presented coping strategies that they have used in the past and continue to use to address the impacts of variable climatic and non-climatic conditions. Climate-related coping strategies included planned measures with a quarter of stakeholders noting they would like to become more energy and water efficient and thereby reduce costs. Particular strategies included food vendors cooking on traditional coal pots, the installation of solar lights in the Bay Garden area and running ice-boats slower to burn less fuel. Electricity use is also being monitored and recycling encouraged. In addition, five of the six accommodations had put up notices for their guests to conserve energy and water as recommended by Charara et al. (2011) in chapter 5 (section 5.2.1). Two beach-related stakeholders also said they have learnt to monitor the weather and cope with any adverse impacts, i.e. wait for it to pass. Furthermore, two fishers noted the use of infrastructure to cope, such as a radio to monitor weather and the use of a GPS, fish finder or sonar to track fish. James (2008) notes that the fisheries sector in the Eastern Caribbean has coped with climate variability, such as floods, coastal erosion and storms, by taking precautions to weather effects, shifting to other economic activities, improving technology and fishing methods, more integrated management of fishing operations and abandoning fishing.

> *"I have a fish finder, sonar and a GPS. When a fish bank is found, the fishers contact one another to share the information*." (Fisherman 8, SH 22)

To cope with the climatic and non-climatic stressors, thirty percent of stakeholders discussed reducing their expenses. This included vendors and smaller accommodations/ restaurants adjusting their human resources by cutting staff hours if the weather was poor (i.e. excessively rainy) and/or business was slow. Both groups also lowered costs by reducing meal portions. Some fishers used a mix of paid crew and trainees, instead of an all paid crew. Some beach-related activities reduced the prices of their services and local advertising costs. Some stakeholders also engaged family or friends to work for the business, which they could pay less.

Twenty percent of stakeholders talked about ceasing their livelihood temporarily or permanently if the weather was too variable (i.e. heavy rain) and/or business was slow. This included closing one's shop early and sending staff home. When the weather was not conducive to fishing, fishers stayed home and waited for it to improve. Some beach vendors checked the weather forecast and if it was raining past a certain point, stayed home. One small hotel temporarily closes its hotel during any slow business period. Moreover, forty percent of stakeholders engaged in another livelihood activity to provide supplementary income, including vendors engaging in catering, sewing, painting or gardening. Some fishers engaged in non-fishing employment (i.e. carpentry or odd jobs) in the off-peak fishing season or other slow fishing periods. Ten beach-related and accommodation/ restaurant stakeholders offered other tourist-related services such as food and drinks, bus tours or seamstress services or had other businesses like a market-vegetable garden, accommodation rentals or professions such as a barber, bartending or accountant. In addition, excluding fixed businesses such as accommodations and restaurants, a quarter of the other stakeholders noted they sometimes carry out their livelihood at another time or location. This included three craft vendors selling in other locations. If fish were moving due to changes in currents, some fishers fished in other locations. One water-sports operator found alternate places for water-sports when the weather is bad due to swells, wind or rain.

To address primarily non-climatic changes, a quarter of tourism stakeholders, apart from fishers, engaged in more aggressive and creative marketing towards tourists. This included Bay Garden vendors diversifying their food items, soliciting customers, presenting creative table dressings or offering more creative craft pieces. The vendors are also attempting to bring tourists to the Fish-market other nights besides Friday. Accommodations and restaurants are also attempting to bring in more tourists by offering special hotel promotions and opening their businesses earlier or closing later. Moreover, almost sixty percent of all stakeholders noted they had absorbed any increased costs and made do with less income. The craft, food and beach vendors feared that if they increased their prices, they would sell less. The majority of fishers noted they had to adjust to having less income, due to less fishing days, as the price of fish they sell is fixed. The accommodations and restaurants had also absorbed costs to retain customers. Nevertheless, twenty percent of the stakeholders, apart from fishers, said they passed on increasing costs to customers. In particular, four vendors and two accommodations / restaurants addressed the VAT increase by slightly increasing their prices. The passing on of costs is easier for larger hotels with wealthier clientele and it has been also noted that smaller businesses function on smaller overheads with very little capital/capacity to implement major adaptation strategies (Turton et al., 2010).

To cope with the impacts of multiple climatic and non-climatic stressors, stakeholder indicated they had access to different capitals and resources (i.e. social, financial, physical, human, natural and political), further to those noted in chapter 2 (Table 1, section 2.2.3.3). Half the stakeholders noted they could rely on family, friends, tourists and/or fellow fishers (social capital). In particular, many food, craft and beach vendors and smaller accommodations/ restaurants noted they could rely on family and friends if they need extra help to run their businesses or to carry out any repairs in the aftermath of any weather-related events. Some food, craft and beach vendors also maintained websites or social media accounts to build long-term relationships and business with tourists and obtain another supply source of goods. Three fishers stated they could rely on family members to help them financially or to captain their ice-boat. Three reef-fishers also shared their boats and carried additional people to reduce costs, which also provided increased safety in extreme weather. Furthermore, some tourist businesses had arrangements with external agencies to help market their business. Some hotel staff bartered and exchanged goods with fellow staff. Staff/ managers of accommodations / restaurants also relied upon networks with tourists to solicit additional business.

Almost forty percent of stakeholders had financial capital in the form of infrastructure or content insurance, with those who didn't noting its high costs or questioning its benefits. Tourism Org 5 provided infrastructure insurance for the eight Bay Garden food stalls and five beach-related activities, to protect against fire, floods and thefts. Two of the four ice-boat owners had their boats insured. Two of the food vendors and one of the larger beach-related water sports activities had content insurance. One smaller accommodations/ restaurant also had content insurance, while those associated with a larger business complex did not need to.

In addition, thirty percent of stakeholders had access to some type of physical capital, either formal or informal. This included three food vendors having access to a vehicle to move around items in extreme weather conditions. All the five craft vendors had tarps to sell under in rainy conditions. Two of the beach vendors had no formal stalls and relied on tents and umbrellas. The five accommodations/ restaurants located on the coast had more established infrastructure to protect against storms. Furthermore, three stakeholders had access to other human capital, which could help with their business. This included two food vendors having training in 'fish *quality assurance*' and '*small business management'*. One of the ice-boat Captains was taking navigation and computer courses through the Oistins Small Boat Owners Association (OSBOA), representing day-boat owners. Moreover, some of the stakeholders had access to other natural capital, including four food vendors having relatives working as fishermen, from which they could obtain fish directly. One stakeholder had land to grow produce, which she could then sell to the market.

Almost half of the stakeholders had access to political capital, through affiliation with a local organization, which could help cope with stressors through initiatives such as emergency planning. Stakeholders, who were not members of any groups, were not sure of its benefits and if so, found the cost prohibitive. Four food vendors were members of the Bay Garden Vendors Association and periodically attended meetings. Further to the results noted for the destination-community indicator #18 in chapter 6 (Table 14), the BGVA had no Emergency Management Plan and Tourism Org 5, who manages the space, was looking to develop one with appropriate stakeholders. One craft vendor created the Oistins Craft Vendors Association though had found it challenging to recruit membership. In regards to fisheries, six fisher-folk were members of the Oistins Fisher-Folk Association, even though they were not sure if it was functioning. Two fishers, who also fished on small boats, were members of the OSBOA. The Oistins Users Committee had developed a '*Draft Rapid Response Plan'* for in-shore and off-shore boats and the OSBOA had an EMP to remove small boats.   The Fisheries Division also had developed a national disaster EMP.

Larger hotels and some restaurants were part of Tourism Org 3, which could provide discounts to attract tourists and provide lower Value Added Taxes. Smaller hotels were part of the *'Intimate Hotel Association'* (75 rooms or less). Tourism Org 3 had developed an EMP for accommodations, ancillary services and transportation, though at the time of research was not available to the public. The larger hotels had also developed their own EMPs and took standard precautions. Smaller hotels also organized EMP sessions with their staff. For independent businesses, no formal EMPs existed, only basic precautions. One water-sports operator was a member of the '*Barbados Water Sports Association'*. Lifeguards had plans to deal with water-based emergencies and addressing weather-related events included putting up '*red-flags'* and closing the lifeguard tower.

7.3.4 Limits or Constraints to Cope

Stakeholders also detailed the limits or constraints (barriers) they faced when trying to cope with any changing climatic and non-climatic conditions. A few stakeholders noted there was too much competition of tourism services on Barbados. In particular, a food vendor and taxi driver stated there were too many vendors and taxis on the island, resulting in too much competition and making it hard to increase prices. Some food vendors and accommodations/ restaurants also noted that the all-inclusive cruise ships can take away local business as tourists often eat or room on board. Furthermore, some of the large hotels work with foreign tour operators, to sell airfare and hotel packages, and do not pass on increasing local and social costs.

Some stakeholders noted high costs or lack of funds (debts) as a limit to coping with any stressors. One craft vendor found their monthly fee of $50 BDS to Tourism Org 5 to be too high, as most craft vendors only sell on Friday nights. One of the food vendors had a lot debt, hampering her ability to work and buy fish to sell at the Fish-Fry. All the fishers stated they would like to be paid more for their fish catch. In addition, a few stakeholders mentioned location as a constraint to coping. One of the food vendors was unhappy with their stall location towards the back of the market, which they thought was more exposed to winds and less visible to tourists. Some fishers also noted the lack of a new fishing agreement with Trinidad and Tobago, which would allow Barbadian fishers access to the fisheries within its Economic Exclusive Zone (Cumberbatch & Hinds, 2013).

In addition, some stakeholders noted conflicts amongst each other. The fishers felt that the craft vendors should move their stalls from Oistins beach, so when adverse weather arrives, day-boats can be quickly hauled up. A few fishers also found tourist activity off the Oistins jetty (i.e. snorkeling with the turtles) to cause conflict with the ice-boats docking and off-loading (see chapter 4, Photo 3). Furthermore, lifeguards noted that not all tourists and locals follow their '*red-flag'* warnings, which indicate no swimming when the waves are rough. The lifeguards can only inform about adverse swimming conditions and the beach can only be closed after notification by Emergency Management Org 2. The Researcher observed lifeguards, tourists and locals swimming with *'red* *flags'*. One stakeholder also noted the lack of capacity and bureaucracy of Barbados' government and thought it was too large for the island's population.

In summary, as only some impacts noted by stakeholders are climatic in nature, the limits to coping almost exclusively pertain to non-climatic impacts. Perhaps some limits will pose greater constraints for future climate change adaptation, when climatic impacts become more severe. Similar findings were found by Kajan (2013) in her examination of adaptation in small arctic tourism communities, that '… *although currently the climatic extremes do not severely interrupt the communities' lives, adaptive strategies may become exhausted and problems occur when weather extremes expand beyond the normal deviation…'* p. 296.

7.4 Future Stressors

7.4.1 Exposure-Sensitivities

Stakeholders were asked their opinions regarding the climate continuing to change in the future, as predicted by the scientific community. Predicted impacts to small islands, including long-term and short-term changes in climate, were presented to stakeholders to initiate the discussion (as presented in Appendix D). Specific climatic changes predicted for Barbados by the end of the 21st century were detailed in chapter 4 (section 4.2.2.3) and include surface temperature increases of up to 3.0^{o}C, lower precipitation, warmer days and hotter nights (Campbell et al., 2011; T. C. Hall et al., 2013). Furthermore, sea-level rise could rise up to 2.15 metres by the end of the century (Bindoff et al., 2007; Rahmstorf, 2010) and the intensity of tropical cyclones is predicted to increase (Knutson et al., 2010). Mitigation responses to address emissions from the transportation sector will continue to be developed and could also impact the region (Scott et al., 2012).

Stakeholders had ranging opinions on the future climatic predictions, which might have been more consistent if they were better versed on the science, a challenge in incorporating local knowledge due to limitations in observations of the environment (Ford & Pearce, 2012; Tibby et al., 2007). Out of those who responded, thirty percent were concerned about projected climate-related changes and that they should prepare for future changes by taking actions to mitigate emissions (i.e. conserve energy or use less fuel) and learn how to adapt. Stakeholders also thought there is a need to further educate people about climate change impacts. Mitigation action should also be taken by large greenhouse gas emitters abroad. Institutional informants were concerned about the impact of any transportation mitigation policies (i.e. APD Tax), as Barbados is far from the tourist source markets (i.e. 5-9 hour flight from North America and Western Europe).

Twenty percent of stakeholders thought that there is not much else one can do to address or prepare for future climate change impacts. Eighteen percent were not concerned or had not thought about future changes, were living '*one day to the next*' and noted they will no longer be living in the future. Furthermore, four individuals were quite religious and thought God would take care of them. Four stakeholders thought that if Barbados remains safe and friendly, tourists will return even due to the impacts of the recession or variable weather. They were not concerned about the increasing intensity of storms, as Barbados is not in the hurricane belt and the construction of its buildings is very stable.

> *"I am not worried as I believe in the Bible and these things will happen before Jesus comes… Scientists don't control the weather; God does… He* (God) *decides if Barbados is going to be 'licked-up'".* (Bay Garden Food Vendor 3, SH 3).

Moreover, other stakeholders were not too sure (confident) about climate change predictions or how to address them (16%). In addition, four stakeholders thought it would be best to wait and see what happens. Four other stakeholders were not too sure about future climate predictions and whether scientists were accurate, as even everyday weather is not always predicted correctly. These findings are consistent with those found by Turton et al. (2010) in their study of climate change adaptation in four Australian tourist regions. The authors found that key decision makers noted there was ample uncertainty in the community about human's role in climate change and projected impacts to prohibit adaptation.

Stakeholders were then asked whether they thought such climate-related changes could impact upon the destination community of Oistins and further increase the vulnerability of their tourism-related livelihoods. Most stakeholders felt that future changes could result in direct impacts to their natural environment (i.e. beaches, fisheries or coral reefs), many of which are important for tourists. In particular, five fishers thought predicted changes could affect fisheries activities and fish populations in the future. Six thought high winds could affect the beach and coastal environment, through impacts such as sand erosion. Physical infrastructure could also be further damaged (i.e. food stalls, boats or hotels/ restaurants on the coast).

In addition, approximately forty percent of stakeholders felt that any significant future climatic impacts could lead to a decrease in tourists visiting the island and therefore decrease in business. In particular, food vendors felt that any projected increases in rain would affect business, via a decrease in the number of tourists and locals who visit the Bay Garden Vendors. Heavier or increased-rains could affect also affect beach-related activities as tourists like the sun. Seven beach-related activities also noted that any increased winds could lead to less swimming by tourists and less water-sports activities (i.e. catamaran use). Some stakeholders thought that increased heat could lead to increased energy bills through demands for air-conditioning. Moreover, if hurricanes are projected to became more intense, that could lead to fewer tourists visiting the island, as also noted by Forster et al. (2012). Nevertheless, some stakeholders thought that projected changes could result in some opportunities. Seven thought any projected wind increases could result in the uptake of certain water-sports activities (i.e. surfing). Projected rain increases could also result in increased business for taxis and enclosed vendors. Furthermore, impacts from any future changes in climate would be felt beyond the tourism sector and would affect everyone in Barbados.

Finally, stakeholders were asked whether they perceived non-climatic changes (i.e. social and/or economic conditions) would continue to change in the future and if so, whether it would result in further impacts to their tourism-related livelihoods. The majority of stakeholders stated that if the social and economic conditions noted earlier remained un-changed or worsened, they would continue to cause negative impacts and affect everyone.

7.4.2 Adaptive Strategies and Resources/Support Available

Based on previous experiences of coping with social, economic and environmental changes, as indicated in section 7.3.3, Caribbean people are envisioned to be able to continue to adapt to such changes in the future (Kelman, 2007; Lazrus, 2012). This section presents the strategies that stakeholders could use to adapt to the future impacts of any climatic and non-climatic changes. Participants answered the question if they had noted a concern about future changes in environmental, social and economic conditions as indicated in the previous section. The also link to current coping strategies mentioned in section 7.3.3, with only new strategies that be employed in the future being detailed. Further to the criteria noted by Field et al. (2014),

adaptation responses pertained to vulnerability reduction, incremental adaptation and transformative adaptation. These responses will be discussed further in chapter 8 (8.2.1) and

Table 23.

Some stakeholders were not sure what else they could do to adapt to future climatic or non-climatic changes, apart from what they are doing to currently cope. Others suggested reducing import dependence and the impact of rising fuel costs by fostering a greater reliance on the consumption and production of local fisheries and food, including importing food from neighbouring countries like St. Vincent and Guyana, as also suggested by the Ministry of Tourism (GOB, 2012) and Moore et al. (2012). Accommodations and restaurants could also ask tourists to conserve energy and water and if need be, charge more for air-conditioning or water-use, as recommended by Charara et al. (2011). The energy efficiency of infrastructure (i.e. accommodations, restaurants and enclosed stalls) could also be improved.

> "*Barbados should foster greater food security and import food from neighbouring islands like St. Vincent and Guyana".* (Tourism Key Informant, SH 48).

Seven stakeholders noted they would cease or seek other livelihood options if future conditions became too difficult to continue their current livelihood. Options to complement their existing livelihood, or switch it entirely, included working in other services such as a maid, bartender or chef, who could be housed in less exposed tourism facilities, though could still feel the impacts of any long-term declines in the sector. Two accommodations/ restaurants also talked about expanding their business through increased marketing to tourists abroad or locally. A few stakeholders noted they could adapt their existing livelihood by continuing it in another location. In particular, surfing could be taught in a location where the water is less rough. Furthermore, if future weather conditions affected fish movement, fishers could travel further and longer to catch fish. This latter strategy would only be useful to a degree, as if the weather also became more variable, it would be more difficult to travel further, in addition to the cost of supplementary fuel

To adapt to the impacts of multiple climatic and non-climatic stressors, stakeholders indicated they would need further access to capitals and resources, building upon those they have to cope as noted in section 7.3.3. In regards to social capital, small boat owners should be discouraged from fishing on their own, especially in the advent of adverse weather, and could use tools like the '*c-fish-catch'* app to help fish. Beach vendors could co-operate and set prices with each other and continue to maintain networks with tourists. A hotel staff worker suggested creating a cooperative amongst fellow staff to buy items in bulk from a whole seller to alleviate the increasing costs of goods. Furthermore, the availability and access to financial capital (i.e. loans) for vendors and fishers should be improved, so stakeholders can improve their businesses (i.e. obtain new equipment) or buy their own boats or taxis and thereby keep a greater portion of their earnings. Insurance costs should also be reduced for small business and three vendors were considering getting content insurance, which could address any losses due to weather-related events. The British Air Passenger Duty Tax should also be annulled in the Caribbean.

Additional physical capital could also be sought to minimize the impacts of any future stressors. To address increasing rain, more tents should be provided for food vendors, without blocking any evacuation exists. Infrastructure should also be improved, such as the addition of peaked roof on food stalls to keep rain out. Tour Org 5 plans to install solar lighting to improve visibility, improve drainage near the craft area and create a sheltered area for craft vendors. For fishers, better facilities are also needed to haul-up ice-boats in Oistins in advent of variable weather, as currently boats are taken to Bridgetown. The government could also retrofit and better design ice-boats to improve the fishing capacity and provide more pelagics for local and tourist consumption (as to be discussed in section 7.4.3) and establish competitive and higher fish-prices. For beach-related activities, booths could be provided for informal beach vendors, though the licensing fee might serve as an inhibitor. Existing infrastructure, such as lifeguard huts, could be upgraded to withstand any variable weather. Additional equipment, such as jet-skis, could also be obtained for lifeguards to patrol further in stormy weather. To improve human capital, Tourism Org 5 could promote training for Bay Garden and beach vendors in business planning, marketing and money management. Furthermore, regarding natural capital, Barbados' fishing industry could consider controlled fishing (aquaculture) to provide enough pelagics for local and tourist consumption.

> *"If the fisheries industry remained local, that would be better. For this, the design of vessels should change, including proper refrigeration facilities. As fishers are spending a few months at sea, they could process at sea"*. (Fisheries Key Informant, SH 24).

Certain adaptive strategies would require political capital and the support of local and national institutions. At the destination community-scale, it would be useful if the Bay Garden Vendors Association and the Oistins Craft Vendors Association publicized their mandates and recruited additional members to facilitate cooperation and develop an Emergency Management Plan. The preparation of EMPs could be mandated by the national government as part of the process of applying for a vendor's license. In addition, the capacity of fisher-folk organizations should be strengthened to facilitate greater membership, awareness of benefits (i.e. courses offered by OSBOA) and create a fishermen's coop to store and set fish prices. The smaller business are considering joining Tourism Org 3, as it could provide duty-free status, less VTAs and assistance in preparing EMPs. Under certain weather circumstances, lifeguards noted it would be useful if they were allowed to close the beach, as full consultation can take a lot of time.

Nationally, stakeholders indicated that the government should continue to diversify the local tourism product by marketing Oistins' history and fisheries activities, as also noted by the Ministry of Tourism in the '*White Paper'* (GOB, 2012). The government could establish shops and a processing plant at the Oistins Fish-Market to sell value added fish to Bay Garden vendors and the hotels. It should also acknowledge the increasing operating costs for small and large businesses, and consider lowering them through measures such as lowered taxes**.** Moreover, the fuel subsidy for fishers should be increased, though this might be difficult to do as fuel prices are set internationally. The government could also further encourage the use of renewable and alternative sources of energy, which it aims to do as noted in chapter 4 (section 4.2.3) (GOB, 2012). Furthermore, the tourism market should be diversified away from a '*north-south'* relationship to neighbouring countries in the '*south'* (i.e. Argentina and Brazil), contradictory to the marketing efforts planned by the Ministry of Tourism to long-haul BRIC countries (GOB, 2012). More broadly, stakeholders also noted there is the need to diversify the economy beyond tourism, as also noted by (Gössling et al., 2008; C. M. Hall et al., 2013).

In summary, the majority of recommended strategies, resources and support to adapt to future stressors pertained to non-climatic stressors or the more near-term or minor impacts from climatic stressors, when tourists are still envisioned to visit the island. Stakeholders were for the most part not considering the impacts of more severe climatic changes (i.e. SLR), which are predicted to significantly impact upon the sector and its demand (Bigano et al., 2007; J. M. Hamilton & Tol, 2007;

Scott et al., 2012). As noted by Kajan (2014) in her study of climate change adaptation in arctic tourism communities, "…*though several adaptation strategies are deployed, future vulnerability may increase due to ineffective adaptation mechanisms",* p. 1. Furthermore, the adaptation strategies suggested differed by scale, with some that could be undertaken locally by destination-community stakeholders and others that would require the support of national or international stakeholders (this notion of '*nested vulnerability'* will be discussed further in chapter 8 (section 8.3.2.2)). Table 22 presents the adaptation strategies identified by community-level and national level stakeholders via the CBVA interviews, which were not contradictory and could be aligned.

Table 22. Adaptation Strategies Identified by CBVA Interviews

Adaptive Strategies
Local
• Strengthen adaptive capacity of local tourism and community organizations to facilitate any adaptation initiatives (i.e. development of EMPs, record keeping of businesses and fish catches). • Foster greater food security and reliance on local food and fisheries, including food imports from neighbouring islands. • Promote conservation of energy and water by tourists, for which require proper equipment. • Improve availability and access to loans and reduce insurance and permitting fees for small businesses.
National
• Diversify, expand and create a value-added local tourism product (i.e. marketing of Oistins' history, creation of fish shops). • Diversify the tourism market from a '*north-south'* relationship to neighbouring countries in the '*south'* (i.e. Argentina and Brazil). • Diversify the economy beyond tourism (no specific examples mentioned by local stakeholders, see chapter 5 (section 5.4.2)). • Cease the Air Passenger Duty Tax.

7.4.3 Limits or Constraints to Adapt

Stakeholders concluded the Community-Based Vulnerability Assessment by discussing any limits or constraints they would face when trying to adapt to future climatic and non-climatic changes. The constraints listed link to those faced when coping with current changes as presented in section 7.3.4. The perspectives that there is "*nothing one can do to prepare for future climatic changes"*, that one should *"take one day at a time*" or that uncertainty remains in the anthropogenic role in climate change, can also be considered a barrier to adaptation (Scott et al., 2009; Scott et al., 2012; Turton et al., 2010), as noted under future exposure-sensitivities in section 7.4.1. The majority of limits or constraints noted below pertain to locally-based adaptations.

Some of the tourism and community organizations that support the stakeholders are weak and are limited by a lack of capacity, as generally noted by Scott et al. (2009; 2012). In particular, the food and craft vendors would benefit from more support from the Bay Garden Vendors Association and Oistins Craft Vendors Association, which could facilitate members working together to develop adaptation initiatives. Furthermore, high permitting fees by government can hamper new tourist-related business. Fisher-folk would also benefit from more support from local associations such as the Oistins Fisher Folk Association, Oistins User Committee and Oistins Small Boat Owners Association to facilitate adaptation initiatives. Many of the fishers stated they would need to be paid more for their fish catch to account for rising operating costs. Fisher folk also lack capacity in their fish-catch and book keeping, which is required in order to access greater loans. James (2008) and McConney et al. (2009) note that adaptive capacity for fisher folk in the Caribbean remains hampered by a lack of capital and relevant information, weak fisher folk organizations and low bargaining power and inadequate addressing of climate change in many fisheries management plans (James, 2008; McConney et al., 2009).

> "*I created the Oistins Craft Vendors Association in 2009... There is not a lot of togetherness* (amongst vendors) *and it is hard to coordinate meetings. The majority of people joined, though the association is not very active and doesn't have any unity. It is hard to get support from the membership*". (Craft vendor 2, SH 10).

There also financial constraints (lack of funds) to purchase improved infrastructure, such as more secure huts on the beach or the retrofitting of ice-boats to harvest more fish, or to provide higher wages to government or private sector staff to address rising living costs. Stakeholders felt that if Barbados fostered the sale and production of more local items for local and tourist consumption (i.e. crafts and fish), the effects of economic crisis would be less. For this, the Government could put duties on the high amount of imported fish that enters the market and thus support the local supply, which the Ministry of Tourism also supports, yet provides no details as to how (GOB, 2012). To undertake such an initiative, there would need to be an examination of whether the local fish supply could be increased to meet local demand without causing over-fishing. Moreover, monitoring the use of energy, in particular air-conditioning use by tourists would be difficult without the investment in proper equipment.

Efforts have been taken at the destination-community level to reduce vulnerability and build adaptive capacity, though have not been very successful. The South Christ Church District Emergency Office has tried to hold meetings (i.e. fire prevention) in Oistins, but had poor attendance, perhaps because the community is more urbanized and busier and/ or because community members were not interested. The SCC DEO has also gone door to door to identify '*vulnerable'* people, as per the National Assistance Board definition, and carried out a simulation exercise for coastal zone flooding. A community level stakeholder noted that there is general apathy in Oistins and many people consider '*God to be Bajan'*, that is that God will protect them. This can be a common finding in the comprehension of climate change vulnerability, also found by Shakeela and Becken (2015) in their understanding of tourism leaders' perceptions of risks, "*…People's religious beliefs and high levels of fatalism regarding future disasters also attenuated risk perceptions*", p. 78. The SCC DEO noted that it would be helpful if the national Department of Emergency Management continues to support and fund the local DEO activities, for instance by running *s*ensitization programs at the national level or offering training courses and funding.

7.5 Summary of Empirical Results of CBVA

The Community-Based Vulnerability Assessment results suggest that, in the winter of 2011, interviewees were for the most part familiar with climate change and its possible impacts, though recent non-climatic stressors were thought to be more important and to be causing far more adverse impacts to the tourism sector and their resultant livelihoods. Stakeholders were facing varying degrees of biophysical and social vulnerability due to changes in weather, in particular minor and local-level impacts due to increased heat, increased and heavier rains and increased winds. Yet, this weather variability was not found to be affecting the activities or use of tourism-related facilities, by tourists who were visiting Barbados.

All stakeholders were facing social vulnerability due to non-climatic stressors, in particular the continued effects of the 2008 economic crisis and inflation on the island. Individuals working within small to mid-scale tourism-operations faced the highest exposure-sensitivities and lowest adaptive capacities to climatic and non-climatic stressors (i.e. the Bay Garden Food and Craft Vendors, fishers, operators of beach-related activities and managers and staff of small restaurants and hotels). The stakeholders were drawing upon a variety of strategies and resources to cope with both types of stressors, though as only some impacts were climatic in nature, the limits to coping for the most part pertained to non-climatic stressors. Perhaps certain limits will pose greater constraints for future adaptation, when climatic impacts become more severe (i.e. increased water shortages or the impacts of sea-level rise). In regards to future climate change exposure sensitivities, stakeholders who identified climate change as a future threat, were thinking of near-term or minor weather changes, not its more significant or severe impacts of sea-level rise or storm damage. This was evident due to certain of the recommended adaptive strategies being immensely solvable, i.e. providing more tents for food vendors to address increasing rains. Furthermore, the adaptive strategies suggested differed by scale, with some that could be undertaken locally by destination-community stakeholders and others that would require the support of national or international stakeholders, as detailed in Table 22.

The CBVA results imply that vulnerabilities regarding climate change and the tourism sector are not well understood at the tourism destination community level, meaning that local stakeholders will continue to require external assistance for anticipatory adaptation. Furthermore, the manner, in which stakeholders are coping with present climatic and non-climatic stressors and plan to adapt to future changes, provides some insight in how they could adapt to further minor changes in weather. Risk perception is often connected to adaptive capacity as a prompt for action (Parkins & MacKendrick, 2007; Vincent, 2007b). Furthermore, how local stakeholders could adapt to the future impacts of significant or more extreme climate-change needs to be further investigated. For these reasons, continued efforts should be made to enhance the adaptive capacity of stakeholders to current and future stressors, particularly those facing high exposure-sensitivity, including increasing their understanding of climate change and its possible future impacts to the tourism sector and to their destination-community. This could also mean diversifying the island's economic activities, to increase the potential for sustainable adaptation and development (Kaján, 2014).

Lastly, regarding broader scale measures of tourism adaptive capacity for Barbados, as noted in chapter (section 4.2.4.1), the island ranked in the top third of countries in the 2013 '*Travel and Tourism Competitiveness Index'*, due to its positive attitude toward tourists, prioritization and funding towards the sector and timely collection of sector data (WEF, 2013). Barbados could improve its degree of customer satisfaction and continue to protect its natural environment to further strengthen its travel and tourism competitiveness (WEF, 2013). As the TTCI rating focuses on tourist perceptions, it somewhat contextualizes capacity at the destination community-scale by prioritizing the sector and encouraging the protection of natural resources.

7.6 Summary and Conclusion

This chapter has provided this research's empirical results pertaining to a Community-Based Vulnerability Assessment in the tourism destination community of Oistins. In summary, the CBVA was able to identify stakeholders at risk and distinguish relative vulnerability and provided some value in community-based adaptation. For the tourism sector, the approach highlighted that most vulnerabilities and adaptation measures identified by stakeholders occurred above the destination community scale. The remaining information brought forth for the sector was not novel and was thereby limited in advancing the understanding of climate change vulnerability of the destination community. Chapter 8 will further discuss the above points and the utility of the CBVA and indicator approaches in understanding vulnerability at the tourism destination community scale.

Chapter 8

Discussion

8.1 Introduction

This chapter discusses the results of the national tourism climate change vulnerability assessment of Barbados and the vulnerability assessment of the destination community of Oistins, presented in chapters 5, 6 and 7 respectively. It commences by reflecting upon the research's empirical findings from the national assessment, the indicator and CBVA approaches, including their recommended adaptation strategies, the capacity of local organizations and suggests future adaptation strategies for the island and the destination-community. The chapter then discusses the research's methodological findings by reflecting on the utility of the indicator and CBVA approaches in examining the destination community's vulnerability, with the latter providing a detailed examination of 'nested' vulnerabilities. It also includes investigating whether the two approaches can be used in combination or offset any limitations of the other. The chapter then examines the relationship between household level vulnerability and the destination community. It concludes by discussing the practicality of defining a tourism destination at the community scale.

8.2 Reflections on Empirical Findings

8.2.1 Recommended Adaptation Strategies by Stakeholders

Simpson et al. (2012) note that *"Adaptive capacity in the institutions across Barbados is generally good, but efforts are restricted by limited financial and technical resources and limited enforcement of policy and laws"*, p. xxxiii. This research ascertained that the adaptive capacity of Barbados and its destination community of Oistins was influenced by inter-relationships with its social, economic and biophysical features such as institutions, infrastructure and ecosystems, as suggested in chapter 2 (section 2.5.3.2). These inter-relationships became evident due to the different types of adaptation strategies brought forth by stakeholders, as summarized in Table 22. In particular, the strategies suggested by the national assessment, destination-community indictors, household level indicators and the CBVA approaches differed by goal, according to the categories presented by the IPCC AR5[55] (Field et al., 2014). Adaptation strategies recommended by the regional and national stakeholders, via the national level vulnerability assessment, pertained primarily to physical and structural responses and thus the goal of vulnerability reduction or incremental adaptation. Strategies suggested by the destination community indicators could be used to measure progress towards reducing vulnerability and adapting incrementally, while those brought forth by the household level indicators could be used to measure progress solely towards reducing vulnerability. Adaptation strategies brought forth by the CBVA approach were the broadest and pertained to vulnerability reduction and to incremental and transformative adaptation, as discussed in chapter 2 (section 2.2.1). Further to the criteria and types of transformative changes noted by Field et al. (2014) in

Table 23, it is important to consider the challenges, opportunities and equity issues associated with such changes (Klein et al., 2014). Moreover, the CBVA led to discussions about behavioural change pertaining to transformative adaptation at the community and tourism worker level (i.e. beach vendors setting prices cooperatively). This finding helps to fill a gap in the tourism and climate change literature, which to date has discussed behavioural change amongst tourists (Higham, Cohen, Peeters, & Gössling, 2013; Huebner, 2012), the tourist trade (McKercher, Mak, & Wong, 2014) and at the managerial and governance levels (Shakeela & Becken, 2015). More generally, this identification of transformative adaptations is noteworthy, as the IPCC AR5 indicates that adaptation strategies need to move beyond the predominant consideration of structural and physical measures (Klein et al., 2014; Mimura et al., 2014; Noble et al., 2014), as outlined in chapter 2 (section 2.2.1). A mix of local, national and international actors would be responsible for implementing the strategies and many of them could be applied beyond the tourism sector. Additional adaptation options that became evident through this research are summarized in chapter 9 (section 9.3.2.3).

[55] Table TS.7

In addition, there is the need to examine the usefulness, durability, consequences, long-term feasibility and cost of any climate change adaptation strategies (Ford et al., 2012; Pearce et al., 2012), as detailed in chapter 2 (sect 2.4.3.2). It was not within the scope of this research to examine in detail the adaptation responses suggested by each method, though some insight can be made regarding potential costs. In examining tourism leaders' perceptions of climate change risks in the Maldives, Shakeela and Becken (2015) found that investing in adaptation was considered an extra business expense that could have uncertain payback times, which this research was not able to confirm as local stakeholders were for the most part not thinking of long-term climatic changes. Furthermore, Kajan et al. (2014) in their examination of adaptation costs in tourism, found that *"Which activities contribute to adaptation and which to general development remain a challenge in studying the costs of adaptation, especially at a local level*", p. 6. Kajan et al. (2014) also found that "… *large investments may decrease the flexibility to respond to changes quickly (though larger establishments are in general financially more capable of coping with unexpected expenses)…; small businesses seem to be most affected in terms of financial costs (though they are fairly flexible in their operational environment)"*, p. 5-6. Such insights would be important for decision-makers to consider when developing adaptation strategies with small or large tourism operators in Oistins. Lastly, in reference's to Wong et al.'s (2013) criteria to enhance small island policy environments for tourism sector adaptation, this research found that Barbados' government departments have somewhat raised the climate change awareness and commitment of officials, industry and community, through the development of initiatives pertaining to tourism and adaptation as noted in chapter 5 (section 5.4.1). Nevertheless, there remains the need for a more consistent use of terminology and implementation of initiatives. Policy tools that encourage the implementation of adaptation policies also remain to be created (E. Wong et al., 2013).

Stakeholders should also think beyond disaster risk reduction and move towards mainstreaming climate change adaptation in tourism, as also noted by Turton et al. (2010), "…*adaptation for tourism destinations should be part of the general community management processes… must be incorporated as part of…"destination management" and (community/ resource) "risk management*", p. 442. As a result, the local District Emergency Organization and the Constituency Council should collaboratively 'map' and develop an EMP for the destination-community, which could serve as the basis for a long-term climate change adaptation plan. To consider tourism in such a plan, the South Christ Church DEO's '*Community*

Profile' should also identify guest-houses, hotels and tourists in Oistins, especially those that are not registered with the Barbados Hotel and Tourism Authority [Tour Org 3].

Table 23. Goals of Adaptation Strategies Brought Forth in each Assessment

Goal	Vulnerability Reduction	Incremental Adaptation	Transformative Adaptation
National Vulnerability Assessment	• Hazard and vulnerability mapping (CDEMA, 2009d). • Coastal Risk Management (GOB, 2012).	• Engineered: Sea walls and coastal protection (CCCCC, 2009b). • Laws and Regulations: Water Conservation (UNECLAC, 2011), and National Adaptation Strategies (CCCCC, 2009b; GOB, 2001a).	
Destination Community Indicators *(Indicator noted)*	• Disaster risk management (i.e. building codes, early warning systems, hazard mapping, #19) • Ecosystem management (i.e. maintaining coasts, #24, 25).	• Institutional: *economic responses* (i.e. insurance) and *Government policies and programs* (i.e. disaster planning/ preparedness,#17,18, tourism management, #13,20) • Structural/ physical (i.e. fisheries co-management, #9,11)	
Household Level Indicators	*All of the indicators* • Human development (i.e. education, health, nutrition, gender equity), • Poverty alleviation (i.e. insurance schemes, social safety nets) • Livelihood security (i.e. incomes, assets, livelihood diversification, reliance on social networks) • DRM (i.e. early warning systems)		
CBVA	• Poverty alleviation (i.e. insurance schemes, social safety nets) • Livelihood security (i.e. incomes, assets, livelihood diversification, reliance on	• Institutional: *Economic responses* (i.e. cash transfer, taxes and subsidies, insurance) and *Government policies and programs* (i.e. disaster planning and preparedness)	Spheres of change: • *Educational* (i.e. Tourists conserving water and energy) • *Political* (i.e. Diversify tourism economy;

Goal	Vulnerability Reduction	Incremental Adaptation	Transformative Adaptation
	social networks, improved infrastructure) • DRM (i.e. early warning systems)	• Social: *Behavior responses* (i.e. reliance on social networks, livelihood diversification).	Consumption of local resources). • *Practical* (i.e. Behavioural shifts in working cooperatively). • *Personal* (i.e. Belief changes that influence climate change responses).

8.2.2 Capacity of Local Organizations Operating in Oistins

Discussions via the focus groups and with key informants to develop and apply the indicators and to carry out the CBVA, led to the insight that some of the community-groups operating in Oistins lacked capacity in regards to management, staffing and coordination with other organizations. Stakeholders suggested that to improve the capacity of organization's working within Oistins, there needs to be better co-ordination amongst the various groups working at the community level and their respective sectors (i.e. community mobilizing, disaster management, tourism and fisheries). At the time of research, there was some overlap of activities and not enough sharing of information, in particular for the collection of data pertaining to household indicators. There also seemed to be some tension between the District Emergency Office and the newly established Constituency Council, as the two organizations were clarifying how they could work together and where their mandates overlapped. In the Caribbean coastal-marine context, the capacity of local government to address changing climate could be enhanced with support from higher-level government (Pittman et al., 2015) (also related to fostering nested arrangements to address complex problems, which will be discussed in section 8.3.2.2). Furthermore, through the focus groups, stakeholders appreciated the opportunity to meet and learn about each other, including ascertaining what type of information each party was collecting.

In addition, further to the limits and constraints to adapt to future stressors detailed in chapter 7 (section 7.3.4), some community organizations found the residents of Oistins difficult to mobilize or engage in community events, including those pertaining to disaster preparedness. For instance, as noted in chapter 4 (section 4.3.4), the Barbados Red Cross [Em Mgmt Org 3] '*Building Safer, More Resilient Communities Project'* was carried out in Oistins in 2010. The purpose of the Project was to mobilize Barbadian communities to prepare for any future disasters, including assessing the needs of the local District Emergency Office and developing vulnerability assessments. This involved the Red Cross carrying out an initial baseline assessment of Oistins' disaster management preparedness and building awareness of the issue with its key community stakeholders (i.e. the police and businesses). The Red Cross attempted to collaborate with the local DEO and the Constituency Council, by holding their introductory meetings in Oistins in conjunction with the DEO, to which only three people attended. In total, five people participated in the Red Cross workshop in Oistins. Participation in other open-houses was also low, so the Red Cross ceased the Project in Oistins. The organization decided to execute the Project in two communities in the St. George and in St. John Parishes and is launching it in four other communities (The Barbados Advocate, 2011a). These other communities portrayed greater interest in the Project, perhaps as they were smaller and more tight-knit, and community members had more time to engage in its activities.

8.2.3 Future Adaptation Strategies for Barbados and Oistins

Interpreting the results of the national and community-based vulnerability assessments provided some interesting insight as to the future of tourism in Barbados and Oistins in light of climate change. The national assessment presents presented an '*outcome'* understanding of vulnerability using the climate as its starting point, while the CBVA presented a '*contextual'* understanding of vulnerability using the community as its starting point, with selected climate attributes. This framing was demonstrated in the conceptual framework presented in chapter 2 (section 2.6.1). As also noted in chapter 2 (section 2.3), each assessment provided a different yet complimentary framing of climate change, also to be discussed in the *'nested'* understanding of vulnerability in section 8.3.2.2.

Mid-century BAU scenarios foresee doubling tourist arrivals to Barbados, along with increased water scarcity, and mid to late-century scenarios foresee less tourist accommodation capacity due to sea level rise degrading tourism infrastructure and assets. Further to the notion of 'transformative adaptation' discussed in section 8.2.1, Barbados could adapt the composition and emphasis of its tourism product, by maintaining and further developing its luxury tourism infrastructure, attractions and coastal features on its west coast, as suggested in chapter 5 (section 5.5.3). Communities such as Oistins on the south coast will face dwindling natural features, but could continue to market their 'cultural' and 'community' tourism attractions, as also suggested by local and national level stakeholders. Even though focusing on higher end tourism on the west coast would lead to a higher economic yield per tourist and counteract some of the projected shortfalls in accommodation, Barbados and its communities, such as Oistins, will still need to diversify their economies beyond tourism to avoid significant adverse effects on employment. Appropriate policy tools, ample financing and enhanced implementation, monitoring and enforcement capacity of Barbados regulatory agencies will be required to foster any adaptation measures (Mycoo & Chadwick, 2012; Mycoo, 2013; E. Wong et al., 2013).

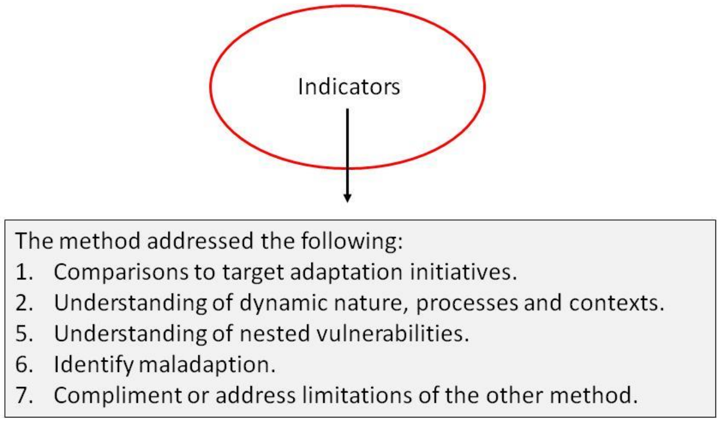
8.3 Reflections on Methodological Findings

The following section discusses the utility of the indicator and the CBVA approaches in assessing the vulnerability and adaptive capacity of the tourism destination community of Oistins, based on the criteria noted in chapter 2, Figure 3 (section 2.6.2). In particular, the chapter discusses whether either of the approaches brought forth new information, and if so, how they advanced the understanding of tourism climate change vulnerability for the destination community. To re-iterate, Figure 3 presented the following criteria in which to examine the two methods' ability to assess the vulnerability and adaptive capacity of the destination community: 1) facilitate comparisons, within and amongst the community, to target tourism sector adaptation initiatives; 2) capture the dynamic nature of vulnerability and understanding of its processes and contexts; 3) be inclusive of stakeholders and consider their livelihood issues, 4) account for multiple stressors; 5) be sensitive to scale and demonstrate how any locally identified vulnerabilities link to those identified nationally and regionally, 6) identify maladaptation; and 7) whether the two approaches can be used in combination or offset any limitations of the other method.

8.3.1 Utility of Indicator Approach

Further to the discussion of strengths and limitations of indicators noted with this research, as detailed in chapter 6 (section 6.4), this section reflects on the value of the indicator approach and any new information brought forth in advancing knowledge gaps to understand vulnerabiilty at the tourism destination community scale. Figure 13 demonstrates how the indicator approach met the criteria identified in Figure 3, which is further discussed below.

Figure 13. The Indicator Approach's Assessment of Tourism Destination Community Vulnerability



In general, it was difficult to comprehensively assess the climate change vulnerability of a tourism-destination community such as Oistins, situated in a small dense island, via an indicator approach. Even though many indicators were conceptually relevant and considered implementable and operationally feasible to apply (as detailed in chapter 6 (section 6.2.1)), the majority of indicators were found challenging to apply at the time of research or in the near future at this scale. In particular, stakeholders did not think it was relevant and feasible to develop and apply (collect data for) exposure indicators for direct climate change, as there is too much data variation at the community scale. Indicators pertaining to the community's sensitivity and adaptive capacity might have been feasible to apply if the destination community had a defined spatial boundary. Though after engaging in the indicator development and application exercise, stakeholders concluded that even if one was able to establish a specific boundary around the destination community or a '*site-specific'* attraction such as the Bay Garden Vendors Area, it would not be feasible to apply the majority of the indicators at the scale due to the lack of data. This finding partially contradicts the recommendation of Hinkel (2011), that indicators are only appropriate for identifying local systems when they can be narrowly defined. This research was able to define the system, but not able to collect data for it. Moreover, at the household level, many of the indicators developed were considered implementable and operationally feasible to apply through enumeration districts. Furthermore, it was found that all of the indicators could be applied due to the defined boundaries of the neighbourhoods, though only a few were being applied consistently by various parties, with none pertaining to tourism. In addition, even though data could be examined at the household level, parties found it more worthwhile to analyze data trends regionally (parish) or nationally.

As noted in chapter 6 (section 6.2.2), ten indicators were applicable at the destination-community scale and were therefore able to provide a partial assessment of the vulnerability of Oistins, based on determinants pertaining to the indirect biophysical impacts of climate change, the economic sensitivity of the tourism sector and political, financial and natural capital. For the remaining indicators, little information was available at the destination community scale and would be difficult to extract from national or Caribbean level data. In regards to the criteria noted in Figure 13, as only ten indicators were applicable at the destination community scale, with three exclusive to the tourism sector, the indicators would partially be able to compare vulnerability amongst similar communities and ascertain where tourism sector adaptation funding is most needed, as recommended by Bours et al. (2014) *(criteria #1*). Nevertheless, the applicable indicators could be used to identify certain vulnerable systems at the destination community scale as suggested by Hinkel (2011) and monitor baseline vulnerability over time, as further detailed in section 8.3.3.1. The applicable indicators could be used to measure progress towards reducing vulnerability (i.e. hazard mapping, maintaining coasts), and adapting incrementally (i.e. disaster planning, tourism management, insurance and fisheries co-management). Moreover, as the applicable indicators partially measured progress for certain determinants, they provided only some insight into their influencing processes and contexts (*criteria #2*). The household level indicators could identify vulnerable individuals within households of the tourism destination community, though comparability amongst households, and understanding of influencing processes and contexts, would not pertain to the destination community boundary and would be made at the parish level (*criteria #1 and #2).*

Moreover, '*up-scaling'* the ten applicable indicators could allow for an understanding of nested vulnerability between local and national/ regional scales (*criteria #5*). Adger (2004) and Brooks (2005) note that when '*up-scaling'* local level indicators to the regional and/or national levels, context-based generic indicators are more likely to capture the local level determinants of vulnerability. For these reasons, this research based the tourism destination community indicators on local process-based indicators developed in the literature (Bollin & Hidajit, 2006; Hahn et al., 2009; Parkins & MacKendrick, 2007; UNWTO, 2004a). The destination community indicators that were found conceptually relevant, even though they were not all feasible to apply at the destination community scale of Oistins, could be combined (averaged/ aggregated) into a composite index and allow for a comparison of determinants at the national scale. This could be attempted in a more distinct tourism-destination community in a larger island and measure relative vulnerability based on a collective score of multiple indicators. As noted earlier, the majority of household level indicators being applied in Oistins are already being '*up-scaled'*, with data being analyzed at the parish or national level. In addition, as detailed in chapter 2 (section 2.4.2.2), national level indicators can be limited in their portrayal of higher level variation by oversimplifying or misrepresenting process-based contextual features of vulnerability at the local level (Adger et al., 2004; Birkmann, 2006a; Füssel, 2009). The CBVA findings of this research also pointed to the reverse, as local stakeholders did not identify the larger-level risks facing their community and therefore misrepresented the relative risks of external and local change. The notion of nested vulnerability pertaining to these results is discussed in section 8.3.2.2.

On the flip side, vulnerability indicators for the tourism sector have only been developed at the national level by Perch-Nielsen (2010), as noted in chapter 2 (section 2.5.5.1). This research followed the author's recommendation by applying her conceptual framework, regarding the categorization of exposure, sensitivity and adaptive capacity national level indicators, and attempting to '*down-scale'* them to the destination community scale for the comparison of beach destinations. By undertaking this exercise, it was ascertained that '*down-scaling'* the national level tourism indicators allowed for some understanding of local processes and contexts (i.e. coastal management, tourism's economic impact on the community, emergency management planning, and availability of insurance) and thereby informed the development of some destination community level indicators (i.e. examining tourism numbers at the destination community scale). Indicators were modified as best they could, to suit a destination community scale. Overall, it was found challenging to scale down the national indicators, especially as it was often not feasible to obtain data (apply the indicators) at the destination community-scale for a small dense island like Barbados. This latter research finding was thus not able to comprehensively follow Perch-Nielsen's (2010) recommendation. The research was able to apply her framework for tourism-related national-level indicators at a destination level, but was not able to comprehensively derive local indicators. For small islands like Barbados, it would be better to develop and apply tourism indicators at the national level. For the tourism sector as a whole, destination indicators could be useful in a more distinct destination-community, in a less dense or larger island. In addition, it was even more challenging to have the national level indicators inform the household level indicators, as the scale of the latter was so small and the socio-economic determinants were more household oriented. Nevertheless, a few of the determinants examined in the destination community and household indicators were similar to national level indicators and modified to suit the particular scale, for example: '*Destination community's share of total tourist arrivals for recreation'* (Indicator: #13, chapter 6 (Table 14)), leading to *'% of households dependent on a tourism-related activity as a primary source of income'* (Indicator: #16, chapter 6 (Table 16)).

To avoid mal-adaptation *(criteria #6),* certain applicable indicators could be used to screen adaptation measures for any adverse effects by considering whether they excessively burden the most vulnerable and create high opportunity costs (*Indicator #23*: availability of insurance), reduce incentives to adapt (*Indicators #17,18,19:* existence of Emergency Management Committee, availability and circulation of EMPs and Risk Maps) or nurture path dependency through development patterns that are challenging to change in the future (*Indicators #24,25*: erosion protection measures and regular beach monitoring) (Barnett & O'Neill, 2010). Overly precise climate predictions could also lead to maladaptation if they are misinterpreted or used incorrectly (Dessai et al., 2009), which is important to consider when applying any exposure indicators (*Indicators #9,11*: changes in biodiversity). Based on the application of these indicators, apart from *Indicator #23* which was not being applied at the time of research, no evidence of maladaptation was found.

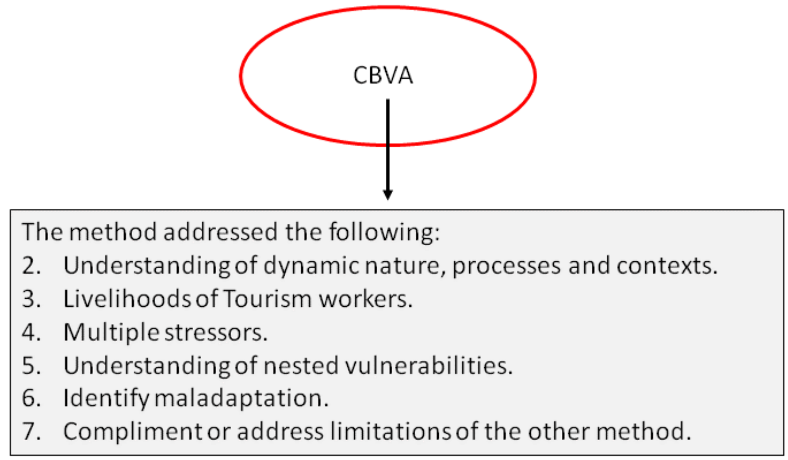
The indicator approach was not found to consider the livelihoods of tourism workers (*criteria #3*) or account for multiple stressors (*criteria #4*). In regards to criteria #3, the application of indicators, even though they attempted to examine determinants related to the sustainable livelihoods capitals, were limited to information that was readily available. Furthermore, none of the sustainable livelihood indicators pertained distinctly to the livelihoods of stakeholders engaged directly in the tourism sector. In addition, the destination community indicators, while attempting to capture information at the community scale, did not point to any specific groups of stakeholders as being more vulnerable than another, but spoke for issues pertaining to the destination as a whole. The results of the household level indicators, as noted in chapter 6, (section 6.3.4), were able to identify the types of tourism-related employment individuals within the neighbourhood participated in. If this data was to be correlated with determinants pertaining to the gender of the household head, health, financial resources, housing materials and education levels, further insight could be made regarding the vulnerability of tourism destination workers.

In summary, apart from the logistical challenges noted, this research found that the development and application of tourism destination community indicators in Oistins were limited in advancing the understanding of climate change vulnerability at the destination community scale, as they did not provide any new information. Any information provided pertained to the understanding of tourism climatic *pathways #1* and *#2*, as depicted in Figure 1 and Figure 2 (chapter 2). Nevertheless, some value could be gained from using the applicable indicators to compare sites and overcome the scaling up and out limitations of the CBVA approach (*criteria #7*), as to be discussed in section 8.3.3. The indicators might have been easier to apply, if they were broadened to consider other sectors or be more community-based, as suggested by Kajan (2014) in her study of natural-resource dependent tourism destination communities and contradictory to sector-specific recommendations (Füssel, 2010; Hinkel, 2011). Nevertheless, in a small island state such as Barbados, it would still remain challenging to systematically collect information at the community scale. A tourism-destination community indicator approach might be more feasible in a more distinct destination community in a larger less dense island. Moreover, for a small dense island such as Barbados, it might also be more useful to define a tourism destination nationally, as further discussed in section 8.5.

8.3.2 Utility of CBVA Approach

The following section reflects on the value of utilizing the Community Based Vulnerability Assesment approach and any new information brought forth in advancing knowledge gaps to understand vulnerabilty at the tourism destination community scale. Figure 14 indicates how the CBVA approach met the criteria identified in chapter 2, Figure 3. The section first discusses how the approach met criteria #2,3,4 and #6 and then discusses criteria #5. Criteria #7 is discussed in section 8.3.3.

Figure 14. The CBVA Approach's Assessment of Tourism Destination Community Vulnerability



8.3.2.1 Criteria #2,3,4 and #6

This research found that the Community-Based Vulnerability Assessment approach provided for a detailed understanding of the processes and contexts influencing the exposure, sensitivities and adaptive capacities of tourism stakeholders in the destination community *(criteria #2).* This was due to the fact that it involved a larger group of stakeholders, as in addition to consulting key informants, it more thoroughly involved those whose livelihoods were most connected to tourism. As a result, a more comprehensive understanding was obtained of the various stressors affecting the community, including their coping and adaptive strategies and any limits faced.

Furthermore, the approach enabled a more thorough consideration of the '*sustainable livelihoods'* assets and the livelihoods of tourism workers *(criteria #3).* For instance, even though The CARIBSAVE Partnership asked the Researcher to remove the political capital indicator from the conceptually relevant household list presented in chapter 6, Table 15 [*Indicator #20*: Trust in government institutions], political and governance issues were brought up in the CBVA discussions. Furthermore, even though no cultural capital indicators were presented in the destination-community or household level indicators, related issues arose in the CBVA discussion (i.e. the notion that God will protect Bajans in the event of climate change). In addition, the CBVA results provided the most detailed information regarding the vulnerability of tourism stakeholders, in particular workers most dependent on the tourism related activities of the destination. As noted in chapter 7 (section 7.5), individuals working within small to mid-scale operations faced the highest exposure-sensitivities and lowest adaptive capacities to climatic and non-climatic stressors and resultant impacts to their livelihoods. This included the Bay Garden Food and Craft Vendors, the fishers, operators of beach related activities and managers and staff of small restaurants and hotels. In addition, Scott et al. (2012) note that "… *climate change is only one of several macroscale drivers of future tourism development and there has been limited analysis of the potential interaction with other major drivers*", p. 3. As the questions for the CBVA approach were semi-structured and not fixed to particular data points, it allowed for the investigation of a broader definition of stressors and multiple drivers of vulnerability, including the four climatic pathways noted in Figure 1 and Figure 2 *(criteria #4)*.

As the CBVA approach was found to be fairly comprehensive in examining the processes and contexts influencing the destination's vulnerability (*criteria #2*), it was able to screen for the following mal-adaptations (*criteria #6*). These include maladaptations which 1) exacerbated the climate change problem they were attempting to adapt to by increasing GHG emissions (i.e. increased use of air conditioning by certain hotels to address increasing heat), 2) excessively burdening the most vulnerable (i.e. higher insurance costs) 3) creating high opportunity costs relative to alternatives (i.e. marketing Barbados to tourists in China vs. neighbouring '*south-south'* countries), 4) reducing incentives to adapt (i.e. fatalist attitude by many community-level stakeholders) and 5) nurturing path dependency through development patterns that are challenging to change in the future (i.e. increased marketing to long-haul tourists in China and India) (Barnett & O'Neill, 2010).

A limitation of the CBVA results is that it could foster comparisons of vulnerability within the community, though would be limited in its comparison of findings across and beyond the community (Birkmann, 2006a; Smit & Wandel, 2006). The application of common assessment frameworks can facilitate comparisons across communities to identify common characteristics (Simpson, Gössling, Scott, Hall et al., 2008; Smit et al., 2008), though would face challenges due to the in-depth time and research requirements of the CBVA approach (*criteria #1*). Furthermore, the subjective qualitative nature of the CBVA results meant that its responses were not always comprehensive or rigorous, which could further limit comparisons.

Another factor limiting the comparison of CBVA findings is that its results portrayed the determinants of vulnerability at a particular point in time, thus hampering its ability to speak beyond a specific context

(Ford & Pearce, 2012; Ford et al., 2012). This research attempted to obtain longer-term data over a 10 year span, nevertheless the majority of the interview results pertained to short term (more recent) data, in particular for current exposure, due to the memory of respondents. Even though participants were able to accurately relay some of the environmental changes in the past few years, they had a difficult time recollecting changes for the entire ten year period. Furthermore, some of the stakeholders perceived impacts were inaccurate, such as the perception that temperatures had become cooler at night, thus confirming the findings of Parkins and MacKendrick (2007) that perceived impact, does not always translate to real impact. In addition, in regards to '*future-exposure sensitivities*', respondents only seemed to be thinking of short-term climate variability and less extreme climate impacts, like slight increases in rain. Many did not appear to understand the full risks of extreme or long-term climate-related events, for instance increased rain might result in more business for taxis, though heavier precipitation and any flooding, infrastructure damage or business interruptions could also deter tourists (Scott et al., 2012).

8.3.2.2 Understanding of Nested Vulnerabilities (Criteria #5)

As noted in chapter 2 (section 2.4.3.1), place-based case-studies often focus on vulnerability assessment at the local level and do not consider the larger scale determinants that can affect whether local adaptations are viable (Adger, Eakin et al., 2009; Ford et al., 2010; Keskitalo, 2009; O'Brien & Leichenko, 2000). This research undertook a nested approach to distinguish vulnerability determinants at multiple scales of governance and detail interactions between roots and results of vulnerability across geographic scales as recommended in the literature (Adger, Eakin et al., 2009; Ford et al., 2010; Keskitalo, 2010; Schröter et al., 2005). In addition, nested, multilevel governance can encourage the 'fit' or match of adaptive capacity to the cross-scale dynamics of the particular systems (Armitage et al., 2009; Cash et al., 2006). Furthermore, a multi-level structure enables issues to be dealt with at the suitable scale relative to the scale of problem (Pittman et al., 2015).

This research found that the CBVA approach allowed for the examination of tourism-related issues within a larger more fluid boundary. Data collection was not constrained to a fixed border, as it could be collected within the community of Oistins and outside of it, which suited the dense nature of Barbados and its spread of tourism facilities. In this context, as noted in chapter 4 (sections 4.2.4 and 4.3.1), it can be useful to consider Oistins' tourism establishments in a '*cluster*' concept (CDEMA, 2009c; CDEMA, 2009d). This wider understanding of tourism-related vulnerability at the tourism community scale enabled the examination of the results within a national level understanding of sectoral vulnerability.

The national climate change vulnerability assessment of Barbados' tourism sector, presented in chapter 5, found that tourism and climate change initiatives have been initiated regionally and nationally, though are not comprehensive, lack consistency, do not provide specific recommendations and are at times contradictory. Furthermore, studies have examined climate change and tourism at the Caribbean or the national level (CDEMA, 2013c; GOB, 2001a; GOB, 2012), though only a few have address climate change adaptation (CCCCC, 2009a; UNECLAC, 2011). As community tourism is promoted by international and national level stakeholders to reduce poverty and diversify Barbados' tourism product, an understanding of destination-community scale vulnerabilities remains important (GOB, 2012; Gössling et al., 2009; UNWTO, 2004b). As a result, information gaps remained in the community level understanding of tourism and climate change vulnerability in Barbados, including a comprehensive consideration of multiple stressors.

Chapter 5,Table 10 (section 5.2) presented the vulnerabilities of Barbados' tourism sector to climatic and non-climatic stressors as identified by key regional and national level stakeholders (CCCCC, 2009b; CDEMA, 2009d; GOB, 2001a; GOB, 2012; UNECLAC, 2011). Table 24 below represents those vulnerabilities, excluding magnitude and confidence level in impacts. It also compares the vulnerabilities noted by national and regional stakeholders, to those perceived by Oistins' stakeholders, via the CBVA, and ascertains where any similarities or gaps exist. The CBVA column indicates whether vulnerabilities were identified currently (C), in the future (F) or not (N).

Table 24. Noted Vulnerabilities of Barbados' and Oistins' Tourism Sector to Multiple Stressors

	# of Studies (out of 5)	CBVA	Timing of Impact
Climatic Stressors			
Pathway 1 – ***Direct Impacts of Climate on the Tourism Sector***			
Changes in storm intensity and rainfall patterns.	4	C	2050
Higher temperatures leading to greater energy and water use and higher operating costs.	3	C	2100
Warmer winters in key source-markets and in Barbados leading to less tourist arrivals.	3	N	2100
Higher capital costs to protect beach properties and to market destination.	3	N	2030
Pathway 2 – ***Indirect Climate-Induced Environmental Changes***			

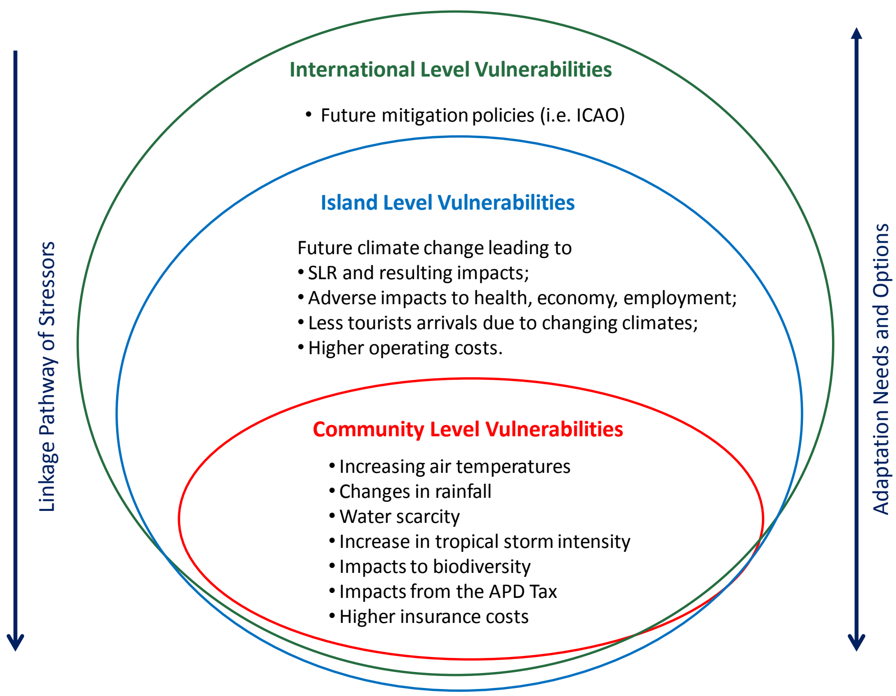
Increased SLR, impacting upon beaches and relocation of infrastructure, leading to higher capital costs.	5	F	2100
Coral bleaching affecting diving.	4	N	2030
Water scarcity.	3	C	2050
Reduced fisheries biodiversity.	2	C	2050
Impacts upon local food production.	1	C	2030
Pathway 3 – *Indirect Climate-Induced Socio-Economic Changes*			
Indirect climate induced socioeconomic changes.	0	N	2050
Pathway 4 – *Impacts Caused by Mitigation and Adaptation Responses in Other Sectors*			
Mitigation responses, in particular APD.	2	C	2030
Higher operating insurance costs	2	C	2030
Non-Climatic Stressors			
Heavy consumption and cost of imported energy and food.	4	C	
Economic dependence on tourism.	3	C	
Volatile oil prices, leading to increased airfare and operating costs (inflation).	2	C	
Valuable coastal infrastructure.	2	C	
High population density.	2	C	
Prolonged global financial crisis.	1	C	
Rising food prices (inflation).	1	C	
Currency fluctuations.	1	N	

Note: F = Future, C = Current, N = Not considered at all

Community level stakeholders perceived minor, near term and local-level climatic stressors to be currently impacting them, which were not found to be affecting tourism-related activities. These stressors included changes in tropical storm intensity and rainfall patterns, increases in air temperatures, lower water availability, reduced fisheries biodiversity and impacts to food production, which are all predicted to increase in magnitude by mid to late century (apart from impacts to food production). Stakeholders faced varying impacts from these direct and indirect changes to their tourism-related livelihoods, which included higher energy costs, business interruptions, infrastructure damage (*pathway #1*) and on natural assets important for the destination (i.e. fish and food) (*pathway #2*). Stakeholders also perceived the more immediate impacts from the Air Passenger Duty Tax mitigation policy, even though they are not proven in the literature (Scott et al., 2014; Seetaram et al., 2014), and increased insurance costs (*pathway #4*). Local stakeholders perceived the impacts of the majority of the non-climatic stressors presented in Table 24.

Local stakeholders did not recognize other significant vulnerabilities that future climate change could bring to the tourism sector, which were identified by island (national and regional) stakeholders. These included changing weather in key source-markets and in Barbados leading to less tourist arrivals, though only the former scenario is predicted to change tourist preferences, and higher operating costs to protect coastal properties (*pathway #1*). Other unforeseen vulnerabilities included sea-level rise, leading to deterioration of coastal conditions and saline intrusion (*pathway #2*). No impacts were identified for *pathway #3*, in regards to climate-induced socioeconomic changes leading to adverse impacts on the economy or employment. In addition, local and national level stakeholders did not recognize vulnerabilities due to future international mitigation policies, such as one by the International Civil Aviation Organization, and how it could affect their plans to market Barbados' tourism sector to long-haul tourist markets (*pathway #4*). Figure 15 presents this 'nested' understanding of tourism-sector vulnerabilities at different scales. The Figure is based on the conceptual framework portrayed in chapter (section 2.6.1).

Figure 15. Nested Understanding of Tourism-Sector Vulnerabilities at Different Scales



8.3.2.3 Summary

In summary, even though the CBVA approach did not provide significant novel tourism sector information, a significant finding was that it allowed for the nested examination of vulnerabilities between community, island (national and regional) and international scales. The approach provided novel value in highlighting that most long-term and extreme vulnerabilities occur above the destination-community scale and are therefore largely outside the control of Oistins. This finding brings into question whether local tourism-stakeholder driven adaptation can remain viable and whether sectoral and local adaptations are always consistent. Furthermore, at a broader community scale, the approach more comprehensively met the criteria of Figure 3 (chapter 2). This wider approach has advantages in understanding vulnerability, as also noted by Kajan (2013) for two small resource dependent tourism destination communities in the Finnish arctic '… *the proposed approach is more natural-resource-based than simply tourism-centred, it allows other opportunities to emerge than those merely focusing on tourism…'*, p. 297.

8.3.3 Indicator and CBVA Approaches *(criteria #7)*

As noted in chapter 2 (section 2.4.1), it is useful to consider whether quantitative and qualitative approaches can complement each other to analyze a system's vulnerability (Arakida, 2006; Bours et al., 2014; Cardona et al., 2012; Rosenzweig & Wilbanks, 2010). The indicator and the Community-Based Vulnerability Assessment approaches present different methods to examine a local system's vulnerability, with the former claiming to facilitate rapid assessments and the latter in-depth research. Yet, due to the inadequate assessment of the implementation, monitoring and evaluation of adaptation initiatives to date (Mimura et al., 2014; Noble et al., 2014), assessment requirements for decision-makers might not be '*rapidly'* met by indicators and in-depth research carried out in a certain period of time (for instance a year) might be rapid enough. Furthermore, apart from the CBVA approach highlighting discrepancies in the understanding of tourism-related vulnerabilities at different scales, this research found both methods to be limited in advancing knowledge gaps in the understanding of tourism and climate change vulnerability at the destination community scale. Though for a broader community-scale, both methods could provide value and work in combination to address limitations of each other *(criteria #7,* Figure 14). The following section examines whether one approach can offset any limitations posed by the other or whether the two can be used in combination to understand vulnerability at the destination-community scale.

8.3.3.1 Use of Indicators to Overcome Scaling Limitations of CBVA

Ford and Pearce (2012) and Ford et al. (2012) recommend that additional place-based methods such as longitudinal studies, community-based monitoring and focused adaptation research are needed to foster comparative assessments across and beyond communities and to more comprehensively capture the dynamic nature of vulnerability, including representing determinants beyond a particular point in time. For small islands systems, Nurse et al. (2014) also note the need for improvements in baseline monitoring, to differentiate between observed and projected impacts, long term monitoring and the assessment of community-based adaptation. Comparative research is also needed to distinguish the role of climatic and non-climatic drivers and better understand differences within islands (Nurse et al., 2014). In addition, to foster climate change governance in the Caribbean context, Pittman et al. (2015) suggest encouraging community members to undertake social and environmental monitoring to support existing programs in places with limited funds.

This research considers focused adaptation research, which can include aspects of community-based monitoring and longitudinal studies, to investigate and monitor a particular determinant of adaptive capacity and how it can be transformed into adaptation. One output of CBVA, which could advance methodology, is to continue to use the approach to establish a baseline and utilize indicators to monitor long-term whether any planned adaptations are working. This research suggests that focused adaptation research can be facilitated by using indicators to overcome the scaling up and out limitations of the CBVA approach, by identifying any applicable destination-community indicators that could be used to monitor progress on the adaptation measures detailed with the CBVA approach. Such a combined approach could therefore avoid having to undertake another comprehensive place-based assessment for a certain number of years, which is time and resource intensive (Ford et al., 2010).

Chapter 6 (Table 14) presented ten tourism destination community indicators that were being applied or could have been in the near future at the destination community level. The list is not comprehensive, but pragmatic, and as noted in section 8.3.1, provides partial insight into the vulnerability of the destination community, pertaining to the indirect impacts of climate change, the economic sensitivity of the tourism sector and political, financial and natural capital. As presented in Table 25, the indicators pertaining to exposure, sensitivity and adaptive capacity could monitor certain determinants of the baseline vulnerability detailed in the CBVA results, within the confines of a defined boundary. The ten indicators provide numerical analysis, normative and descriptive criteria and benchmarks to evaluate/ monitor adaptation planning goals (as described in chapter 6, Table 19). It is important to note that this application of the destination community indicators would not be a comprehensive portrayal of the processes and contexts influencing the destination's vulnerability and would monitor determinants pertaining to vulnerability reduction (e.g. hazard mapping) and incremental adaptation (i.e. existence of a functioning Emergency Management Committee). The timeframe would need to be further determined.

Table 25. Destination Community Indicators that could Monitor CBVA Baseline Vulnerability

Indicator
EXPOSURE: Change in the suitability of the climate for the tourism destination community
1. Biodiversity: Change in mean *reef fish* harvest in the past 30-years: *In-shore* reef and *off-shore* reef (slope) fisheries [Most socially and economically valuable species for tourism] **[#9]**
2. Biodiversity: Changes in coastal ecosystems of the destination (i.e. % of live coral cover) **[#11]**
SENSITIVITY – Social, economic and biophysical characteristics of the destination community, which affect its susceptibility to climate-related events
3. Destination's share of total tourist arrivals for recreation **[#13]**
ADAPTIVE CAPACITY - Social, economic and biophysical characteristics of the destination community which affect its ability to adapt to climate related-events
4. Existence of functioning Emergency Management Committee **[#17]**
5. Availability and circulation of *Emergency Management Plans (EMPs)* or *Disaster Risk Management Strategies* for destination **[# 18]**
6. Availability and circulation of Risk (Hazard) Maps for the destination community **[#19]**
7. Ranking of tourism destination and/or attraction [#20]
8. Availability of insurance for tourism related employment and infrastructure for impacts due to weather variability **[#23]**
9. Effective erosion protection measures in place in vulnerable areas **[#24]**
10. Beaches monitored on a regular basis **[#25]**

Similarly, chapter 6 (Table 16) presents 11 indicators that were being applied at the household level. Of these, Table 26 presents the three adaptive capacity indicators that could serve to monitor aspects of the long-term baseline vulnerability detailed in the CBVA results. The three indicators also pertain to numerical analysis, normative and descriptive criteria and benchmarks to evaluate/ monitor adaptation planning goals. The other eight applicable indicators pertain to sensitivity and household characteristics within the defined neighbourhood, which were not asked in the CBVA interviews (i.e. demographics, health, financial need and housing quality). As noted above, the application of these indicators would not be a comprehensive portrayal of vulnerability and would only capture some of the processes and contexts influencing adaptive capacity at the household level (i.e. human, social and natural capitals). The three indicators could monitor household level determinants, as detailed in the CBVA interviews, pertaining to vulnerability reduction through human development (e.g. education), incremental adaptation through reliance on social networks and transformative adaptation by assessing the consumption of local resources. The timeframe would also need to be further determined.

Table 26. Household Level Indicators that could Monitor CBVA Baseline Vulnerability

Indicator
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources (assets) that determine a household's capacity to adapt
1. Knowledge within the sector on climate change, its potential impacts and possible actions [via % of household heads and members (over 15) who've completed secondary school]. **[#21]**
2. Range and scope of social capital contacts **[#22]**
3. % of households with access to one or more natural resources **[#23]**

8.3.3.2 Use of CBVA to Capture Non-Applicable Indicator Determinants

The following section presents the tourism destination community and household level indicators that were found conceptually relevant to develop, but that were not being applied at the destination community or household-scale. As some of the determinants were considered useful by various parties, this section examines whether a Community-Based Vulnerability Assessment approach could collect the data, while noting that it would provide a descriptive and disaggregated accounting of vulnerability, the purpose of which is to not be aggregated and provide a long-term comparable analysis.

8.3.3.2.1 Destination-Level Indicators and CBVA

Table 27 presents four destination-community indicators for which the CBVA approach could augment or collect data in a descriptive and disaggregated form, which community organizations noted would be helpful in their local planning adaptation efforts. All of the indicators pertain to exposure, in particular perceived experience with extreme climate events and any noted changes in biodiversity. In particular, quantitative information could be further augmented for one of the applicable indicators pertaining to biodiversity [#9], by collecting descriptive qualitative data. Data could also be collected solely by via the CBVA approach for the remaining three exposure indicators [#1,2,10], for which no destination level information exists. Any data collected would not be portrayed in indicator form, but considered contextually in community-based surveys. Any limitations pertaining to the CBVA approach would need to be considered, including representation of determinants at a particular point in time (Ford et al., 2012). The remaining non-applicable indicators were not found feasible to collect qualitative data for at the tourism destination scale.

Table 27. Destination-Community Level Indicators that CBVA could Augment or Capture

Indicator	Data being currently collected at the Tourism destination community scale via Indicators?	If not currently collected, future applicability, data type and possible organization(s) to collect
EXPOSURE: Change in the suitability of the climate for the tourism destination		
1. *Frequency* of extreme climate events in the past 30 years (# of tropical storms that develop into Category 1 hurricanes) **[#1]**	• Not applicable at the destination community scale.	• Could extract GCM data for Barbados. • Could collect via CBVA approach.
2. Intensity of the worst extreme event in the past 30 years (# of homes severely destroyed by a Category 1 hurricane) **[#2]**	• Not applicable at the destination community scale.	• Could extract GCM data for Barbados. • Could collect via CBVA approach.
3. *Biodiversity:* Change in mean reef fish harvest in the past 30-years: In-shore reef and off-shore reef (slope) fisheries. [Most socially and economically valuable species for tourism] **[#9]**	• Not currently collected at the destination scale, though could be. Data has been collected, though not analyzed systematically.	• Fisheries Div could collect mean size, mean weight, catch/ trip, as only need a few boats to examine changes in catch/ per unit of effort. Could define it to the Oistins area. • Could rely on local fisher knowledge for changes in catch and movement via CBVA. [Could also serve as a CBVA Monitoring tool as noted in Table 25.
4. *Biodiversity:* Change in mean fish pelagic harvest in the past 30-years. [Most socially and economically valuable species for tourism] **[#10]**	• Not feasible to collect or examine at the destination community scale. Shared stock and resource assessment for migratory large pelagic and flying fish occurs on a regional or international basis.	• Fisheries Division has trends for pelagic. May have extracted national-level data for dolphin. Analysis would not be at destination level, but could extract. • Could rely on local fisher knowledge for changes in catch or movement via CBVA.

8.3.3.2.2 Household Level Indicators and CBVA

As noted in chapter 6 (Table 16), stakeholders developed and selected 26 indicators as possibly implementable and operationally feasible to apply at the household level, with 11 being collected by various organizations. Out of the 15 indicators that data was not found feasible to collect systematically at the household level, but still deemed relevant by some community stakeholders, Table 28 presents 10 that could be collected qualitatively via the CBVA approach. These include four indicators for exposure [#1,2,3,4], three for sensitivity [#5,11,13] and three for adaptive capacity [#18,24,26]. Only one of the exposure indicators relates specifically to tourism [#4]. The exposure indicators pertain to perceived experience with extreme climate events, changes in weather and any resultant injuries or impacts to tourism-related livelihoods. The sensitivity indicators pertain to perceived risk from hazards and any noted food or water shortages. The adaptive capacity indicators pertain to perceived improvements in management of climate-related events, availability of insurance and actions taken to address climate-related events. As noted earlier, it is important to remain cogniscent that perceived impacts do not always translate into real impacts (Parkins & MacKendrick, 2007).

Similarly to the destination level indicators, the purpose would be to capture the household determinants in a descriptive and disaggregated form, which some organizations noted would be helpful in their local adaptation planning efforts. Any data collected would not be portrayed in indicator form, but considered contextually in community-based surveys. As further detailed in section 8.4, stakeholders would need to consider whether to collect such household information within the scope of defined neighbourhoods or at the site of tourism-related employment with the CBVA approach. Chapter 6 (Table 16) provided further details as to the utility of collecting the information and possible organizations that could collect it.

Stakeholders did have some contradictory opinions as to the relevance of the noted indicators:

- *Indicators #2,3,11* – the local District Emergency Office did not find relevant as they questioned how accurate would any projections be due to recall bias and the consideration of other stressors. Furthermore, even if the information was collected, who would use it and how? Other key informants, including the Constituency Council, thought the information was relevant.
- *Indicators #1, 4, 18, 26* – Other key informants thought the information might be useful to collect via international projects (i.e. a study to see which destinations would benefit from adaptation planning].
- *Indicators #5, 13, 24* – the local District Emergency Office and Constituency Council found relevant.

Table 28. Non-Applicable Household-Level Indicators that CBVA could Capture

Indicator
EXPOSURE of the Household to Climate-Related Events: Tropical Systems
1. Average number of tropical systems, including hurricanes OR periods of drought in the past 10 years, leading to physical impacts on the households **[#1].**
2. % of Households that note long-term changes in air-temperature and precipitation in the past 10 years **[#2].**
3. % of Households with an injury as a result of the most extreme climate-related event in the past 10 years [**#3**].
4. % of Households that experienced climate-related impacts to tourism-related livelihood [**#4**].
SENSITIVITY – Current health, food and water characteristics that determine household sensitivity
5. % of households with perceived risk from a particular hazard **[#5].**
6. % of households that do not have adequate food throughout the year **[#11].**
7. % of households reporting water conflicts **[#13]**
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources that determine a household's capacity to adapt

Indicator
8. % of HHs that thinks management of climate-related events could be improved in their neighbourhood **[#18].**
9. % of households that have a variety of insurance [i.e. health, house (strong winds, flooding, high waves and fire), private, national insurance/ government pension] [**#24**]
10. % of households taking more than one action (change to livelihood activities) in response to a climate-related event [**#26**].

8.3.3.3 Summary

The particular approach to assess the vulnerability of a tourism destination community should be based upon the particular needs of the study: whether a '*rapid assessment'* is required for the community, with a clearly defined boundary, or a disaggregated and descriptive assessment. As noted earlier, the indicator and CBVA approaches were found to be limited in advancing the understanding of tourism climate change vulnerability at the destination scale, though methodological value could be obtained if the two approaches were used in combination at a broader community-scale. This could involve undertaking a detailed Community-Based Vulnerability Assessment in a particular community and then applying the indicators, presented in Table 25 and Table 26, to monitor certain processes and contexts of its baseline vulnerability. One would only be able to integrate the indicator and the CBVA approaches at the destination community scale within common spatial and temporal boundaries.

8.4 Household Vulnerability and Tourism Destination Communities

Whether or not a person can adapt at the household level, depends on their knowledge base, "…*which may enable them to anticipate change and identify new or modified livelihood opportunities; and their access to further resources required to achieve this*", p. 12 (Vincent, 2007b). Collecting data on household level vulnerability provided insight on the socio-economic determinants of the two neighbourhoods, how they are associated with vulnerability and whether it allowed for the identification of vulnerable stakeholders within the tourism destination community. As noted earlier, only a few indicators pertained specifically to tourism-related livelihood issues.

8.4.1 Livelihoods Connections of the Neighbouring Households to the Tourism Destination

This research found that the residents engaged in tourism-related employment in the two neighbourhoods adjacent to the Bay Garden Vendors Area and the Oistins Fish Market did not all work in the tourism facilities of Oistins and that the persons working in the destination's tourism facilities did not all live in Oistins. As detailed in chapter 6 (section 6.3.4), almost half (41%) of the households surveyed had household heads and/or other household members engaged in tourism-related livelihoods. The majority of employment pertained to workers in small, medium or large enterprises in the accommodation, food and fishing industries. A few members were also engaged as tour operators, property developers and in transportation. People, who lived in the two neighbourhoods, were found to have been living in the area for a long time (i.e. elders or families with property there). Moreover, out of these households engaged in tourism-related livelihoods, 40% had members who travelled to another community outside of Oistins for work. In addition, many people who worked in Oistins live in the surrounding communities (i.e. Silver Sands). In the past, the livelihoods of Oistins might have been more closely linked to neighbouring households, but now Barbadians are more transient for work (Leslie, 2010). The percentage of Oistins' residents working in the tourism industry outside their communities might contrast to other Caribbean islands, which are less densely populated and have more distinct communities, and tourism-related livelihoods thereby more connected to the neighbouring community (i.e. Jamaica or St Lucia).

As detailed in chapter 3, in the focus group to develop the household-level indicators, participants were asked about the different approaches to carrying out household surveys: should surveyors execute the surveys directly in the neighbourhood(s) in proximity to the tourism destination community, even though residents might not work in the neighbouring destination or with people directly at their site of livelihood in the destination community? Stakeholders stated that this depends on what type of information is being collected. As one of the goals of this research is to examine the viability of developing indicators for tourism destination communities and households, the Researcher chose the former approach, based on examples presented in the literature pertaining to the development of household level indicators, where data is collected in distinct neighbourhoods. It should be noted that none of those studies had a tourism focus, as none were available at the time of research design. Furthermore, the academic surveys examined to develop household level indicators were carried out in small rural communities (Hahn et al., 2009; Vincent, 2007b), while tourism-destinations can also exist in larger urban or peri-urban areas.

Nevertheless, by surveying the neighbourhoods in proximity to the tourism destination community, the Researcher was able to consider additional socio-economic determinants influencing vulnerability, such as the conditions of the homes. The approach also presented a defined boundary in which to examine how systematically information is collected for the development and application of indicators. If researchers wanted to ensure that they would obtain household level information from people directly employed by the tourism industry, then interviewing stakeholders at their place of work would have been more appropriate, like that undertaken by the CBVA method. These insights point to a future research direction (as noted in chapter 9, section 9.4), that is whether neighbourhoods within or in proximity to a tourism destination community, should be considered part of the destination community.

Furthermore, three household level indicators in chapter 6 (section 6.3.4, Table 18) provided some insight regarding pre-storm and post-storm experience (Tropical Storm Tomas) and whether households and their livelihoods were impacted by climate-related events. Sixty-eight percent of respondents were interviewed shortly after the storm hit the island, yet two indicators received higher responses for the average number of extreme-events (72%) [*Indicator #1*] and percent of households experiencing climate-related impacts to their livelihoods (80%) [*Indicator #4*]. One cannot infer significant insight from the two indicators, as the sample size is not significant, though can obtain insight regarding the recall biases, that the most severe and more recent events are most likely to be remembered (Hahn et al., 2009).

8.4.2 The Use of Household Data Collected and the Appropriate Scale of its Analysis

As noted in chapter 6 (section 6.3.3), the Barbados Statistical Department collects and examines a fair amount of household level data at the parish and national level. Much of this information is used to generate national statistics, for instance the percentage of individuals employed in the tourism sector (chapter 6 (Table 16), Indicator #16). This information could be '*downscaled'* to the community level, if stakeholders found it to be relevant and wanted to make comparisons amongst destination communities (to be further discussed in the next section). Furthermore, some of the household information is collected less systematically and examined by the local Police and District Emergency Office (i.e. Table 16, *Indicator #10* (households with chronic illnesses) and *Indicator #22* (range and scope of social contacts). Stakeholders discussed having the Police and DEO share their descriptive information with the Department of Statistics, but if so, data would have to be collected more rigorously and systematically. Other stakeholders did not find it relevant to examine such information at the national level, because it is considered more useful in a disaggregated and descriptive form. This leads to the conclusion that it depends upon the type of information being examined and for what purpose.

Stakeholders concluded that vulnerable people should be continued to be identified at the destination community level for emergency planning and adaptation efforts, via disaggregated household data (i.e. % of households headed by seniors, who live alone). General at risk groups should be identified nationally, through the collection of census household data (i.e. % of households headed solely by women). This latter finding and efforts to undertake emergency management planning could suggest that stakeholders' sense of vulnerability and adaptive capacity could be less tied to livelihood and more to governance issues and the role of institutions in fostering social capital formation.

8.5 Defining a Tourism Destination

Defining a tourism destination can be challenging as it can refer to a range of spatial scales and operations within the sector, including countries, provinces, municipalities and other administrative or imagined spatial units, tourist resorts or single tourist products (Saarinen, 2004). In this research, focus group stakeholders were asked whether it was useful to define Oistins, or part of it, as a tourism destination community (via a boundary). As noted in chapters 3 and 4, key informants recognized that Oistins presents a unique tourism destination community to examine livelihood issues through small-scale tourism activities. As noted in section 8.3.1, after engaging in the indicator development and application exercise, stakeholders concluded that even if one was able to establish a specific boundary around the destination community, it was not feasible to apply several of the destination-community indicators at such a small scale.

Moreover, when asked about the utility of defining several communities and their accompanying neighbourhoods in Barbados as tourism destination communities, some stakeholders thought that it would be more useful to undertake a community definition, which includes a tourism destination, versus a distinct destination community. The second definition might result in competition with other communities in the island who also want to promote tourism and might feel that a tourism designation indicates that a particular area is better than theirs. This definition could also cause challenges from a political standpoint, especially if one indicates that a destination community is more vulnerable than another to climate-related events. Furthermore, this latter point presents a barrier for climate change adaptation in the tourism sector, in particular the sector's sensitivity to imagery and in acknowledging any climate change risks (Calgaro, Lloyd et al., 2014; Scott et al., 2009; Scott et al., 2012). If stakeholders were reminded that one of the purposes of identifying vulnerability can be to facilitate the targeting of adaptation initiatives, their perspective might have changed. To avoid such conflicts, certain stakeholders concluded that for a small island the size and density of Barbados, it would be more useful to define the tourism destination nationally, realizing that such an approach would not allow for the examination of processes and contexts influencing adaptation of the sector at a community level. For this, contradictory perspectives on the importance of and continued reliance on the tourism sector would also need to be addressed (chapter 6 (section 6.4.2)) and whether the island should diversity beyond tourism. A national definition would also enable the identification of non-material and intangible attributes of adaptive capacity, such as 'sense of place', attachment or identity (Lewicka, 2011; Marshall & Stokes, 2014), which this research did not find exclusive to Oistins, but more nationally, especially through the comment '*God is Bajan'* and that everything will be ok.

8.6 Summary and Conclusion

The majority of climate change impacts posed to Barbados' tourism sector are out of its control (e.g. increasing temperatures and sea-level rise) and if even if the island was to acknowledge all of the impacts, there is not much it can do locally or nationally to prevent them. Small islands, such as Barbados, therefore remain at the mercy of the international community in terms of concrete actions to reduce greenhouse emissions and receiving adaptation assistance for the tourism and other sectors. To advocate for action in these two climate change responses, Barbados should continue to work collaboratively with other islands, through organizations such as the Alliance of Small Island States. At a local scale, continued efforts should be made to enhance the adaptive capacity of tourism stakeholders to current and future climatic stressors, particularly those facing high exposure-sensitivity, including increasing their understanding of climate change and predicted impacts to the tourism sector and to their destination-community. At a national scale, the island should consider altering the composition and emphasis of its tourism product, while diversifying its economic activities as a whole. At any scale, it is important to consider differences in equity and power and thereby encourage appropriate 'buy-in' from affected parties.

In summary, by examining the results of this research, it is concluded that the indicator and CBVA methods provide different types of data in their portrayal of the vulnerability of the tourism destination community of Oistins. The development of destination community and household level indicators were not found to be relevant or feasible for a destination community such as Oistins. Even if certain indicators were found relevant to develop, the majority were not applicable at the destination community scale due to a lack of data. Household level indicators were found to be applicable at the household scale, though systematic data analysis was found to be more relevant and feasible at the parish or national level, including tourism-relevant data. The CBVA approach most comprehensively assessed the destination's vulnerability and provided value in highlighting 'nested vulnerabilities' between scales. The research also suggests that at a broader community scale, methodology can be advanced by utilizing the indicator and CBVA approaches in combination to offset limitations of the other. The following conclusion chapter presents the response to each research question, contribution and potential use of research finding and future research ideas.

Chapter 9
Conclusion

9.1 Introduction

This research set out to deepen the understanding of processes and contexts influencing climate change vulnerability at the tourism destination community scale in a small island developing state. The research had two goals, with the first examining the influence of climatic and non-climatic stressors on the pre-existing vulnerability of a destination community, including its local tourism stakeholders. The second goal employed two methods to assess vulnerability across and within the community and determine whether either or both can advance knowledge gaps in this understanding at the destination community scale. Through this process, the research contributed a theoretical understanding of tourism sector vulnerability in a small island developing state, empirical evidence on stressors affecting the island and destination-community and methodological approaches to assessing the vulnerability of a particular sector, geographic area and scale.

The following chapter concludes the research by highlighting how its findings responded to the research questions presented in the introductory chapter. It then presents the theoretical, empirical and methodological contributions of the research, including potential use of findings for each. Directions for further research are also recommended, emphasizing where there is need for additional knowledge to continue to contribute to adaptation efforts for tourism destination communities.

9.2 Responding to the Research Questions

The following section outlines how the results and discussion chapters responded to the research questions set forth in the introduction of this dissertation.

Goal # 1

9.2.1 Question 1: Distribution of Vulnerability between Destination and Household levels

How are climate change vulnerabilities differentially distributed within the destination community and household levels? Furthermore, what are the specific or unique vulnerabilities of tourism workers, vendors and small and medium enterprises?

The indicator and the CBVA approaches differed in their portrayal of differential vulnerabilities amongst stakeholders within the tourism destination community. The results of the destination community indicators did not point to any specific groups of stakeholders as being more vulnerable than another, but spoke to issues pertaining to the destination community as a whole. The household level indicators identified the types of tourism-related employment individuals within the neighbourhood participated in (i.e. in small, medium or large enterprises in the accommodation, food and fishing sectors), though did not provide much additional sector specific data. If this data was correlated with other household level determinants (i.e. gender of the household head, health, financial resources, housing materials and education levels), further insight could be made regarding the vulnerability of the tourism destination workers.

Moreover, the CBVA results provided the most detailed information regarding the differential vulnerability of tourism stakeholders, in particular workers most dependent on the tourism related activities of the destination. Individuals working within small to mid-scale tourism-related operations in Oistins faced the highest exposure-sensitivities and lowest adaptive capacities to climatic and non-climatic stressors and resultant impacts to their livelihoods. This included the Bay Garden Food and Craft Vendors, the fishers, operators of beach related activities and managers and staff of small restaurants and hotels.

Furthermore, this research did not find the relationship between vulnerability (exposure-sensitivity) and adaptive capacity to always be inverse, thereby supporting the findings of certain scholars (Gaillard, 2010; Handmer, 2003). For instance, the tourism destination community of Oistins faces high exposure to climate-related events, though also demonstrates a high adaptive capacity due to the existence of an Emergency Management Committee and the monitoring of its beaches. The destination-community also faces low adaptive capacity as emergency plans and risk maps within the community are not coordinated within the tourism sector or link to different scales.

9.2.2 Question 2: Connection of Household Vulnerability and Tourism Destination Communities

i) How connected are the livelihoods of the neighbouring households to the tourism destination community? What does this imply for the best method to collect data on household-level vulnerability for tourism destination communities?

This research found the livelihoods of almost half of the residents in the two neighbourhoods of the tourism destination connected to the tourism sector, though not all persons working within the sector worked within the tourism facilities of Oistins. As a result, it was confirmed that the best method to collect data on household vulnerability for destination communities depends on what type of information is being sought and for what purpose. Surveying household vulnerability in the neighbourhoods within the tourism destination provided a defined boundary in which to examine the systematic collection and application of any indicators. It also permitted the observation of certain socio-economic conditions influencing vulnerability, such as the conditions of the homes. Interviewing stakeholders at their place of work could ensure that household level information is obtained directly from individuals engaged by the tourism industry, though would not allow for the aggregation and long-term comparable analysis of the data.

ii) How should the household data collected in the destination community best be used? What is the appropriate scale of its analysis: household level, destination community level or both?

By undertaking the household indicator development and application exercise, stakeholders were able to examine relevant information being collected and discuss how to prioritize its collection and use by government authorities and others. In particular, stakeholders concluded that disaggregated household data (i.e. perceived experience with climate related events or % of households headed by seniors, who live alone) should continue to identify vulnerable people at the destination community level for emergency planning and adaptation efforts. Systematic household data should continue to be collected to identify general at risk groups and be analyzed at the parish and national level (i.e. % of households solely headed by women).

Goal # 2

9.2.3 Question 3: Viability of an Indicator Approach

How viable is the development and application of local level indicators to comparatively assess the vulnerability of tourism destination communities, including its households?

This research found that it was not viable to develop and apply local level indicators for a tourism destination community in a small island developing state, like Barbados, as data for the majority of conceptually relevant indicators was not able to be collected at this scale. As Barbados is considered 'data-rich' compared to many other SIDS, this finding can be extended to most other SIDS. Furthermore, any developed indicators were found challenging to apply, unless within a defined '*site-specific'* boundary like the Bay Garden Vendors Area or the Oistins fish-market. Even within such a defined boundary, the problem of data availability persisted for the majority of indicators at the destination community scale. Due to this limited application of indicators, only some of the processes and contexts influencing Oistins' vulnerability were able to be understood pertaining to the indirect biophysical impacts of climate change, the economic sensitivity of the tourism sector and political, financial and natural capital. At a broader community-scale, some value from the indicators could be obtained by utilizing them to monitor certain vulnerability determinants detailed with the CBVA approach (to be discussed in question #4, section 9.2.4).

Household level indicators were found easier to develop and apply through enumeration districts. Many indicators were being applied at the time of research, though they were not exclusively tourism specific. Furthermore, analysis of household data usually occurs at the parish or national level. It was not found worthwhile to examine tourism-related household data at the destination community scale, as not all residents in the neighbourhoods engaged in such livelihoods. Interviewing tourism stakeholders at their place of work would allow for the collection of sector-related household data, though this did not allow for the aggregation of data. Similar to the destination community indicators, some value from the household level indicators could be obtained by utilizing them to monitor certain vulnerability determinants (e.g. households that experienced climate-related impacts to tourism-related livelihoods) detailed with the CBVA approach at a broader community-scale.

9.2.4 Question 4: Strengths and Limitations of the Indicator and CBVA Approaches

What are the strengths and limitations of the Indicator and CBVA approaches in assessing vulnerability at the tourism destination community level?

General strengths noted with the applicable indicators in this research included their ability to provide specific information pertaining to the determinant of interest, their collection of longer-term and more systematic data, their ability to collect and analyze information within clear boundaries, their capability to function across sectors and their provision of different types of information. Limitations noted in their use were data availability, jurisdictional duplication and time consistency, contradictory indicator directions and differing stakeholder opinions. Strengths were also noted based on specific criteria to examine the approach's assessment of the destination-community's vulnerability. As only ten destination-community indicators were able to be applied, these strengths included being able to partially facilitate comparisons amongst destination communities and provide some insight into its influencing processes and contexts. The applicable indicators also enabled an understanding of nested vulnerability between local and national/ regional scales and could be used to screen adaptation measures for certain maladaptations. The approach was not found to consider the livelihoods of tourism workers or account for multiple stressors.

CBVA strengths noted in this research, based on specific criteria pertaining to its assessment of tourism destination-community vulnerability, included its ability to provide a more detailed understanding of influencing processes and contexts. It also enabled a more thorough consideration of the sustainable livelihoods assets and the livelihoods of tourism workers. The CBVA approach considered a broader definition of stressors and multiple drivers of vulnerability (i.e. climatic and non-climatic conditions). It allowed for the examination of tourism-related issues within a larger more fluid boundary, including a more comprehensive consideration of vulnerabilities at larger scales. The approach was also able to screen for certain maladaptations. Limitations noted with the approach included comparison of its findings across and beyond communities, due to its in-depth time and research requirements. Furthermore, the CBVA approach's responses were not always comprehensive or rigorous and focused primarily on a particular point in time, thus providing a baseline understanding of vulnerability.

i) Can the use of indicators overcome the scaling up and out limitations of the CBVA approach? More specifically, can some of the applicable indicators serve to monitor long-term the baseline vulnerability detailed with the CBVA approach?

To foster comparative research assessments across and beyond tourism-destination communities, this research considers focused adaptation research, which can include community-based monitoring and longitudinal studies. This research's findings advance methodology by recommending that indicators be utilized to overcome the scaling up and out limitations of the CBVA approach. It particular, it suggests that the CBVA approach be continued to be used to establish a baseline understanding of vulnerability and that any applicable indicators be used to monitor long-term progress on adaptation measures detailed with the approach. This would need to occur within the confines of a defined destination community or enumeration district. In the context of this research, the application of only certain destination-community indicators resulted in a partial portrayal of the processes and contexts influencing the community's vulnerability, in particular those pertaining to vulnerability reduction (e.g. beaches monitored on a regular basis) and incremental adaptation (e.g. existence of functioning Emergency Management Committee).

ii) For any indicators that are found relevant to develop, but challenging to apply at the tourism destination community-scale, can their determinants still be portrayed through the CBVA approach?

Data pertaining to some of the indicators that were found conceptually relevant, but not entirely applicable at the destination community or household-scale, could be augmented or collected qualitatively via a CBVA approach. The destination level indicators pertained to exposure and any perceived experiences with extreme climate events and any noted changes in biodiversity. The household level indicators pertained to perceived experience with extreme climate events, changes in weather and any resultant injuries or impacts to tourism-related livelihoods. Sensitivity indicators pertain to perceived hazard risk and any noted food or water shortages. Adaptive capacity indicators pertain to improvements in climate-related events management, availability of insurance, action taken to address climate-related events. Collecting information on these determinants was deemed useful by community level stakeholders (i.e. the DEO, Constituency Council and Police) for local adaptation planning purposes. Such information would remain descriptive and disaggregated and be considered contextually in community-based surveys.

9.3 Theoretical, Empirical and Methodological Contributions

The findings from this research provide the following theoretical, empirical and methodological contributions, which could inform theory, practice and policy decisions.

9.3.1 Theoretical Contributions

The conceptual framework developed in chapter 2 (Figure 2) proved useful in assessing the vulnerability of the tourism sector at several scales. In particular, the framework confirms the importance of understanding the impacts of multiple climatic and non-climatic stressors at the community, island and international scales, as depicted in chapter 8 (Figure 15). The framework thereby provides a contribution to the tourism and climate change literature, as it could be applied by other tourism dependent small island developing states to assess their sector vulnerability. A weakness of the framework, is that the placement of pathways or stressors is not always easy to categorize by scale, for instance as 'exogenous' or 'international'. More broadly, the portrayal of tourism destination vulnerabilities with multiple stressors and scales in Figure 15 also validates the use of an integrated approach to assess climate change vulnerability, as discussed in chapter 2 (section 2.2.3.3). This includes the consideration of a modified sustainable livelihoods approach.

9.3.2 Empirical Contributions

9.3.2.1 Relevance to other Tourism Destination Communities

This dissertation responds to the first research goal by concluding that Oistins' tourism stakeholders were exposed to minor and local level impacts of climatic stressors, though non-climatic stressors were currently causing more far adverse impacts to the sector, which is likely the case for other destination communities in the Caribbean and worldwide. The impacts of climatic stressors might become more prominent in the future, when impacts are predicted to increase. Furthermore, this research advances the understanding of tourism and climate change vulnerability at the tourism-destination community scale and what scale might be best to examine sector adaptation options in small islands like Barbados. Many significant vulnerabilities identified by local and national stakeholders occurred above the destination community scale (e.g. sea-level rise and impact of mitigation policies). Some stakeholders could adapt to future climatic changes at the local level (e.g. energy conservation), though the national government will also have to play a role (e.g. diversifying the economy beyond tourism). As tourism-related climate change vulnerabilities were not well understood at the destination community, local stakeholder driven anticipatory adaptation remains questionable, thereby demonstrating that sectoral and community-level adaptations are not always consistent. In the case of SIDS, this finding suggests that it is more useful to consider tourism-related adaptations at the national scale and obtain broader adaptation information at the community scale.

9.3.2.2 Relevance in Oistins, Barbados and the Caribbean

This research's findings are of policy relevance to stakeholders consulted in Oistins, Barbados and throughout the Caribbean. In Oistins, this research found that current climate variability or extremes is largely irrelevant in the destination-community, especially relative to non-climatic stressors, and in particular the global economic crisis. Furthermore, the minor and local level climatic changes experienced to date have not resulted in any significant impacts to the tourism sector in Oistins or in Barbados. In regards to future-exposure sensitivities, stakeholders who identified climate change as a future threat were focused on near-term or minor weather changes, not its more significant or severe impacts of sea-level rise or storm damage. The manner in which stakeholders are coping with present climatic and non-climatic stressors and plan to adapt to future changes provides some insight in how they could adapt to further minor changes in weather. How local stakeholders could adapt to the future impacts of significant or more extreme climate-change needs to be further investigated. For these reasons, continued efforts should be made to enhance the adaptive capacity of stakeholders to current and future stressors, particularly those facing high exposure-sensitivity within the destination community, including increasing their understanding of climate change and its possible impacts to the tourism sector and to their destination-community.

Nationally, moderate tourism growth is predicted for the Caribbean sector in the next 15 years, which even then will lead to tourism arrivals doubling for Barbados by mid-century. Such projections will necessitate Barbados to more immediately address issues of sustainability pertaining to natural resources (i.e. water) and adequate accommodation for tourists, coupled with more significant climate change impacts mid to late century (i.e. SLR and acute water shortages). These mid to latter century impacts could further impact upon Barbados' key assets, such as beaches and infrastructure (i.e. accommodations) and decrease demand and capacity to house tourists. These insights provide Barbados time to transformatively adapt its tourism product, while also diversifying its economic activities as a whole (e.g. increased export of financial services). Transformatively adapting the island's tourism industry could involve catering to fewer tourists by continuing to develop its luxury brand on a protected west coast and maintaining Oistins as an example of cultural tourism on an increasingly degraded south coast. It could also involve the island more seriously addressing the carbon intensity of any tourism policy, in particular reducing aviation emissions by *'demarketing'* itself from European and Asian source-markets to closer source markets in the Americas. To facilitate this, Barbados should develop a climate change adaptation plan for its tourism sector. Barbados should also continue to work with other islands to advocate for increased mitigation efforts and adaptation funding.

9.3.2.3 Inform Vulnerability Reduction and Strengthen Adaptive Capacity of Oistins

The results of this research can inform the planning and implementation of appropriate adaptation measures by key tourism stakeholders in Oistins and within the community as a whole. The following are some of the recommendations that came forth from the indicator and CBVA approaches to adapt and strengthen the adaptive capacity of the community of Oistins, including its tourism destination.

From the Destination Community Indicator and the CBVA approaches:

- Government or non-government organizations could work with the local District Emergency Office to develop a coordinated Climate Change Adaptation Plan amongst the various tourism stakeholders of Oistins. Such plans should also be integrated with national level plans, as recommended by CDEMA (2013c).
- If additional tourism sector vulnerability assessments are required, within Oistins or beyond, parties could work with the Guides and Frameworks developed by the Caribbean Disaster Emergency Management Association to undertake assessments at the community and tourist site levels, acknowledging any limitations in their methodology.

From the CBVA approach:

- Community stakeholders, under the guise of the District Emergency Organization or the Constituency Council, could coordinate themselves and submit a proposal to a non-government organization or a donor agency (i.e. Inter-American Development Bank) to further build their capacity to address climate change and its potential impacts.
- The District Emergency Office should continue its '*Community Profile*' of Oistins, and any other similar communities in Barbados, to identify broader community vulnerabilities. This includes identifying perceived risks, vulnerable infrastructure, resource access and tourism facilities, in particular those not formally registered with the Barbados Hotel and Tourism Authority.
- Improved infrastructure should be provided for the most exposed tourism stakeholders in Oistins to shield them against minor weather-related events (i.e. rain protection for the craft vendors and

some operators of beach-related activities). These measures would not be costly and would not provide protection against long-term or more extreme climate-related events.

- Greater clarity should be provided on the meaning of the swimming flags and the enforcement of '*red'* flags indicating rough waters due to strong winds, even though to date swimming in such waters has not deterred tourists. This means clarifying whether lifeguards should enforce the no swimming under '*red-flags'* in rough waters or change warnings (i.e. swim under your own risk). This point might become more of an issue if wind speeds were to increase and cause higher swells (waves), though under such long-term scenarios tourism demand might decrease.
- For the purposes of future adaptation planning, tourism-destinations such as Oistins could work within a '*tourism cluster'* concept to assess vulnerability. CDEMA (2013c) notes that "*The concept of tourism clusters is relatively new to the Caribbean and has not yet attained wide application. The potential usefulness of tourism clusters for DRM and Climate Change Adaptation may have not been fully explored and studied. Propagation of the concept will require concerted measures in a variety of areas such as research, awareness, policy and planning*", p. 36.

9.3.2.4 Tourism Industry of Barbados

The tourism industry of Barbados can benefit from this research, as it identifies gaps pertaining to the understanding of sector climate change vulnerability at the community, national and regional levels. The findings also highlight areas in which the island's sector can build its adaptive capacity and adapt to future climate change impacts. Such insights thereby can assist the island's tourism stakeholders to strengthen its climate change adaptation efforts in an informed and proactive manner.

9.3.3 Methodological Contributions

In regards to the second goal of this research, it is determined that the indicator and the CBVA approaches did not bring forth much novel information and were thereby limited in advancing the understanding of climate change tourism vulnerability of the study area. Of the two approaches, the CBVA provided a more in-depth climate change vulnerability assessment, as it was able to identify stakeholders at risk and distinguish relative vulnerability and provided some value in community-based adaptation. For the tourism sector, the CBVA approach highlighted that most vulnerabilities identified by stakeholders occurred above the destination community scale.

At a broader community-scale, both methods can work in combination, addressing certain limitations of each. In particular, this research's findings recommend advancing methodology by continuing to use the CBVA approach to establish a baseline understanding of vulnerability and utilizing indicators to overcome it's scaling up and out limitations. This would involve identifying those applicable indicators which could monitor long-term progress on adaptation measures detailed with the CBVA approach. Data pertaining to some of the indicators that were found conceptually relevant, but not fully applicable at the destination community or household-scale, could also be augmented or collected qualitatively via a CBVA approach, to assist with local adaptation planning efforts.

9.3.3.1 Relevance to other Tourism Destination Communities

Policy makers, adaptation practitioners, tourism organizations and other tourism destination communities, including the variety of stakeholders consulted in this research, could obtain insight from this research. In particular, its results inform methodologies for future vulnerability assessments of destination communities and thereby inform adaptation planning. In particular insight can be gained regarding:

- The results from the indicator development exercise, which conclude that indicators are not relevant or feasible to develop and apply at the tourism destination community scale, in particular for small dense islands like Barbados. For such islands, tourism indicators would be better developed and applied at the national level. For the tourism-sector as a whole, destination community indicators would be more useful in a more distinct destination-community, in a less dense island, or a larger island.
- The strengthened use of a CBVA by adaptation practitioners, tourism and community organizations, at a broader community- scale, with certain indicators to facilitate long-term baseline monitoring.

9.3.3.2 Stakeholders Consulted in Research

The following findings could be of use to various stakeholders consulted through the course of this research, including community and national-level stakeholders.

General Identification of Indicators

Through the destination community indicator development exercise, stakeholders engaged in a useful discussion as to the utility of defining destinations at the community scale and if so, which indicators were the most relevant and feasible to collect data for. This latter point, including a discussion of data availability and sources for feasible indicators, led to recognition of which parties collected information at the time of research, where there was any overlap and how information sources could be improved in the future. Similar value was obtained through the development of indicators at the household level, as their development generated discussion amongst stakeholders as to their various roles in data collection, where overlap occurs and how they could coordinate amongst themselves in the future. This included local parties improving their collection of local data regarding '*vulnerable peoples'* and obtaining greater clarity on the definition of the household head. Furthermore, through the development of household level indicators, stakeholders were able to prioritize data collection at various scales and its use by government authorities and others.

Household Level Indicators Development:

- Focus group participants were not able to provide a clear definition of the appointed household head. They suggested that for future surveys, specific categories to define the household head should be developed for surveyors, by community leaders and decision makers, to bring more clarity to the respondents.
- The NAB '*vulnerable persons*' definition should also include single parent led families, which are predominantly women, with high dependency ratios and no defined support.

Building Capacity:

Finally, even though not all of the indicators were found relevant or feasible to apply, the indicator development exercise proved useful in generating discussion on the utility of identifying tourism destination communities and assessing their climate change vulnerability. This suggests that participatory methodologies can have a positive impact on adaptive capacity, not because of the data collected, but because of the additional social and cultural capital generated through the exercise itself.

9.4 Future Research Directions

The following topics could be considered as future research directions to further contribute to adaptation efforts for tourism destination communities.

1. Further examination of tourism specific scale issues for small islands. As most vulnerabilities for the sector occurred above the destination community scale, this points to the question as to what is the most approriate scale to examine adaptation for tourism and for tourism communities.
2. Further investigation as to how local level indicators can be developed to support the long-term baseline monitoring of vulnerability detailed with a CBVA approach. Additional indicators could be extracted from CBVA results and compared to any new indicators developed in the literature at the community level and/ or tourism sector.
3. Further understanding of the development of tourism destination community indicators in larger more distinct communities or nation-wide for SIDS.
4. Further investigation of whether neighbourhoods in proximity to a tourism destination community should be continued to be considered as part of the destination community.
5. Further investigation of how to increase local stakeholders' understanding of future impacts of more significant or extreme climate change in a sensitive manner, so they could more comprehensively consider adaptation options.
6. Further understanding of climate change risks and vulnerabilities to the tourism sector and how they interact with each other and non-climatic drivers.

9.5 Summary and Conclusion

This research has investigated the multiple stressors influencing climate change vulnerability at the tourism destination community scale in a small island developing state. It has also examined the application of two methods and examined whether either could further knowledge gaps in the understanding of vulnerability of a tourism destination community. The research's findings contribute to further theoretical, empirical and methodological knowledge on the vulnerabilities facing destination communities in small islands and how to plan for adaptation in the tourism sector, particularly for communities in developing countries and tourism regions considered most vulnerable. Furthermore, although the findings suggest certain adaptation strategies to address stressors from current and future events, it should be noted that the processes influencing a community's vulnerability are highly dependent upon local contexts. In summary, this research has contributed to further understanding of vulnerability processes in small island tourism dependent communities, which can inform more effective sectoral and community-based adaptation initiatives and thereby reduce the impacts of climate change.

Appendix A Supplementary Material

Table 29. Quantitative vs. Qualitative Indicators in the Tourism Context

Quantitative **- where comparable numbers can be obtained over time (numerical/ empirical)**	***Qualitative*** **- demonstrate normative or descriptive parameters**
Raw data (e.g. number of tourists visiting a site/year).	**Category indices** - describe a state or level of attainment on a graded list (e.g. level of protection of natural areas).
Ratios, where one data set is related to another showing a relationship (e.g. ratio of the number of tourists to local residents in high season).	**Normative indicators** - related to existence of certain elements of tourism management and operation (e.g. existence of tourism development plan).
Percentage, where data is related to a total, a benchmark or an earlier measure (e.g.% change in tourist arrivals).	**Nominal indicators** which are in essence labels (e.g., Blue Flag certification, which is based on an independent checklist in beach management but that appears to users as a single Nominal Yes/No indicator).
	Opinion-based indicators (e.g. level of satisfaction of local residents relative to tourism or specific elements). Normally based on questionnaires and expressed numerically (quantification of qualitative data).

Adapted from: UNWTO (2004a), p12.

Figure 16. UNWTO Steps to Develop Indicators

Research and Organization

Step 1. Definition/delineation of the destination.
Step 2. Use of participatory processes.
Step 3. Identification of tourism assets and risks.
Step 4. Long-term vision for a destination.

Indicators Development

Step 5. Selection of priority issues.
Step 6. Identification of desired indicators.
Step 7. Inventory of data sources.
Step 8. Selection procedures.

Implementation

Step 9. Evaluation of feasibility/implementation.
Step 10. Data collection and analysis.
Step 11. Accountability, communication and reporting.
Step 12. Monitoring and evaluation of indicators application.

Source: UNWTO (2004a)

Table 30. Climate Data for Barbados from 2000 to 2012

Years	Av. monthly mean min temp (°C)	Av. monthly mean max temp (°C)	Av. monthly rainfall (mm)	Av. monthly # of rain days	Av. monthly mean wind speed (kt)
2000	24.00	29.90	106.6	12.67	11.50
2001	24.30	30.10	101.5	10.33	11.83
2002	24.50	30.30	80.4	11.25	12.17
2003	24.40	30.60	229.0	10.33	11.83
2004	24.50	30.10	279.0	13.92	10.92
2005	24.90	30.70	284.0	12.50	10.83
2006	24.80	30.60	243.0	12.00	13.33
2007	24.80	30.31	252.0	11.75	13.41
2008	24.40	30.11	268.0	12.08	13.08
2009	24.80	30.30	233.0	11.58	**13.58**
2010	**25.31**	**30.89**	**300.0**	12.50	12.08
2011	24.20	30.22	284.0	**15.75**	10.83
2012	24.30	29.98	248.0	11.50	13.17
Average	Chapter 1024.55	Chapter 1130.32	Chapter 12223.73	Chapter 1312.17	Chapter 1412.20

Source: Barbados Meteorological Service (2014a; 2014b; 2014c)

Table 31. Envisioned Risk to the Surveyed Households in the next 10 years (2010-2020)

Q #44 – Risk in the next 10 years, in order of largest number chosen (Some identified more than one)	**% of Households**
i) Don't know	25.4% (18 HHs)
ii) Increase in weather variability and in climate-related events (i.e. impacts to house, beach)	**21.1% (15 HHs)**
iii) Nothing or Hope there won't be anything	18.3% (13 HHs)
iv) Illness (declining health, disability, death in the family)	15.5% (11 HHs)
v) Unemployment	12.7% (9 HHs)
vi) Decreased economic activity (recession)	**11.3% (8 HHs)**
vii) Increasing costs of living	**9.9% (7 HHs)**
viii) Crime	4.2% (3 HHs)
ix) Increase in non-climate related events (i.e. fire)	2.8% (2 HHs)
x) End of the world	2.8% (2 HHs)
xi) Might or will be dead	2.8% (2 HHs)

Appendix B

Destination Level Indicators

1. **Scoring Framework** (for destination and household level indicators) – *Sample used for Focus Group #3*

2. **Indicator Development Worksheet** (for destination and household level indicators)

3. **Table 32. Conceptually Relevant List of Tourism Destination Level Indicators (37 indicators)** – Rationale and relationship to vulnerability; limitations; suggested modifications and score from the focus groups and key informants; the resulting indicator and the unit of analysis.

4. **Table 33: Refined List (Possibly Implementable) of Destination Level Indicators (25 indicators)** - Data and type of information being collected; years; future applicability and responsible organization; relevance and comparability amongst tourism destinations; identified thresholds/ any results; and additional comments/ future suggestions.

B1. Scoring Framework to Develop Tourism Destination [and Household] level Indicators to Assess Climate Change Vulnerability

Name: ____

Organization Representing: ____

EXPOSURE - *Change in the suitability of the climate (frequency and intensity of climate-related events) for the tourism destination*							
Indicator	**Evaluation Criteria: *Low =1, Medium = 2, High = 3***					**Ind total out of 15**	**Group total**
	Relevance Does it respond to a '*change in the suitability of the climate*' and provide information that will aid in its management[56]?	**Feasibility** Is it *useful*, *practical* and *affordable* to collect and analyze the data at the Destination Level?	**Credibility** Is it *currently* supported by valid and reliable information from credible sources (*or could be*)?	**Clarity** Is it easy to understand and clear to users?	**Comparison** Is it useful for comparisons over time and across destinations?		
Indicators # 1 – 11 presented (see Table 13), with blank rows to add additional indicators							
SENSITIVITY – *Characteristics of the tourism destination which affect its susceptibility to climate related-hazards*							
Indicators # 12 – 20 presented (see Table 13), with blank rows to add additional indicators							
ADAPTIVE CAPACITY - *Social and economic characteristics of the tourism destination, which affect its ability to adapt to climate-related events*							
Indicators # 21 – 37 presented (see Table 13), with blank rows to add additional indicators							

[56] That is make a difference to a decision affecting the exposure of the destination.

B2. WORKSHEET TO DEVELOP & IMPLEMENT TOURISM DESTINATION [AND HOUSEHOLD] LEVEL INDICATORS

For the **top three indicators** chosen for *exposure*, *sensitivity* and *adaptive capacity*, please provide further insight on their development and possible application (implementation).

1. **Indicator (including units)**

____

____

2. **Relevance:** a) To whom is it relevant and b) how will it be used?

____

____

3. Feasibility (Availability)

a) Is it currently available at the destination level? ____
b) If so, in what form?
____
____

c) If not, what data would need to be collected? *(Is it currently being collected, will it have to be extracted from one or more source, or will it have to be collected newly, through monitoring, questionnaires etc.?)*

____

____

d) Who should cover the cost and technical needs of data collection and analysis?

____

e) How often would the information need to be collected?

____

4. Comparability
a) Is the indicator in use in this form in other destinations and/or are there standards of comparison to which it can be related?

Table 32. Conceptually Relevant List of Tourism Destination Community Indicators

Chapter 3, Table 5 provides more details on the '*scoring framework*', where each of the indicators were scored from 1-3 for five components (relevance, feasibility, credibility, clarity and comparison) for a maximum total of 15.

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups *(Relevance, Feasibility, Credibility, Clarity and Comparison)*							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
EXPOSURE: Change in the suitability of the climate for the tourism destination [11 Indicators]														
Direct Impacts Increase in *extreme climate-related events* relevant to the tourism industry (i.e. hurricanes or drought), which can lead to intense rainfall, floods, storm surges and/or landslides.	**1. Frequency of hazard events in the past 30 years (ex. change in max 5-day precipitation total)**	• Merge of tourism (Simpson & Ladle, 2007; UNWTO, 2004a), community (Bollin & Hidajit, 2006) and national (Perch-Nielsen, 2010) level indicators. • For #1 and #2, Perch-Nielsen (2010) suggested precipitation as a proxy for extreme events and chose flood indicators. • UNWTO (2004a) define extreme events as hurricanes, cyclones, flooding, drought and temperature extremes. Frequency and damage measure impact and show trends important to industry and destination. It is possible to compare with weather data worldwide, though most meaningful information is that of changes over time in the destination. • The higher the frequency of events, the higher the exposure. Past events can be used as proxy for future extremes.	• Need to distinguish different categories of extreme events, as some islands experience Category 1 hurricanes more than others. • For small islands, most modeling occurs at the regional levels. The topography of small land masses, like Barbados, causes too much variation. Community-level data is too disaggregated, complex, uncertain and has too much variation (Academic #4).	• ***Frequency*** of storms/ hurricanes is easier to categorize as extreme events. Flooding is a consequence (FG2, Academic #4).	FG1	3	3	3	3	3	15	• ***Frequency* of extreme climate-related events in the past 30 years** (i.e. # of tropical storms that develop into Category 1 hurricanes) [FG2].	• Ex. Number	• Perch-Nielsen (2010) retrieved data from GCMs for two 30 year periods (1961-1990 & 2041-2070).
					FG2	3	1	3	3	3	13			
					FG3	1	2	3	?	2	8			
					FG4						ds[57]			
	2. Intensity of the worst hazard event in the past 30 years (Ex. absolute change in fraction of total precipitation due to events exceeding the 95th percentile of the climatological distribution for wet days)			• ***Not*** many places measure intensity, they measure rainfall (Academic #4).	FG1	2	3	3	3	3	14	• ***Intensity* of the worst extreme climate-related event in the past 30 years** (i.e. # of homes severely destroyed by a Category 1 hurricane) [FG2].	• Ex: Number	• Perch-Nielsen (2010) retrieved data from GCMs for two 30 year periods (1961-1990 & 2041-2070).
					FG2	3	1	3	3	3	13			
					FG3	1	2	3	?	2	8			
					FG4						ds			
	3. *Probability* of possible hazard events (chances/ year)				FG1	3	3	2	3	2	13	• ***Probability of extreme future*** climate-related events (chances/ year) – (# of tropical storms that develop into Category 1 hurricanes) [FG2].	• Ex. Number	• Modeling of data 30-years into the future.
					FG2	3	1	3	3	3	13			
					FG3	3	3	3	0	3	12			
					FG4						ds			
	4. *Expected intensity* of possible hazard events.				FG1	3	2	2	3	2	12	• ***Expected intensity of extreme future*** climate-related events - (# of homes severely destroyed by a Category 1 hurricane) [FG2].	• Depends	• Modeling of data 30-years into the future.
					FG2	3	1	3	3	3	13			
					FG3	3	3	0	0	3	9			
					FG4						ds			
Direct Impacts *Long-term changes* in air temperature and precipitation.	**5. Mean standard deviation of the daily average maximum temperature by month**	• District (regional)-level indicators (Hahn et al., 2009). The greater the change from the average (likely higher), the higher the exposure.	• Reliance on short time period [4-year period]. • For small islands, analysis of trends occurs mostly at the regional levels. Data could be collected at destination level.		FG1	2	3	3	3	2	13		• °C (or % change)	• Hahn et al. (2009) present average data spanning four years from National Stats Dept.
					FG2	3	2	3	3	3	14			
					FG3	3	3	3	3	3	15			
					FG4						ds			
	6. Mean standard deviation of the daily average minimum temperature by month				FG1	2	3	3	3	2	13		• mm (or % change)	
					FG2	3	2	3	3	3	14			
					FG3	2	3	3	3	2	13			
					FG4						ds			
	7. Mean standard deviation of average precipitation by month	• District (regional)-level indicators (Hahn et al., 2009). The greater the change from the average (could be higher, could be lower), the higher the exposure.			FG1	2	3	3	3	3	14		• mm (or % change)	
					FG2	3	2	3	3	3	14			
					FG3	3	3	3	3	3	15			
					FG4						ds			

[57] Ds = did not score as had already ascertained that data would not be available at the tourism destination scale.

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups *(Relevance, Feasibility, Credibility, Clarity and Comparison)*							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
	8. **Mean climate: suitability of the climate for the type of tourism present** (Ex: Change in modified Tourism Climate Index)	• TCI considered more accurate than use of temperature alone (Perch-Nielsen, 2010). • ↑ TCI shows increased vulnerability [50-59: '*acceptable*', 80-89: '*excellent,* 90-100: '*ideal*'].	• TCI based on expert judgement and not empirically verified (Perch-Nielsen, 2010); Tourist climate preferences inconsistent over residence zones, resort conditions or comfort perceptions (Rutty & Scott, 2013; Rutty & Scott, 2014a; Rutty & Scott, 2014b).		FG1	3	3	3	3	3	15		• Ex: -20 to 100	• Perch-Nielsen (2010) retrieved data from GCMs for two 30 year periods (1970-1999 & 2041-2070).
					FG2	3	1	1	1	3	9			
Indirect Impacts Biodiversity loss - Strength of climate change that might affect flora and fauna.					FG3	3	3	0	0	3	9			
					FG4						ds			
	9. **Biodiversity [Most socially and economically valuable species for tourism]. Change in mean fish harvest in the past 30 years– *In shore and off-shore reef fisheries.***	• The greater the change from the mean (higher or lower), the higher the exposure (Academic #1). • *Reef* fisheries are located closer to Oistins' coast and thus a good indicator.	• Hard to separate impacts to fisheries unique to water quality and temperature (Acad. #2). • Changes in mean could be due to other stressors (i.e. pollution, changes in fishing patterns and boat type) (Academics #1 & 2).		FG1	3	2	3	3	3	14	• After FG3, Academic #1 recommended two separate indicators, with one focusing on change in mean reef fish harvest - *in-shore* and *off-shore* reef fisheries.	• Ex: % Change in average yield?	• Data for the past 30 years and modeling 30 years into the future.
					FG2	3	3	3	3	3	15			
					FG3	3	3	2	?	2	10			
					FG4	3	3	3	3	3	15			
	10. **Biodiversity [Most socially and economically valuable species for tourism]. Change in mean fish harvest in the past 30 of years – *Pelagic species.***	• The greater the change from the mean (higher or lower), the higher the exposure (Academic #1). • *Pelagics* are the main resource of the fisheries industry and live near the water surface.	• *Same comments as Ind # 9.* • Pelagics are not distinct to a particular community and face a high degree of inter-annual and seasonal variation (McConney, Mahon, & Oxenford, 2003).	• This is new and recommended in FG #2.	FG1						n/a	• After FG3, Academic #1 recommended two separate indicators, with one focusing on change in mean fish pelagic harvest.	• What % change, scale?	• Data for the past 30 years and modeling 30 years into the future.
					FG2						n/a			
					FG3						n/a			
					FG4	3	3	3	3	3	15			
	11. **Changes in coastal ecosystems of the destination** (i.e. coral reef beds, sea-grass population and sea-eggs)	• Perch-Nielsen (2010) presented '*required adaptation of corals to increased thermal stress*'. • Local indicator of change specific to the destination, which would affect fisheries (i.e. coral bleaching). • Coral cover good measure of general reef health. • Need to determine which SIDS-specific coastal and marine characteristics are good indicators of climate change (McConney et al., 2009).	• Changes in coastal ecosystems could be affected by other stressors, such as storm run-off, accretion and/or over-fishing (GovtOrg#2, R1)].	• This is new and recommended by Academic #1, after FG3, in particular examining rates of accretion or erosion.	FG1						n/a	• Changes in coastal ecosystems of the destination (i.e. coral reef beds). • Decided to focus on coral reefs, as monitored specifically in the Oistins area (GO#2R2).		• Perch-Nielsen (2010) referenced data presented by Donner et al. (2005), which compared from 1980-1999 to projections for 2050-2059.
					FG2						n/a			
					FG3						n/a			
					FG4	3	3	3	3	3	15			

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
SENSITIVITY - Social, economic and biophysical characteristics of the tourism destination, which affect its susceptibility to climate related-events [9 indicators]														
Economic Sensitivity Economic Diversification	**12. Destination community's economic sector mix for employment (% related to tourism)**	• Modified from community and destination level indicators (Bollin & Hidajit, 2006; Parkins & MacKendrick, 2007). Reflects importance of the tourism sector. The higher the dependence on tourism, the greater the sensitivity.	• None determined.		FG1	3	3	3	3	3	15		• Ratio or <u>Number</u>	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	0	0	0	0	0	0			
					FG3	3	3	3	2	3	14			
					FG4						ds			
	13. Destination community's share of total tourist arrivals for recreation	• The greater the share, the greater the sensitivity as tourists are most sensitive to changes in climate vs. those visiting for businesses or to see friends and family (Perch-Nielsen, 2010).	• Represents sensitivity and exposure (Perch-Nielsen, 2010; UNWTO, 2004a).		FG1	3	3	3	3	3	15		• % of <u>total</u> arrivals	• UNWTO tourism stats. • Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	3	3	1	2	3	12			
					FG3	3	3	3	2	2	13			
					FG4	3	3	3	3	3	15			
Value of tourism infrastructure [PHYSICAL CAPITAL]	**14. Percentage of tourist infrastructure located in vulnerable zones**	• Shows degree of exposure of industry to significant climate related events (UNWTO, 2004a). The greater the value or number, the greater the sensitivity.		• ZM **merged** with #15, after FG1 as it is more precise.	FG1	3	3	2.5	3	3	14		• % of beds, % of hotels, value of infrastructure or # of tourism jobs (UNWTO, 2004a). • US $ or Number	• Fixed point in recent time or short-range of recent years (3-5 years).
	15. Value of [or # of] destination community's tourism infrastructure in coastal zone below estimated maximum storm surge levels or equivalent	• Shows sensitivity of industry to significant climate related events (UNWTO, 2004a). The greater the value or number, the greater the sensitivity.	• Maximum storm surge levels would affect the whole island.	• GO#2R1 suggested estimating to Category 4 storm surge levels [1 in every 50 yr storm] which would affect whole island.	FG1	3	1	3	3	3	13	• Value of [or # of] destination's tourism infrastructure located in coastal zone below estimated Category 4 storm surge levels.		• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	0	0	0	0	0	0			
					FG3	3	3	1	3	3	13			
					FG4	3	3	3	3	3	15			
Robustness of tourism infrastructure and resources towards extreme events.	**16. Population annually affected by meteorological extreme events**	• The greater the numbers, the greater the sensitivity. Provides info on how a destination can cope with extreme events (Perch-Nielsen, 2010).	• Presents sensitivity and exposure.	• FG4 didn't like exclusive focus on tourism (fisheries focused).	FG1	3	3	3	3	3	15	• Destination related employment and infrastructure annually affected by meteorological extreme events [FG1]	• % of <u>population</u> or infrastructure	• Perch-Nielsen (2010) presented 9-yr range data from International Disaster Database (EM-DAT, 2006).
					FG2	3	3	2	2	3	13			
					FG3	3	3	3	3	3	15			
					FG4	3	3	3	3	3	15			
Environmental management [NATURAL CAPITAL]	**17. Tourism dependent on species that are considered vulnerable to climate change**	• UNWTO (2004a). The greater the %, the greater the sensitivity.	• Hard to distinguish what makes a species vulnerable and if any changes are caused by climate change only or other factors.		FG1	1	1	1	1	1	5	• FG3 [exp] also picked as *'ecosystem resilience'* (impact of climate change on coral reefs), scored as 6.5.	• %	• Fixed point in time
					FG2	3	3	3	?	2	11			
					FG3	3	2	2	2	2	11			
					FG4						ds			
Sea Level Rise Proximity of tourism infrastructure and resources to the maximum shoreline	**18. Length of low lying coastal zone with more than 10 persons/ km2**	• The longer the length, the greater the sensitivity (Perch-Nielsen, 2010).	• Estimation very rough, conducted on country level but intended for regional aggregation (Perch-Nielsen, 2010).		FG1	1	1	2	2	1	7	• GO#2R1 suggested **removing** as too difficult and not feasible to apply at this scale of study.	• Eg. Km <u>per</u> 1000km/ coastline	• Global vulnerability assessment for SLR (Hoozemans et al., 1992). Fixed point in recent time (2000).
					FG2	0	0	0	0	0	0			
					FG3	2	3	1	3	3	13			
					FG4						ds			
	19. Number of people additionally inundated	• Perch-Nielsen (2010) added to make results of #18 more robust. The higher	• None determined.	• FG1 in current state scored as 0.	FG1	0	0	0	0	0	0	• GO#2R1 suggested **removing** as too	• Eg. People / million inhabitants	• IPCC Response strategies to SLR (1990). Fixed point in recent time
					FG2	0	0	0	0	0	0			

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
	once a year given a sea-level rise of 50cm	the number, the greater the sensitivity.		Recommended taking out '*once a year*', as inundation could occur more often.	FG3	3	2	1	2	2	10	difficult and not feasible to apply at this scale of study.		(1990).
					FG4						ds			
	20. Beach area to be nourished in order to maintain important tourist areas.	• Perch-Nielsen (2010) added to make results of #18 more robust. The higher the number, the greater the sensitivity.	• None determined.	• FG1 in current state scored as 0. Recommended adding in '*width and length*'. • FG4 and GO#2R1 didn't like exclusive focus on tourism and thought should apply to '*all areas*'.	FG1	0	0	0	0	0	0	• GO#2R1 suggested **removing** as not relevant, too difficult and not feasible to apply at this study scale and should not have exclusive focus on tourism.	• Eg. Km <u>per</u> 1000km/ coastline	• IPCC Response strategies to SLR (1990). Fixed point in recent time (1990).
					FG2	3	2	2	2	2	11			
					FG3	3	3	3	3	3	15			
					FG4	0	0	0	0	0	0			

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the- literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
ADAPTIVE CAPACITY - Social, economic and biophysical characteristics of the destination which affect its ability to adapt to climate related-events [17 indicators]														
PHYSICAL CAPITAL	**21. National standards exist for construction of new tourism infrastructure to be set-back from the shoreline [or tourism organizations that follow codes]**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006; Simpson & Ladle, 2007)	• None determined.	FG1 scored high, but a key informant who dealt with standards asked to remove, as Barbados already meets the standard.	FG1	3	3	3	3	3	15	• Researcher **removed**, as FG1 presented an '*expert*' opinion. • FG3 [EXP] re-suggested. • Even if Barbados has good building standards, could be useful as indicator in other Caribbean countries. Could change to enforcement.	• To be determined.	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						n/a			
					FG3	3	3	2	0	2	10			
					FG4						n/a			
Societal capacity • Public participation [SOCIAL AND PHYSICAL CAPITAL]	**22. Existence of an Emergency Management Committee with Parish level representatives**	• The existence of an EMC indicates a higher adaptive capacity (Bollin & Hidajit, 2006).	• Need to note the capacity of an EMC and that it might be volunteer-based. EMCs often focus only on '*extreme weather events*' and not long-term climate change.	FG1 chose as one of top indicators, even though initially scored low, perhaps due to group discussion.	FG1	3	3	2	2	3	13	Existence of functioning Emergency Management Committee (i.e. local DEO with public representatives at Destination Level) [FG3].	• Scale	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	3	3	3	3	3	15			
					FG3	1	3	2	2	3	11			
					FG4	3	3	3	3	3	15			
Management & Institutional capacity • Emergency Plans • Risk map [PHYSICAL CAPITAL]	**23. Availability and circulation of Emergency Management Plans at Parish level (ex. existence of EMPs for tourist zones/ % of tourist areas included)**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006; UNWTO, 2004a). • Tourism EMP relates to emergency planning and can include climate-related events. Existence of a plan indicates a degree of preparation. No single benchmark for all destinations. Comparison of extent of coverage, degree of	• EMP would only apply to '*extreme weather events*'. Planning or adaptation for long-term climate change often not considered (i.e. increased air temperature or drought). • Determining comprehensiveness of availability and circulation.		FG1	3	3	3	3	3	15	Availability and circulation of *EMPs* or *DRM Strategies* for the Destination that have been operationalized in the past 10 years [FG3].	• Scale	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	3	3	3	3	3	15			
					FG3	3	3	3	2	3	14			
					FG4	3	3	3	3	3	15			

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the- literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups	Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
		preparation over time is most useful (UNWTO, 2004a).						
	24. Availability and circulation of risk maps at Parish level	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).	• Determining comprehensiveness of availability and circulation.		FG1 3 3 3 3 3 15 FG2 ds FG3 3 2 3 ? 3 11 FG4 ds	Availability and circulation of risk (hazard) maps for Destinations that have been operationalized in the past 10 years [FG1].	• Scale	• Fixed point in recent time or short-range of recent years (3-5 years).
Economic Capacity Economic resources available to adapt [FINANCIAL CAPITAL]	**25. Ranking of destination and/or attraction by tourists**	• Researcher created as this type of information available for the destination community. • The higher the importance of tourism for a destination community, the more resources might be allotted to develop the sector and build its adaptive capacity.	• None determined.		Not applicable as created after the focus groups.		• Ranking <u>of</u> #1, #2, or #3 (scale)	• Past 10 to 20 years.
	26. GDP generated by the local tourism industry	• Reflects importance of tourism sector (Perch-Nielsen, 2010; UNWTO, 2004a);. • The higher the importance of tourism, the more resources might be allotted to build adaptive capacity.	• Not all SHs liked the tourism distinction at the local level. • Need to be able to precisely define the local tourism industry.		FG1 3 3 3 3 3 15 FG2 0 0 0 0 0 0 FG3 3 3 3 2 3 14 FG4 3 3 3 3 3 15	Share of annual GDP generated by the destination's tourism industry [FG1]	• % GDP	• Fixed point in recent time or short-range of recent years (3-5 years).
	27. Local GDP per capita (USD), purchasing power parity (total locally generated GDP)	• Strong economy acts a safety net in case of hazards, pre and post-event adaptation (Perch-Nielsen, 2010).			FG1 3 0 0 0 0 3 FG2 3 3 3 2 3 14 FG3 0 0 0 0 0 0 FG4 ds	Total locally (destination level) generated GDP <u>OR</u> Total available local budget in US $ [FG1].	• USD per capita	• Fixed point in recent time or short-range of recent years (3-5 years).
Insurance market	**28. Availability of insurance for buildings**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).		• FG1 recommended specifying for tourism. • FG4 didn't like exclusive focus on tourism.	FG1 3 3 3 3 3 15 FG2 3 1 1 2 3 10 FG3 3 3 2 1 0 9 FG4 3 3 3 3 3 15	Availability of insurance for tourism related employment and infrastructure for impacts due to weather variability or change [FG1].	• Scale	• Fixed point in recent time or short-range of recent years (3-5 years).
Local emergency funds	**29. Local emergency funds as percent of local budget**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).		• FG2 in current state scored as 0. Suggested merging under '*availability and access to emergency funds*'.	FG1 3 1 1 1 3 9 FG2 0 0 0 0 0 0 FG3 3 1 0 0 0 4 FG4 ds	• Destination-level emergency funds as % of local budget [FG1]. • **Removed** as scored low by participants.	• %	• Fixed point in recent time or short-range of recent years (3-5 years).
Access to national emergency funds	**30. Release period of national emergency funds**	• The lower the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).		• FG2 in current state scored as 0. Suggested merging under '*availability and access to emergency funds*'.	FG1 3 0 0 0 3 6 FG2 0 0 0 0 0 0 FG3 2 2 1 5 FG4 ds	• **Removed** as scored low by participants.	• Number (Scale)	• Fixed point in recent time or short-range of recent years (3-5 years).

Determinant	Original Indicator	Rational & Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the-literature, Stakeholders and Researcher	Suggested modifications	Score from Focus Groups							Resulting Indicator [each FG incrementally modified]	Units	Time Frame and/or Original Data Source
Access to international emergency funds	**31. Access to international emergency funds by Destination**	• The greater the value of the indicator, the higher the adaptive capacity.(Bollin & Hidajit, 2006).		• FG2 in current state scored as 0. Suggested merging under '*availability and access to emergency funds*'.	FG1	3	3	3	3	3	15	• **Removed** as scored low by participants.	• Number	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						ds			
					FG3	3	3	2			8			
					FG4						ds			
Mitigation loans	**32. Availability of loans for Disaster Risk Reduction measures [or amount]**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).		• FG2 in current state scored as 0. Suggested merging under '*availability and access to emergency funds*'.	FG1	3	1	?	?	?	4	• ZM added 'for destination'. • **Removed** as scored low by participants.		• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						ds			
					FG3	3	2	3	1		9			
					FG4						ds			
Reconstruction loans	**33. Availability of reconstruction credits for Destination**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).		• FG2 in current state scored as 0. Suggested merging under '*availability and access to emergency funds*'.	FG1	3	0	0	0	0	3	• **Removed** as scored low by participants.		• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						ds			
					FG3	3	2	3			8			
					FG4						ds			
Public works	**34. Magnitude of local public works programs at Destination**	• The greater the value of the indicator, the higher the adaptive capacity (Bollin & Hidajit, 2006).			FG1	3	0	0	0	0	3	• **Removed** as scored low.	• Number	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						ds			
					FG3	3	2	0	0	0	5			
					FG4						ds			
Physical Planning & Engineering • Preventive structures [PHYSICAL CAPITAL]	**35. Percent of Tourist area and infrastructure with sea defenses (or similar)**	• The greater the value, the higher the adaptive capacity (UNWTO, 2004a)			FG1	3	3	3	3	3	15	• GO#2R1 stated not feasible as due to size of island, do not have such specific information for particular destinations. • **Removed** as scored low.	• %	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG1	3	3	3	2	3	14			
					FG3	3	3	0	0	0	6			
					FG4						ds			
Environmental Management • Erosion management [NATURAL CAPITAL]	**36. Effective erosion protection measures in place in vulnerable areas (e.g. sea defenses)**	• The greater the value of the indicator, the higher the adaptive capacity (Simpson & Ladle, 2007).			FG1	3	3	3	3	3	15		• Scale?	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2	3	2	3	3	3	14			
					FG3	3	3	0	0	0	6			
					FG4						ds			
	37. Percentage of Beaches where erosion monitored at least annually	• The greater the value of the indicator, the higher the adaptive capacity (Simpson & Ladle, 2007).	• GO#2R1 found erosion to be too negative of a term as some of it occurs naturally.	• GO#2R1 recommended 'beaches monitored on a regular basis'.	FG1	3	3	3	3	3	15	• Beaches monitored on a regular basis' (i.e. changes in beach width or physical dimensions).	• Scale, % with quarterly	• Fixed point in recent time or short-range of recent years (3-5 years).
					FG2						ds			
					FG3	3	3	0	0	0	6			
					FG4						ds			

Table 33. Refined List (Possibly Implementable) of Destination Community Indicators

Determinant	Modified Indicator	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future applicability and possible organization(s) to collect?	e) Any identified thresholds, specific results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
EXPOSURE: Change in the suitability of the climate for the tourism destination community [11 indicators]								
<u>*Direct*</u> **Impacts***:* Increase in *sudden and extreme climate-related events* (i.e. hurricanes, drought), which can lead to intense rainfall, floods, storm surges and/or landslides.	1. *Frequency* of extreme climate events in the past 30 years (# of tropical storms that develop into Category 1 hurricanes)	• Relevant to local emergency management organizations and national level organizations for preparedness evaluation and risk assessment [FG3].	• Not applicable at the destination community scale. • Caribbean Institute for Meteorology and Hydrology has a monitoring site at Husbands Garden on the west coast (St. James Parish) for wind-speed, rainfall and relative humidity. Best climate data and most historical. Analysis occurs regionally (Caribbean) or sub-regionally. • National Oceanic and Atmospheric Administration collects data on storms and hurricanes at the regional level.	• N/A	• N/A	• Could extract GCM data for Barbados. • Could be easier to apply if stayed with conceptually relevant indicator, which focused on '*extreme precipitation events*'. Barbados Meteorological Service continuously monitors this and has readily available data in digital, tabular form. Analysis would be at the national-level.		
	2. *Intensity* of the worst extreme event in the past 30 years (# of homes severely destroyed by a Category 1 hurricane)	• Relevant to local emergency management organizations and national level organizations for preparedness evaluation and risk assessment [FG3].	• Not applicable at the destination community scale. • Same points as #1.	• N/A	• N/A	• Could extract GCM data for Barbados. • More applicable if stuck with original indicator, which focused on focused on '*extreme precipitation events*'. BMS continuously monitors and has data in digital, tabular form [FG1]. Analysis would be most likely be national-level.		
	3. *Probability of extreme future* events (chances/ year) – (# of tropical storms that develop into Category 1 hurricanes)	• Relevant to local emergency management organizations and national level orgs for preparedness evaluation and risk assessment [FG3].	• Not applicable at the destination community scale. • NOAA makes projections at the regional level.	• N/A	• N/A	• Analysis of future trends occurs at the regional level [Academic #4].		
	4. *Expected intensity of extreme future* events - (# of homes severely destroyed by a Category 1 hurricane)	• Relevant to local emergency management organizations and national level orgs for preparedness evaluation and risk assessment [FG3].						
<u>*Direct Impacts:*</u> *Long-term changes* in air temperature and precipitation. Why is SLR not in here?	5. Mean standard deviation of the daily average maximum temperature by month	• Relevant to everyone, ranging from comfort level to impacts on agriculture. It is comparable [FG2].	• Not applicable at the destination community scale. • has two long-term monitoring sites at the Airport and Golden Ridge (St. George Parish) for rainfall and temperature. Both are near Oistins. Analysis occurs at the national and regional levels.	• N/A	• N/A	• Data could be collected at the destination level, but analysis would occur at the national and regional levels.		
	6. Mean standard deviation of the daily average minimum temperature by month							
	7. Mean standard deviation of average precipitation by month							

Determinant	Modified Indicator	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future applicability and possible organization(s) to collect?	e) Any identified thresholds, specific results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
	8. Mean climate: suitability of the climate for the type of tourism present (Ex: Change in modified TCI)	• Relevant to national tourism organizations with funding from regional tourism organizations. Useful for marketing [FG3].	• Not collected by any organization.	• TCI comprises of temperature, humidity, sunshine, rain and wind.	• N/A	• TCI could be calculated, though would be more relevant and feasible to examine at the national level. Would also need to account for other factors influencing tourist climate preference.		
Indirect Impacts: • Changes to biological resources important for tourism (i.e. fisheries and resources they depend on) • These indicators would only apply to fisheries-based tourism communities.	**9. Biodiversity: Change in mean *reef fish* (coastal pelagic) harvest in the past 30-years - Shallow-reef (*in-shore)* and Deep-slope and bank reef (*off-shore)* fisheries.**	• Relevant to fishing community (socio-economic) and wider population (food security). Important for managing fisheries [FG2, FG3]. • Comparable if destinations include a component of fishing industry [FG2, FG3].	• Not collected at destination scale, though could be as fisheries are close to coast. • Fisheries Market Division (Oistins) has stats on yearly catch, though only since 2005. No analysis of change in harvest or species [Academic #2]. • Fisheries Div. has been collecting national data since the 1950s, with no analysis as only 1-2 boats being consistently monitored [Academic #2].	• The majority of data collected on fishing efforts and landings is used to estimate fisheries production, rather than trends in stock abundance or status (McConney et al., 2003).	• N/A	• Scoring criteria would need to be further developed. • Fisheries Div could collect mean size, mean weight, catch/ trip, as only need a few boats to examine changes in catch/ per unit of effort. Could define it to the Oistins area (Academic #2). • Could also rely on local fisher knowledge for changes in catch and movement (Academic #2).	• Reef-fisheries in Barbados have been on the decline due to (FG4, (GOB, 2004)).	
	10. Biodiversity: Change in mean fish off-shore *pelagic* harvest in the past 30-years.	• Relevant to fishing community (socio-economic) and wider population (food security). Important for managing fisheries [FG2, FG3]. • Comparable if tourism destinations include a component of fishing industry [FG2, FG3].	• Not feasible to collect at the destination community scale as pelagics are not distinct to a particular community. Shared stock and resource assessment for migratory large pelagic occurs on a regional or international basis (McConney et al., 2003), [Academic #2]. • Fisheries Market Division (Oistins) has stats on yearly catch, though only started in 2005. No analysis of change in harvest or species [Academic #2]. • Fisheries Division monitoring dolphin, flying fish and wahoo across the island since 1955. Attempts to regionally analyze under C division of Caribbean Regional Fisheries Mechanism (CRFM). Can factor in changes in boats and engine sizes [Acad #2]. • *'Seas around us'* project looking at global patterns of fish species range changes with climate change [looks at Caribbean too]. FAO also doing some research (Academic #2).	• FAO subsidiary looking at flying fish (Coast Atlantic Caribbean Fisheries – WEFCAF-C). Have adhoc flying fish working group, latest one in 2008 [Academic #2].	• N/A	• Fisheries Division has trends for pelagic, may have extracted national-level data for flying fish and dolphin. Analysis would not likely be destination level, but could extract. • The majority of data collected on fishing efforts in Barbados is used to estimate fisheries production rather than trends in stock abundance or status (McConney et al., 2009). • Could rely on local fisher knowledge for changes in catch or movement (McConney et al., 2003).		• A much greater issue for fishermen, vs. change in fisheries stock, is the vulnerability of their infrastructure to damage (homes, fish-fry, all of the installations), which is a huge part of their livelihoods [Academic #2].
	11. Changes in coastal ecosystems of the destination (i.e. % of live coral cover)		• Govt Org2 monitors health of 46 reef sites around Barbados on a 5-year basis. Most of work is done by CERMES (Academic #2). • Near-shore reefs closest to Welches and Miami beaches, frequented by tourists in Oistins, are '*Welcome Inn*', few tens of metres from '*Windsurfer*' patch-reef monitoring site (GO#2R2).	• Statistics on reef health. • Which coral species you look at depends on what you are looking for and on which fish species [Academic #2].	• 30-year time frame.	Stakeholders suggested a coral reef cover indicator, which could score as: • 1 = cover of 30% or more • 2 = cover of 15-20% or more 3 = cover of 10% or less	Seagrass population down in Oistins, due to accretion causing smothering. Flourishing in some areas. Important for sea-urchins (delicacy, right now moratorium) [GO#2R1].	• Can attribute most of 40% coral mortality to coral bleaching (Oxenford et al., 2008)[GO#2]. • '*Healthy Reefs for Healthy People*' has 53 indicators used by Mesoamerican bank [ecological and social and human indicators] (Healthy Reefs, 2014).

Determinant	Modified Indicators	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future Applicability and possible org(s) to collect?	e) Identified Thresholds, results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
SENSITIVITY - Social, economic and biophysical characteristics of the tourism destination community which affect its susceptibility to climate related-events [5 indicators]								
Economic Sensitivity Economic Diversification	12. Destination's Economic sector mix for employment (% related to tourism)	• Relevant to general public and international community (government depts., labour movements and private sector) [FG3].	• Too difficult to collect at the destination scale.	• N/A	• Fixed point in recent time or short-range of recent years (3-5 years)	• Possibly by Statistical Dept, Ministry of Finance and Economic Affairs or Ministry of Tourism [FG3].		
Fish-Market not fully dependent on tourists (no precise stats on this)	**13. Destination's share of total tourist arrivals for recreation**	• Relevant to all types of tourism organizations (government, national, regional) [FG2]. • Comparable in other destinations. • Useful to keep track of tourists visiting Fish-Market for management purposes [FishOrg 1].	• Yes, though data not collected consistently. • CTO (Tourism Org 6) contracted by Ministry of Tourism (Tourism Org 2) collected exit survey stats on '*places of interest* [attractions] *visited during stay by country of residence'* from 2001-2006 (CTO, 2006). Applied to Oistins Fish-Fry. • Nothing specific on share of tourist arrivals to Oistins hotels or restaurants.	• Exit survey statistics.	• Fixed point in recent time or short-range of recent years (3-5 years).	• Scoring criteria would need to be further developed. CTO/ MofT could continue to collect data pertaining to number of visitors to Oistins Fish Fry. • Stakeholders could consider measuring share of tourist arrivals via accommodation vs. visits to attractions, as tourists visit more than one attraction. Questions remain of relevance or feasibility due to dense nature of Barbados.	• Between 2001-2006, average of 26.2% of visitors visited Oistins Fish-Fry from U.S., Canada, UK, Other Europe, Caribbean and other countries [TO#5R2]. Second most popular attraction. • 95% of tourists along south coast visit Oistins [FG4].	•
Value of tourism infrastructure	14. Value of [or # of] destination's tourism infrastructure located in coastal zone below estimated Category 4 storm surge levels		• Not currently applied at the destination scale. GO#2 has projections for Category 4 storm surges, though models for whole island.	• N/A	Category 4 storm is 1 in every 50 years [though could change]. Would affect the whole island [GO#2].	• Could extrapolate destination level data from GO#2 modeling. Would that be useful? • Could obtain figures on infrastructure from Land Valuation Department.	• A 30 m (setback) from the mean high water mark is required for new developments. NCC didn't follow in BGVA redevelopment in 1989-90, as needed to be below main road. Zoning Exception [GO#2R1]	• TO#2R2 referred me to '*Economic Value of Coastal Resources*' study of tourists' perceptions, expenditures and willingness to pay (Schuhmann, 2009). Focused on coastal features, not infrastructure. • BGVA sits in a depressed area on reclaimed land which used to be houses and beachfront [FG1]. • As Oistins in a basin, it is more vulnerable to storm surges. When south winds blow it is the only place in Barbados that boats are damaged [FG4].
Environmental management	15. Tourism dependent on species that are considered vulnerable to climate change (i.e. consumption of particular fish species or viewing of coral reefs).	• Vulnerable fish depend on how you define niche.	• Currently not being applied and no clear data source [FG2]. • Coral reef viewing does not occur in Oistins.	• N/A	• N/A	• Hard for SHs to distinguish which fish species are more vulnerable to climate change, due to lack of studies.(McConney et al., 2009).		
Extreme events: Robustness of tourism infrastructure and resources towards extreme events	16. Destination related employment and infrastructure *annually affected* by meteorological extreme events (e.g. flooding, strong winds).	• Relevant to Government of Barbados, insurance industry, regional and national organizations. Could be used to inform policy development and decision-making [FG3]. • Not sure if comparable [FG3].	• Currently not applicable at destination scale, as only national figures available. • *Employment* – National Insurance Scheme or Bay Garden Vendors Association. *Infrastructure* – National Capital Commission and Ministry of Agriculture (Fish Market). *Insurance* companies.	• N/A	• N/A	• Indicator #23, *'availability of insurance*', might be easier to apply. • If applied conceptually relevant indicator *'population annually affected'* could get info from Damage Assessment to households after a disaster (HH Indicator #1,Table 16).	•	•

Determinant	Modified Indicators	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future Applicability and possible org(s) to collect?	e) Identified Thresholds, results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
ADAPTIVE CAPACITY - Social, economic and biophysical characteristics of the destination community which affect its ability to adapt to climate related-events [9 indicators]								
Societal capacity • Public participation	**17. Existence of functioning Emergency Management Committee (i.e. local DEO with public representatives at Destination Level)?**	• Relevant to national emergency management department and this could be used for planning purposes with a view to rehabilitate and reconstruct [FG2]. • Comparable as there are DEOs across the constituencies [FG3].	• Yes, as a District Emergency Organization [Emerg Mgmt Org 1] exists for the SCC Parish, which includes Oistins, though not with an exclusive tourism focus. • National Dept of Emergency Management [Emergency Management Org 2] is aware of the DEO's activities.	• Level of awareness of EMC could be addressed through development and implementation of EMPs or Risk Maps [represent beyond the tourism destination]. • Could score as: • *Is there an EMC?* ***No =1, Yes = 2?*** *If Yes, has it developed an EMP and/or Risk Map? = 3, Has the EMP or Risk map been implemented in the past year = 4, Implemented in 5 years+ = 5*	5 year range.		• For Oistins, a DEO exists at the Constituency Council level with public representatives from various groups. This covers a larger area than the tourism destination.	• Could also look at: whether EMC has documented risk for communities; frequency of meetings and/or activities conducted to create awareness, ex. household surveys [FG3]. • National Dept of Emergency Management has a report that examines activities and how to build relationships amongst the various DEOs in Barbados.
Management & Institutional capacity • Emergency Plans • Risk map	**18. Availability and circulation of *Emergency Management Plans* or *DRM Strategies* for Destination**	• Relevant for all stakeholders in the community and destination [FG3]. • Comparable amongst destinations.	• EMPs exist at different scales in the community (i.e. community or national) with different sectoral focuses. There is a need for coordination. • The Local DEO would like to create an integrated EMP for Oistins, including the BGVA and other tourism facilities. Information exists, though a Plan hasn't been created due to time and capacity constraints. DEM is understaffed and underfunded (EmMgOrg1).	Could score as: • *Has a Coordinated EMP for the Tourism Destination been developed? No =**1**, Yes = **2**? If Yes, in what form? Draft = **3**, Approved = **4**, Implemented and tested within last year = **5**, Implemented, tested and revised within 5 years + = **6***	5-10 year range.	• Could be if there is coordination amongst local stakeholders and a desire to create a tourism destination community-specific plan. • Potential role/ activity for NGOs.	• A National Tourism EMP has been developed by Ministry of Tourism, Barbados Tourism Authority and Barbados Hotel and Tourism Authority - accommodation, ancillary services, transportation [TO#2R3]. • For the NCC [TO#5] to develop an EMP for the BGVA, it would need assistance from the DEO and DEM. Had discussions with fire service, police, DEO, ambulance service. • Royal Barbados Police prepared a generic plan for all communities, including Oistins. • Fisheries-based Oistins User Committee has drafted a '*Rapid Response Plan'* (focus on boats), to submit to national govt. OUC Plan discussed with OSMBO, which prepared their own EMP to move boats.	• PO#1- Realistic to have evacuation exercises? (Proxies with other disasters, i.e. oils spills useful)? • None of the existing drafted plans are public - BTPA, OUC or RBP. • FG4 was unhappy with the different players and EMPs in the fish-market (small boats vs. large boats/ OUC, OSMBO vs. Market Division or Fisheries). • DEM allows sectors to undertake responsibility (i.e. national level tourism EMP). DEOs responsible for community level.
	19. Availability and circulation of Risk (Hazard) Maps for the Destination, that has been operationalized in the	• Relevant for all stakeholders in the community and destination [FG3]. • Comparable amongst destinations.	• Can be if there is coordination amongst local stakeholders and a desire to create tourism destination-specific maps. • DEO would like to create integrated Risk Maps for the entire destination	• *Has a Coordinated Risk Map for the entire Tourism Destination been developed?* ***No =1, Yes = 2?*** *If Yes, in what form? Draft = 3,*	• 5-10 year range.	• Integrated maps for the entire tourism destination would be useful, though presently, the local DEO doesn't have the time or capacity to create them (EMO#1).	• The Red Cross tried to carry out Risk Map training in Oistins (EMO#1).	

Determinant	Modified Indicators	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future Applicability and possible org(s) to collect?	e) Identified Thresholds, results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
	past 10 years		community of Oistins, starting at the household level. Presently, the local DEO lacks time, capacity and resources to create them [EMO#1].	*Approved = 4, Implemented and tested within last year = 5, Implemented, revised and tested within 5 years + = 6*		• Potential role/ activity for NGOs.		
	20. Ranking of tourism destination and/or attraction	• Relevant for key decision makers to develop policies (i.e. government and/or tourism agencies. • Comparable.	• Yes, though not consistently applied and not sure if will be. • *'Zagat Awards'*, through '*Best of Barbados*' survey, ranked Oistins Friday night fish-fry as #1 nightlife attraction in 2008 and #2 in 2006. Survey funded by the Barbados Tourism Authority and ranked by Zagat members (TO#4).	• Exit survey data.	• Stopped asking nightlife questions in 2009. Such a specific survey only carried out periodically. Might consider carrying out again (TO#4).	• Survey only carried out for two years. • BTPA/ Zagat could continue to carry out the survey on a yearly basis. Agreed that it is useful to periodically rank attractions.		• Night-life rating only captures Friday night Fish-Fry, including food and craft vendors and indirectly fisher-folk. Does not capture surrounding tourism facilities.
Economic Capacity Economic resources available to adapt	21. Share of annual GDP generated by the destination's tourism industry.	• Relevant to key decision makers to develop policies and for planning purposes (i.e. government and/or tourism agencies) [FG2, FG3]. • Comparable [FG2, FG3].	• Currently not being collected at the destination scale and no clear data source. • Ministry of Tourism recommended '*Tourism Satellite Accounting'* carried out by Caribbean Tourism Org to capture direct and indirect benefits of the sector (TO#2R2). The CTO is undertaking TSA at the national level. Not location specific (TO#5R1).	• N/A	• N/A	• Tourism stakeholders in Oistins pay income taxes and Value Added Tax, through which could look at GDP contribution (Tour Org 1). • Defining a distinct local tourism industry in Oistins would be challenging.		
	22. Total locally (destination level) generated GDP <u>OR</u> Total available local budget in US $	• Relevant to key decision makers to develop policies and for planning purposes (i.e. government and/or tourism agencies) [FG2, FG3]. • Comparable [FG2, FG3].	• Currently not being collected at the destination scale and no clear data source.	• N/A	• N/A	• Local groups, such as the OUC, BGVA or Constituency Council could collect data on contribution of key stakeholders towards income [i.e. BGVA, Fisheries Div, Hotels, Restaurants and other activities] [FG2]. • Would be challenging as there are several stakeholders in the community and in distinguishing its boundary.		• Difficult to define tourism destination or a community for the size of Oistins.
Insurance market	**23. Availability of insurance for tourism related employment [vendors, fisher-folk, lifeguards, etc.] and infrastructure (i.e. food stalls, restaurants, boats),** for impacts due to weather variability or change.	• Relevant to tourism-related businesses in the community (i.e. restaurants, hotels, food and craft vendors, fishers). • Not sure about comparability [FG3].	• Employment and Infrastructure insurance is available, though information is not consistently collected at the destination level. • *Insurance* can be provided for infrastructure loss due to weather variability, if individuals pay into it [National Conservation Commission and Ministry of Agriculture (fish-market)]. • *National Insurance Scheme* can provide off-season employment insurance if individuals pay into it. NIS does not provide benefits due to less work due to weather variability.	Could score as: • *Is insurance available to address impacts due to weather variability for employment and infrastructure?* **No = 1, Yes = 2**, If so, amt? Price/ amount?	• Fixed point in recent time or short-range of recent years (3-5 years)	• Information on whether an individual has employment or infrastructure insurance could be collected consistently if coordination amongst local stakeholders. • Benefits for loss of work due to weather variability could be provided by sector specific organizations (i.e. tourism or fisheries org).	• Employment insurance comes through NIS, where payments are voluntary and could receive off-season benefits [FG4]. • Government or large-business employees automatically pay into NIS (i.e. lifeguards, hotel staff). Majority of BGVA vendors pay into NIS [TO#1, TO#6]. Majority of fisher-folk do not pay into the NIS [FO#1]. • Caribbean Catastrophe Risk Insurance Facility (CCRIF) provides insurance for large disasters,	•

Determinant	Modified Indicators	Relevance, Comparability	Data currently being collected? If so, a) by who, how often, what scale and what type?	b) Type of Data currently available	c) Years [How often]	d) If not currently collected at Dest scale, future Applicability and possible org(s) to collect?	e) Identified Thresholds, results for Oistins and/ or Conclusion?	f) Additional comments, future suggestions
							though not only tourism based.. • NCC provides *infrastructure* insurance for their stalls (fire and floods). Some BGVA stalls have content insurance [TO#1, TO#6]. • Only 10% of small boats insured (valued up to $15K US), as usually don't lose boats. Insurance is expensive. Useful for large expensive boats (valued up to $325K US). Fisheries provide insurance for damaged boats, up to $1K US, though most folks don't know and don't apply [FG4].	
Environmental Management • Erosion management	**24. Effective erosion protection measures in place in vulnerable areas (e.g. sea defenses)**	• Relevant to emergency management departments and government departments such as coastal zone management, soil conservation and Ministry of Environment [FG3].	• Yes, as GO#2 profiles physical dimensions of 200 beaches, with 70 selected for detailed monitoring. Erosion protection measures are put in place in vulnerable areas, as needed. • Two of the detailed sites are Welches and Miami beaches (Beaches #1 and 2) in Oistins. • Tour Org5 also analyzes beach risk; stability mapping; rating, evaluation and carrying capacity.	Could score as: • *Have effective erosion protection measures been implemented in vulnerable areas of the tourist destination?* ***No = 1, Yes = 2?*** *If Yes, what types?* • Indicator would consider physical parameters.	• GO#2 has been analyzing trends since 1987.			
	25. Beaches monitored on a regular basis (i.e. changes in beach width or physical dimensions)	• Relevant to emergency management departments and government departments such as coastal zone management, soil conservation and Ministry of Environment [FG3].	• Yes, as GO#2 profiles physical dimensions of 200 beaches, with 70 selected for detailed monitoring. Monitor sites where the coastal processes are the same (Oistins = Sector 2). • Two of the detailed sites are Welches and Miami beaches (Beaches #1 and 2) in Oistins. The fish-market beach is not monitored. • Tour Org 5 also undertakes beach risk analysis; stability mapping; rating, evaluation and carrying capacity analyses.	Could score as: • *Are beaches in the tourism destination monitored on a regular basis?* **No = 1, Yes = 2,** *Yearly = 3, Quarterly = 4* • Indicator would consider physical parameters.	• GO#2 has been analyzing trends since 1987. • Every quarter take lines to calculate beach width, volume, and heights.			

Appendix C
Household Level Indicators

1. Table 34**: Conceptually Relevant List of Household Level Indicators (31 indicators) –** Rationale and relationship to vulnerability; limitations; suggested modifications; the resulting indicator and unit of analysis.

2. Table 35**: Refined List (Possibly Implementable) of Household Level Indicators (26 indicators)** – Household survey question and results; data collected at the time of research; future applicability; identified thresholds; other relevant survey data and additional comments.

3. Household Level **Survey**

Table 34. Conceptually Relevant List of Household Level Indicators

Acronyms of stakeholders - CP = The CARIBSAVE Partnership, FG = Focus Group, DEO = District Emergency Office, DEM = Department of Emergency Mangement, CC = Constituency Council, NAB = National Assistance Board.
Chapter 3, Table 5, provides more details on the '*scoring framework*', where each of the indicators were scored from 1-3 for five components, for a maximum total of 15.

Determinant	Original Indicator + ANALYSIS LEVEL[58]	Rational and Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested Modifications from Stakeholders and the Researcher	Average FG Score	Resulting Indicator	Units of Analysis
EXPOSURE of the Household to extreme climate-related events and long-term changes in climate [4 Indicators]							
Direct Impacts • Increase in sudden and extreme climate-related events. • *Long-term perceived changes* in air temperature and precipitation.	**1. Average number of storm, flood and storm events in the past 10 years (range: 0–7) – C or R.**	• The greater the number of events, the higher the exposure (Hahn et al., 2009). Perceived degree of impact on household from hazard; Nature of perceived impact on community (Parkins & MacKendrick, 2007).	• Recall bias (most severe disasters are most likely to be remembered) (Hahn et al., 2009). As used strong winds as plain language for tropical storms, could be hard for respondents to distinguish winds, which are not associated with tropical storms. Perceived impact, does not always translate to real impact (Parkins & MacKendrick, 2007).	• Focus on extreme events such as tropical systems [including hurricanes, which can lead to intense rainfall, floods, storm surge or landslides] and drought. CP also inquired about earthquakes, I removed in analysis as not climate-related. Use of plain language.	FG deferred to discussion with DEO.	1. Average number of tropical systems, including hurricanes, (leading to intense rainfall, floods, storm surges or landslides) OR periods of drought in the past 10 years.	• Number • Scale • Specific categories
	2. % of households that note long-term changes in air-temperature and precipitation in the past 10 years – C or R.	• The greater the percentage of change, the higher the exposure *[Researcher added]*.	• May not recall subtle changes over a 10 year period. Most likely to remember current or last few years.		FG deferred to discussion with DEO.	2. % of Households that note long-term changes in air-temperature and precipitation in the past 10 years.	• %
Indirect Impacts • Perceived degree and nature of impact.	**3. % of households with an injury as a result of the most severe climate-related event in the past 10 years- R**	• The greater the percentage, the higher the exposure (Hahn et al., 2009).	• Recall bias (severe injuries are most likely to be remembered) (Hahn et al., 2009)	• Initially included death, which Researcher removed as too sensitive.	FG deferred to discussion with DEO.	3. % of Households with an injury as a result of the most extreme climate-related event in the past 10 years (*hazard specific).*	• %
	4. % of households that experienced climate-related impacts to livelihoods [tourism related] – C or R.	• The greater the percentage, the higher the exposure [*Researcher developed to match Indicator # 18].*	• Might be difficult to separate direct or indirect tourism related livelihoods*:* i.e. hotel worker, restaurant worker, food vendor, craft seller, taxi driver, tour operator, fisherman and fish-vendor.	• CP suggested defining livelihood or stating it pertains only to income-generating activities. FG – might be hard to distinctly separate tourism-related activities.	FG deferred to discussion with DEO.	4. % of Households that experienced climate-related impacts to tourism-related livelihoods (income generating activities).	• %
SENSITIVITY – Health, food and water characteristics that determine household sensitivity [15 Indicators]							
Community Risk awareness	**5. % of households with perceived risk from a particular hazard – C**	• The greater the perceived risk, the higher the sensitivity (Parkins & MacKendrick, 2007).	• Perceived risk does not always translate to real risk (Parkins & MacKendrick, 2007).	• Focus group scored 2/ 3 in credibility.	14	5. % of households with perceived risk from a particular hazard	• % • Scale • Categories
Demographic Structure (*Socio-demographic profile)*	**6. % of households where dependent members exceed 4 = populations under 15 or over 65 [Economic and social dependency ratio] – H, N, R**	• Focus group chose the number four. The higher the percentage of households with a high dependency ratio, the higher the sensitivity (Hahn et al., 2009; Vincent, 2007b).		• Chose the number four, as a threshold, in discussion with the focus group.	15	6. % of households where dependent members exceed 4 = populations under 14 or over 65 [Economic and social dependency ratio].	• %
	7. % of households headed by women - R	• The higher the number of women heading households solely, the higher the sensitivity (Hahn et al., 2009).	• In large extended families, when there are several adults working, there can be confusion about who is the household head. Gender influences vulnerability, but it should be considered with age, life stage and class (Vincent, 2007a).	• FG thought that consideration of households headed by women isn't valid exclusively on its own, but should be considered with dependency ratio, income and age. There was continuing confusion on how to define household head [see below].	0	7. % of Households headed solely by women [single or widowed], with a certain income level and/or no social networks.	%

[58] H = Household, C = Community, R = Region/ District, N = National

Determinant	Original Indicator + ANALYSIS LEVEL[58]	Rational and Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested Modifications from Stakeholders and the Researcher	Average FG Score	Resulting Indicator	Units of Analysis
	8. % of households headed by seniors (over age of 65) or retired persons – H.	• The higher the number of retired persons/ seniors heading households, the higher the sensitivity [(Buckle, Mars, & Smale, 2000; King & MacGregor, 2000; Smit & Pilifosova, 2001); police dept, NAB].	• Seniors living on their own could have close networks with family or friends. This should be considered with social networks, income and housing quality.	• Focus group recommended focusing on seniors who live alone and do not have family members and/or friends checking in on them and providing any needed support.	15	8. % of households headed by seniors (over age of 65) or retired persons, who live alone.	%
Health	**9. % of households with a member with a physical disability – H.**	• The greater the number, the higher the sensitivity (Buckle et al., 2000; King & MacGregor, 2000; Smit & Pilifosova, 2001); CP]. Also relates to illness.	• Should clarify type of disability (cognitive or physical).	• FG recommended clarifying cognitive or physical disability. NAB definition (used by DEO and Police) focuses on household heads who live alone, with no support, and have a disability that impairs mobility.	15	9. % of households HEADS with a cognitive or physical disability *that live alone and/or with no support.*	%
	10. % of households with a member suffering from a chronic illness (i.e. asthma, hypertension, diabetes, heart disease) – H, R	• The greater the number, the higher the sensitivity, as chronically sick people place extra burden on the household (Hahn et al., 2009; Vincent, 2007a).	• Chronic illness can be subjectively defined by respondent. Perhaps some illnesses should be ranked higher.	• Participants did not find as relevant as Indicator #9, as not part of NAB Definition.	13	10. % of households with a member suffering from a chronic illness (i.e. asthma, hypertension, diabetes, heart disease)	%
	11. Households where a family member had to miss work or school in the past month due to illness. - R		• Confusion regarding who is a member of the family; Recall bias (most severe episodes are mostly likely to be remembered).	• FG scored 1/3 in relevance and 0 for the remaining. Thought this would be challenging to collect regularly and consistently. **Thus asked to remove.**	1	Have the physical disabilities and/ or serious diseases of your family members meant that they have had to miss work or school in the past month? [Y/N]	%
Food	**12. % of households that do not have adequate food through the year. - R**	• The greater the number, the higher the sensitivity (Hahn et al., 2009).	• May not reflect the overall trend of food scarcity (respondents most likely to remember current year). Could be sensitive to ask and might be better to collect through proxies (i.e. finances).	• FG found not to be feasible, as too sensitive and might discourage respondents from answering. Thought not credible, as if people choose to answer, they might give false information to receive benefits. Perhaps better to assess by proxies: i.e. family size or finances. If asked, should only be asked in neighbourhoods that are in a lower-income bracket and might have additional needs. Scored 2/3 if feasibility and 2/3 in credibility.	13	11. % of households that do not have adequate food through the year.	%
Water	**13. Households that do not have a running water supply in the house - R**	• The more informal option, the higher the sensitivity (Hahn et al., 2009).	• Could be confusion when families have multiple water sources. Need to modify question for urban and rural contexts.	• CP modified from '*HHs that do not have a* consistent *water supply*'.	15	12. % of households that do not have a running water supply in the house	• % • Range
	14. Households reporting water conflicts – R	• The greater the incidents of scarcity, due to supply or costs, the higher the sensitivity [(Hahn et al., 2009); CP.].	• Recall bias (more likely to remember violent conflicts). Need to note differences between urban vs. rural.	• CP suggested scarcity would be better than '*conflict*'. Hahn et al. state (2009) in the '*past year*'. Researcher added a 5-year time span to give historical insight.	15	13. % of households that have heard about water conflicts in the past five years.	• %
Financial	**15. Average *Receive: Give* Ratio – Ratio of # of types of help received by HH in the past month to # of types given - R**	• If HH borrowed $ but did not lend, ratio = 2:1 or 2. If lent $ but did not borrow, = 1:2 or 0.5. The higher the ratio, the higher the sensitivity. If a HH receives $ or assistance, but offers little to others, more vulnerability compared to those with excess $ and time to help others (Hahn et al., 2009).	• Confusion about who is family (immediate) and who is a relative (extended); Reliance on self-reported types of help/support and money exchanges; Does not consider exchange of non-monetary goods.	• Researcher misinterpreted indicator and didn't collect appropriate info. Researcher along with CP collected info on # of HHs that receive financial support and provide financial support. FG scored '*received*' 15 [if a HH is receiving financial support outside of the household, they are not financially sound and more sensitive] and '*provided*' as 0 in original interpretations.	15	14. % of households that *receive* financial support	• % or range
	16. Average *Borrow: Lend* Money ratio - Ratio of HHs borrowing $ to lending $ in the past month - R				0	Did you borrow any $ from relatives or friends in the past month? Did you lend any $ to relatives or friends in the past month? ... Do you *provide* financial? If so what kind and to who? [Y/N] [Q # 10] **REMOVED**	• % or range
Housing Quality	**17. % of Households that have homes [roof and floor] made from lower quality materials (i.e. wood) - H**	• The greater the percentage of vulnerable materials, the higher the sensitivity. Captures a risk to which all households are exposed, regardless of wealth status	• Need to distinguish '*lower*' and '*quality*' of housing materials. '*Vulnerable materials*' might be a better term.	• CP suggested homes made of materials that are '*vulnerable to high wind and hurricanes'*, as '*lower quality*' could be offensive. Took out floor to simplify. Wood, like Greenheart, is very high	15	15. % of households that have homes made of materials vulnerable to damage from high wind and hurricanes.	• %

Determinant	Original Indicator + ANALYSIS LEVEL[58]	Rational and Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested Modifications from Stakeholders and the Researcher	Average FG Score	Resulting Indicator	Units of Analysis
		or livelihood portfolios (Vincent, 2007b).		quality and can be stronger than cement. FG- simply looking at materials not useful. Suggested emphasizing faulty infrastructure (i.e. checklist for cracks, holes in roof, missing foundation) and location (i.e. sheltered or flood-prone area).			
Livelihood	**18. % of Households dependent on a tourism-related *[direct and indirect]* as a primary source of income - R**	• Reflects importance of the tourism sector. The higher the dependence on tourism, the greater the sensitivity [initially agriculture, adapted from Hahn et al. (2009).	• How to define primary - 50% or more? Might be hard to solely distinguish tourism related work, which could be seasonal. This could also contradict any efforts to promote tourism.	• FG found very useful.	15	16. % of households dependent on a tourism-related activity as a primary source of income.	• % • Range
	19. % of households with at least one family member working in a different community - R	• The higher the number, the higher the sensitivity as people have to travel greater distances (Hahn et al., 2009).	• Confusion about '*what is outside of community*'. Only useful for communities that are spaced apart.		Not scored	17. Does anyone in your household travel to a different community for tourism-related work? [Y/N]	•
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources (assets) that determine a household's capacity to adapt [12 indicators]							
Evaluation of Community Leadership *POLITICAL CAPITAL]*	**20. Trust in govt institution to manage impacts and risks associated with a hazard - C**	• Forward looking and assesses potential for collective action and institutional change (Parkins & MacKendrick, 2007).	• Community organizations might find this politically sensitive and not want to risk offending government organizations [The CARIBSAVE Partnership].	• CP asked to remove, as thought it would be too sensitive to ask and did not want to overtly critique government organizations. **THUS REMOVED.**	0 by CP	How much trust do you have in [municipal, provincial or federal government] organizations to properly manage for the following climate related events in your community? *Scale of Trust (1-3), Level of government.*	• Range
	21. Satisfaction with local management efforts of climate-related events in community to date - C.	• FW looking and assesses potential for collective action and institutional change (Parkins & MacKendrick, 2007).	• Community organizations might find this politically sensitive and not want to risk offending government organizations [The CARIBSAVE Partnership].	• Due to same reasons as #20, CP suggested '*whether management of climate-related events could be improved*'. Researcher thinks range offers more insight than yes or no.	8 by CP	18. Do you think the management of climate-related events in your community can be improved? [Y/N]	• Range
Disaster Risk Management	**22. % of households that received a warning about any pending climate-related events. – R**	• The greater the percentage, the higher the adaptive capacity (Hahn et al., 2009).	• Subjective definition of ''*warning*.'' Only relevant for extreme events (i.e. tropical storms).	• FG emphasized extreme events. Scored 2/3 in credibility and comparison. Not so useful.	13	19. % of households that received a warning about any pending climate-related events.	% Y/N
	23. % of households benefitting from more than one DRM Effort - H	• The greater the percentage, the higher the adaptive capacity [The CARIBSAVE Partnership].		• FG scored 2/3 in feasibility. Not so useful.		20. % of households benefitting from more than one Disaster Management Effort	• Range…
Human Capacity [HUMAN CAPITAL]	**24. Knowledge within the sector on climate change, its potential impacts and possible actions [via proxy, % of household heads and members (over 15) who've completed secondary school] - R**	• Higher knowledge about climate change and its impacts could lead to possible actions. Enrolment level chosen over literacy rate, as latter not able to distinguish between most countries (developed in particular) (Hahn et al., 2009; Perch-Nielsen, 2010; Vincent, 2007b).	• Modified from total gross enrolment rate as recommended by Perch-Nielsen (2010). Contradicts Vincent (Vincent, 2007a) who says "*availability of education is an important element of human capital, but its link with age makes it difficult to find an appropriate indicator"* p109.	• Knowledge about climate-related events could be useful.	15	21. Knowledge within the sector on climate change, its potential impacts and possible actions [via % of household heads and members (over 15) who've completed secondary school].	%
Social Networks Interconnectivity in higher level processes [SOCIAL CAPITAL]	**25. Range and scope of social capital contacts - H**	• Households with networks in neighbourhood (bonding capital), external areas and institutions (networked capital) have highest A.C. (Vincent, 2007b).	• Not all respondents will easily answer this question and might need prodding as to who they can ask for help [Researcher].		15	22. Range and scope of social capital contacts	• Scale
	26. % of households with membership in social groups - H	• Membership in groups demonstrates range of social safety nets and if involve fees, reflects economic priorities. The higher the number, the higher the adaptive capacity (Vincent, 2007b).	• Might have to prod respondents.	• FG scored 1/3 for all five categories. Thought irrelevant, as often '*grass-roots'* (i.e. low income communities) do not belong to many social groups, besides the Church. DEO agreed and does not systematically ask, though it might come out	5	Are you an active member of any social groups? (Y/N). If yes, does the group have a fee? [Q #25]	• % and *Range*

Determinant	Original Indicator + ANALYSIS LEVEL[58]	Rational and Relationship to Vulnerability, based on the literature, Stakeholders and Researcher	Limitations based on the literature, Stakeholders and Researcher	Suggested Modifications from Stakeholders and the Researcher	Average FG Score	Resulting Indicator	Units of Analysis
				in conversation. Even if a member of a Church, would Church folks be available in case of an extreme event? Need a firmer and more specific relationship [i.e. family member or friend - **REMOVED**			
PHYSICAL CAPITAL	**27. % of households that own their home and/or other physical resources – H**	• The greater the number, the higher the adaptive capacity [The CARIBSAVE Partnership]. It could show income or assets.	• Should some resources be ranked higher than others (i.e. house or agricultural land)?	• FG scored 2/3 for relevance and feasibility and 1/3 for credibility, clarity and comparison. Participants thought that owning a home is irrelevant and that the type or structure of the home is more useful (whether one owns or rents). **REMOVED**	9	What physical resources do you own (i.e. house, agricultural land, livestock, shop, tour bus, boat]? [Q #28] – KEPT FOCUS ON NATURAL ASSETS IN INDICATOR #23 BELOW.	%
NATURAL CAPITAL	**28. % of households with access to a family farm or household garden (vegetable vs. herb) – H**	• The greater the number, the higher the adaptive capacity as ability to secure food from a variety of sources. [CP].	• How to define '*access*'? Ability to provide what % of the household's food? Should other resources be included (i.e. or fisheries) and if so, should some be ranked higher than others? All the resources could be affected by weather variability.	• CP not sure if this is useful, as few persons in the area surveyed will have this. Persons may have financial means to purchase food in bulk and may have storage in their homes. If the area/country is affected by an extreme event (or even subtle climate change impacts) access for farms won't help. If leave in, then consider other factors such as livestock. FG – need to understand limitation of how each could be affected by weather variability.	15	23. % of households with **access to** one or more natural resources (i.e. household garden, livestock and/or fisheries).	%
FINANCIAL CAPITAL	**29. % of households that have a variety of insurance [i.e. health, house (strong winds, flooding, high waves and fire), private, national insurance (government pension)] – H, R**	• The greater the number, the higher the adaptive capacity (Bollin & Hidajit, 2006), [The CARIBSAVE Partnership].	• Should some insurance be ranked higher than others?	• FG thought that all insurances should be considered equally. Insurance might not cover homes that are close together like in Ashbe Lands (closer than 6-7 ft).	15	24. % of households that have a variety of insurance.	%
	30. % of households with accessibility to a variety of funds – H	• The greater the number, the higher the adaptive capacity [The CARIBSAVE Partnership].			15	25. % of households with accessibility to a variety of funds [*one or more types*]	%
Livelihood	**31. % of households taking more than one action (change to livelihood activities) in response to a climate-related event – H**	• The greater the number, the higher the adaptive capacity. Question asked by Vincent (2007b) in her thesis survey, but not defined as indicator.		• Out of possible actions, FG participants emphasized '*seeking help*' vs. '*engaging in a new livelihood*', as latter might be hard for older people who are entrenched in their careers. Did not think that '*reducing expenses*' was viable, especially for HHs that have a low income. Perhaps range of actions should be examined along with age, as for younger people it is easier to engage in new livelihoods.	15	26. % of households taking *more than one* action (change to livelihood activities) in response to a climate-related event.	%

Table 35. Refined List of Household Level Indicators

Determinant	Modified Indicators [not all applied in surveys, as also refined after survey execution]	Actual Question	Results from Household Surveys Executed in Oistins	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect	More specifics from Surveys in Oistins OR any Identified Thresholds	Additional comments from executing surveys/ future suggestions
EXPOSURE of the Household to extreme climate-related events and long-term changes in climate [4 Indicators]							
Direct Impacts: • Increase in sudden and extreme climate-related events. • *Long-term perceived changes* in air temperature and precipitation.	**1. Average number of tropical systems, including hurricanes, (leading to intense rainfall, floods, storm surges or landslides) OR periods of drought in the past 10 years, leading to physical impacts on the households.**	In the past 10 years, has your household been *physically* impacted by any of the following climate related events? Strong winds (i.e. hurricanes), Flooding, High waves, landslides or water shortage/drought [Y/N?] If yes, what level of impact, what kind of impact and how many times for each? [Q #36 a, b, c, e]	25% (18) Households impacted by [13 HHs Post Tomas]: • Tropical storms/ hurricanes (i.e. Tomas) = 1 time • Strong winds = 1-5 times • Flooding = 1-4 times	• **Stats Dept, Damage Assessment Officers** [volunteers] collect data **after any major disaster** [as reported by individuals, community or DEOs]. Quantify extent of damage to home and household and provide info to Emergency Operating Centre of DEM. Leads to follow-up assessments and/or necessary aid by appropriate agencies. No general stats collected on how often a HH is impacted [households should report any impacts to authorities]. • DEO collects info on *susceptibility* to extreme events at the community vs. individual household level. Not relevant for DEO's day to day work.	• Perhaps for an international project, to determine which destinations would benefit from adaptation planning.	Mostly low level impacts [18 HHs] Types of impacts: • *Tropical storms/ hurricanes/ strong winds* = damage to house [4 HHs], damage to infrastructure around the house [8 HHs], damage to crops/ garden [2 HHs] • *Flooding* = damage to house [2 HHs], damage to infrastructure around the house [1 HH], increased water around the house [2 HHs].	• Recall bias, hard for people to think back 10 years, especially for strong winds or flooding related to non-tropical systems. Most severe event (i.e. Tropical Storm Tomas) remembered. As used '*strong winds'* for plain language for tropical systems, hard for respondents to separate out from similar events which are not associated with tropical systems. • Number of times seemed to be hard for people to recall accurately. Inconsistent responses amongst parties.
	2. % of Households that note long-term changes in air-temperature and precipitation in the past 10 years.	In the past 10-years, have you noticed any long-term changes in climate (i.e. increase or decreasing air temperatures and/or rainfall)? [Y/N]	27 HHs were asked • 22 HHs said yes (31%) • 5 HHs said no (7%) • Main trends - increasing temperature, increasing rainfall and shifts in seasonal weather patterns.	• FG recommended DEO, which does not collect. Not sure if useful , as how accurate would perceptions or observations be due to recall bias and consideration of other stressors?	• Perhaps for an international project, to determine which destinations would benefit from adaptation planning.		• Might still be useful to collect info on people's perception of trends and compare to scientific data? • Obtained varying results. Hard to obtain a long-term time frame at this scale.
Indirect Impacts: • Perceived degree and nature of impact.	**3. % of Households with an injury as a result of the most extreme climate-related event in the past 10 years (*hazard specific).***	In the past 10 years, was anyone in your family injured from any of the climate related events? [Y/N] [Q # 38]	• 100 % (71 HHs) = No	• FG recommended DEO, which does not collect, as not part of their mandate and doesn't think useful.	• Perhaps for an international project, to determine which destinations would benefit from adaptation planning.		
	4. % of Households that experienced climate-related impacts to tourism-related livelihoods (income generating activities).	In the past 10 years, has your household's livelihood been impacted by any of the following climate related events? [Y/N]. If yes, what level and kind of impact? [Q # 37].	21% (15 HHs) LHs impacted by, [12 Post-Tomas]: • 19.7% (14HHs) – strong winds • 7% (5HHs) – flooding • 1.4% (1HH) – high-waves • 1.4% (1HH) – water shortage	• FG recommended DEO, which does not collect, as not part of their mandate.	• Perhaps for an international project, to determine which destinations would benefit from adaptation planning.	• Impacts to livelihood were: closed down tourism infrastructure (i.e. hotel, restaurant, recreational activity, fish-market); ability to carry out or get to livelihood; and impacts to tourists.	• No comments were noted from impacts to: change in resource harvest or ruined coastal/ beach area.
SENSITIVITY – Health, food and water characteristics that determine household sensitivity [13 Indicators]							
Community risk awareness	**5. % of households with perceived risk from a particular hazard**	Do you think CC poses a risk to your community? [Y/N] [Q #34] Do you think you and your home are at *risk* from the following climate related events? If yes, what level of risk and what kind? [Q #35]	69% (49 HHs) felt at risk from the following [25 HHs to more than one], 28 Post-Tomas • 69% (49HHs) – strong winds • 26.8% (19HHs) – flooding • 18.3% (13 HHs) – high-waves • 5.6% (4HHs) - landslides	• FG **recommended** DEO and Constituency Council. • DEO encourages people to identify [list] their risks, i.e. fire, flood, hurricanes, flooding, storm surge. Most people are fairly aware. DEO does not systematically note.	• Constituency Council thinks this would be useful, to increase awareness of community agencies and services. CC haven't determined their protocol for HH surveys and how systematic they would be.		
Demographic structure (*Socio-demographic profile)*	**6. % of households solely headed by women, where dependent members exceed 4 =**	Table listing other household members: name, relationship to household	30 HHs headed by women who are single or widowed and have dependents, of which:	• **Stats census** every 10 years at the Parish level: (size of HH, Table 10.01), (main activity, T10.03) and (family type, T10.05).	• DEO thinks this is useful and that NAB's '*vulnerable persons*' definition should include single		

Determinant	Modified Indicators [not all applied in surveys, as also refined after survey execution]	Actual Question	Results from Household Surveys Executed in Oistins	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect	More specifics from Surveys in Oistins OR any Identified Thresholds	Additional comments from executing surveys/ future suggestions
	populations under 14 or over 65 [Economic and social dependency ratio].	head, age, sex, marital status, highest level of education and occupation [Q #2].	• 3 have *4 or more* family members under 15 (10% cum) • 2 have *4 or more* family members that are students [could be over 15] (6% cum)	• DEO does not look at.	parent led families [predominantly women] with high dependency ratios and no support. NAB agrees.		
	7. % of Households headed solely by women [single or widowed], with a certain income level and/ or no support.	Is there a household head? [Y/N] If yes, what is the gender of the household head? [Q # 1a, 1b]	34 HHs [48%] headed by women: • 30 have other family members living with them [i.e. children, siblings] • 4 live by themselves • 14 (41.2%) receive support • *Income*: 11 (32% cum) could support themselves for 1-6 months, 19 (56% cum) don't know. • *Income breakdown*: 14 (41.2% cum) < $1000, 5 (14.7% cum) between $1000-2000, 13 (38.2% cum) > $2500, 1 (2.9% cum) don't know, 1 (2.9% cum) varies.	• **Stats census** every 10 years, T10.03 (household head by sex and parish). Focus on main activity (i.e. employed, unemployed, retired) but not income level. • **Stats** '*Continuous Household Labour Force Survey*' samples quarterly in different EDs across the island to examine labour force (employed, unemployed) or inactive. Looks at employment by earnings and sex, but not whether household heads are women. • Did not get into thresholds	• DEO recommends collecting this in conjunction with Indicator #22 (social contacts). • DEO thinks NAB '*vulnerable persons'* list should include single parent led families [predominantly women] with high dependency ratios and no defined support. NAB agrees.		• Currently no parties have a clear definition as to how to define a household head. Confusion by survey respondents as to what it means [person who owns the house [if so might not be bringing in income], the person who is the primary income earner, the most senior/ elderly person, an absent head who supports the household [though for stats purposes, they need to be living in the house] or a shared responsibility between two individuals]. Participants decided that HHs categories should be developed by surveyors [i.e. community leaders/ decision makers] and bring clarity to the respondents.
	8. % of households headed by seniors (over age of 65) or retired persons, who live alone.	Determining age of Household head [Q # 1f].	23% (16 HHs) are seniors • 9 women & 7 men *Out of this* • 6HHs (8.5%) live alone • 3 women and 3 men	• **Stats census** collects population by age and household head (T2.01) though not specific to Parish and whether live alone. • **Oistins Police Dept** maintains list of seniors and visits them monthly to track health situation and social networks. Collect next of kin info, so in case of an emergency, can contact them on the senior's behalf. Seniors who don't indicate any supportive family and/or friends are placed on NAB '*vulnerable persons'* list. • **DEO** collects similar information on behalf of NAB.	• Police and DEO recently realized overlap and plan to coordinate/ discuss. Info not collected for statistical purposes.		
Health	**9. % of households heads with a cognitive or physical disability that live alone and with no support.**	Does anyone in your household currently have any physical disabilities? [Y, N] [Q #14]?	9.9% (7 HHs) with a **member** with a physical disability • Of which over half, 4 HHs (11.8%) headed by single/ widowed women, with dependents - *Could include themselves*	• **Stats census** collects by sex, age and type of disability for the whole population (T 2.07-2.09). Don't note whether live alone. • Part of the **NAB** '*vulnerable persons'* definition, in particular if the disability impairs mobility and the individual lives alone with no support. • **Oistins Police** collects on a monthly basis. • **DEO** also collects on behalf of NAB. Though both focus on elders.	• DEO plans to collect HH info beyond elders.		
	10. HHs where the household head or one of its members suffer from a chronic illness (i.e. asthma, hypertension, diabetes, heart disease)	Does anyone in your household currently suffer from a serious (chronic) illness [Y, N] [Q #15]?	42.3% (30 HHs) with Chronic Illnesses • Out of which, almost half headed by single women - (14 HHs, 47% cum).	• **Police** collect in relation to the elderly, especially if they are living alone. • **NAB** has a list of certain illness that they check on (i.e. diabetes, heart conditions). • **Ministry of Health** – collects from administrative			

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			• Asthma and Hypertension the most common.	records.			
Food	**11. % of households that do not have adequate food throughout the year.**	Does your family have adequate food the whole year? [Y/N] [Q # 22]	• 7% (5HHs) said do not have adequate food through the year.	• FG recommended should be asked by organization that has developed rapport with community (i.e. DEO or CC). • **Stats** '*Continuous Household Labour Force Survey*' looks at employment by earnings and sex for the whole population. • DEO does not collect as do not think it would be useful and not part of their mandate.	• Welfare Dept might know if a family is having difficulty, if they come forward themselves. In most areas where people are in need, the community organizations would know [don't need to ask specifically].		• Researcher found this awkward and sensitive to ask, especially as I was a stranger. It might be better to ask by an organization with a closer relationship to the community.
Water	**12. % of households that do not have a running water supply in the house**	Where do you collect water for your household? (*Range from*: piped in the house, private or public supply outside the house to natural source) [Q #19].	• 2.8% (2 HHs) – Do not have piped (running) water inside the house. • 97.2% (69 HHs) – Do have it.	• **Statistics** census looks at type of water supply by Parish (Table 09.12).			
	13. % of households reporting water conflicts	In the past 5 years, have you heard about or experienced water conflicts in your community? *[Y/N]* [Q #18]	• 0%	• FG recommended DEO and/or Constituency Council. DEO does not collect systematically, though would note if came across. DEO suggested the CC as they could present any problems to the authorities. CC does not currently collect.	CC have not put their survey protocol in place.		Would this apply more in rural settings? Depending on score of #12, this could be more relevant.
Financial	**14. % of households that receive financial support**	Do you receive financial support from relatives, friends, the government or religious organizations? [Y/N] [Q #9]	39.4% (28) HHs receive financial support: • 26 HHs (36.6%) as grant, 2 HHs (2.8%) as monetary gift [*could receive from more than one source].* • From: 1 HH (1.4%) spouse, 11 (15.5%) relative, 19 (26.8%) from govt [out of latter 9 HHs receive as seniors' pension… 4 of which live alone.	• If an individual is not working, then asked whether they receive help from friends or receive remittances.			• Misinterpreted: Next time focus on Average Receive*: Give* Ratio – Ratio of # of types of help received by HH in the past month to # of types given.
Housing quality	**15. % of households that have homes made of materials vulnerable to damage from high wind and hurricanes.**	What is the primary material that your house is made out of? [*Range from:* Cement, bricks, wood on concrete blocks to wood]. [Q #29]	• 69% (49 HHs) wood. • 25.4% (18 HHs) cement • 5.6% (4 HHs) bricks	• FG - Info could be collected by asking direct questions or by observation. • **Stats** census T9.02 – Dwelling units by Parish, Occupancy Status and Materials of Outer Walls (wood, concrete block, wood & concrete block, stone, concrete, wood & concrete, other). T 9.03 "…." and Materials or Roof. • Orgs affiliated with **NAB** via their '*universal intake form*': Welfare Dept, Rural Devpt Commission, Urban Devpt Commission, National Housing Corporation. Target homes that are known to have issues or come *after an event* [unless folks report beforehand]. • **DEOs** can note, but don't ask systematically.	• Constituency Council – info on condition would be very useful. Potential role If carry out HH surveys, haven't confirmed or decided yet. • In future indicator could be *'% of Households in poor condition and/or in a sensitive location'* [need checklist of criteria]. • Or, would it be more useful to look at *'% housing rental'*, which indicates where contents are least likely to be insured (CDEMA, 2009d).		

Determinant	Modified Indicators [not all applied in surveys, as also refined after survey execution]	Actual Question	Results from Household Surveys Executed in Oistins	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect	More specifics from Surveys in Oistins OR any Identified Thresholds	Additional comments from executing surveys/ future suggestions
Livelihood	**16. % of households dependent on a tourism-related activity as a primary source of income**	Are you involved in an income generating activity? [Y/N] [Q#4] If so, is a tourism-related activity the main source of income for you or other HH members? If yes, which type? Present a range of direct and indirect options. [Q#5]	62% (44 HHs) of household **heads** involved in an income generating activity, • 40.8% (29 HHs) where tourism-related activity a primary source of income for *Household HEAD and/or other HH members.* Primary activities include (cum %): • Accommodation (37.9%, 11 individuals); • Food industry (41.4%, 12 individuals); and • Fishing related (44.8%, 13 individuals). **40** of total 186 adult popn in the 71 households = 22%	• **Stats** census collects '*economic activity stats'* at national level. Tourism not distinguished as a sector. **Stats** '*Continuous Household Labour Force Survey*' presents *national* employment figures by '*accommodation and food services***'** [doesn't include other tourism related activities]. • **Ministry of Labour** than presents this as % of people employed in sector *nationally.* • **CTO** also collects info on satellite accounting at national level [direct and indirect economic benefits].	• When examining GDP, Stats has a section on spending of tourists, but it would be good to focus on income coming out from tourism. How is the amount being spent by tourists being converted into income for locals? Possibility to look into future, perhaps in collaboration with the Caribbean Tourism Organization. • Focus would remain national.		• Could be contradictory to government efforts to promote tourism and tourism-related employment.
	17. **% of households with at least one family member working in a different community for** tourism-related work.	Does anyone in your household travel to a different community for tourism-related work?	40.8% (29HHs) involved in tourism-related activity • 17% (12HHs) travel to a different community. *Closer* - Dover, Maxwell. *Further* - St. Michaels (Bridgetown), St. James (Holetown), St. Lucy	• No stakeholder is currently collecting this information. Did not find useful.			• How feasible is this in a small island like Barbados? Though the island is densely developed and has a lot of rush hour traffic. So if an individual has to travel far from their home to work, it could take quite a while.
ADAPTIVE CAPACITY – Human, social, physical, natural and financial resources (assets) that determine a household's capacity to adapt [9 indicators]							
Evaluation of Community Leadership	**18. % of HHs that thinks management of climate-related events could be improved in their neighbourhood.**	Do you think the management of climate-related events in your community can be improved?' (Q #43) Y/N	• 63.4% (45 HHs) NEEDS TO be improved • 8.5% (6 HHs) DOES NOT need to be improved • Don't know 22.5% (16 HHs) • Missing 5.6% (4 HHs)	• FG recommended DEO and/or Constituency Council. DEO does not ask as not part of their mandate. Constituency Council has not decided on survey protocol.	• No clear organization. Perhaps for an external organization or international project to see which destinations need adaptation planning].		
Disaster Risk Management	**19. % of households that received a warning about any pending climate-related events.**	If yes, to Indicator #1 [*average # of events to physically impact households*], did you receive a warning about the climate related event before it happened? [Y/N]? [Q #36d]	• 9.9% (7HHs) for strong winds – 50% cum of 14 HHs impacted by climate-related events, 4 Post Tomas. • 2.8% (2HHs) for flooding, 50% cum of 4 HHs impacted by climate-related events, 4 Post Tomas.	• FG recommended DEO and/or Constituency Council. DEO finds this irrelevant and does not ask, as the government usually gives a warning for extreme events, which most people receive via media, friends or family.			• Some respondents might have mixed up extreme and non-extreme events in their responses, as hard to distinguish effects of extreme events (i.e. flooding from tropical storms or flooding on its own). Even if you do not watch the news, someone will contact you about the warning. The issue is how seriously you take it.
	20. % of households benefitting from more than one DRM Effort (relief supplies, evacuation, infrastructural works and/or Information and assistance)	Have you or your community ever benefitted from disaster management efforts? [Q # 41]	• 59.2% (42 HHs) – info & assistance to protect assets • 22.5% (16 HHs) – Infrastructural works to avoid damage from future events. • 9 HHs **more** than one initiative (13%)	• FG recommended DEO and/or Constituency Council. DEO does not see the relevance of this indicator, as even if DEOs run information/ training exercises, not a lot of people participate.		• NO for relief supplies or evacuation as haven't had major extreme events.	• Hard to quantify. Might be hard for community members to define or fully recall. Household might not be aware of all the initiatives undertaken in a community [i.e. infrastructural works, all the various media adds].

Determinant	Modified Indicators [not all applied in surveys, as also refined after survey execution]	Actual Question	Results from Household Surveys Executed in Oistins	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect	More specifics from Surveys in Oistins OR any Identified Thresholds	Additional comments from executing surveys/ future suggestions
Human Capacity	21. **Knowledge within the sector on climate change, its potential impacts and possible actions [via % of household heads and members (over 15) who've completed secondary school].**	Education levels collected as part of demographic profile [Q # 1h, 2e]. Asked specific questions pertaining to knowledge of climate change [Q #33 and 42] though did not use in analysis.	• 62.3% (42) of household *Heads* completed secondary school or more • Additional 115 adults over the age of 15 in the 71 households, of which 99 completed secondary school or more (86% cumulative).	• **Stats Census:** T4.03 - Population aged 15 years and over not attending school full-time by highest level of educational institution. **DEO** does not test a household's level of knowledge about climate change and did not find this feasible, as even if one has knowledge, would one use it? Some people are prepared before, other times people rush around when they get a warning. Most people do not have precautionary provisions and do not connect preventive actions to avoiding hazards, like clearing drains, as expect government to do that.	• CC thinks this would be useful as could lead to a discussion of response/ survival techniques. Haven't established survey protocol yet.		• Tricky again with Household Heads. Need to note many Elders often referred to as Heads, higher rate of not completing secondary school.
Social networks: Interconnectivity in higher level processes	**22. Range and scope of social capital contacts [*Range from*: friends and family, leadership within neighbourhood [BONDED CAPITAL], formal governance structures, and/or contacts beyond the geographical limits of the neighbourhood [NETWORKED CAPITAL]**	If you need help, advice or assistance who are you most likely to ask? If no one was available within your family/ neighbourhood, is there anyone else you would approach for help, advice or assistance to take care of your household? [Q #26].	BONDED CAPITAL: • 69% (49HHs) – family and friends • 7% (5 HHs) – "….." + traditional government NETWORKED CAPITAL: • 4.2% (3 HHs) – "….." + formal government structures • 33.8% (24 HHs) – "……" + beyond neighbourhood	• FG recommended DEO and/or Constituency Council. **DEO** and **Police**, when visiting neighbourhoods/ households, note whether they are elderly, have a de-habilitating illness and/or are single parent families with high dependency ratios [*latter only DEO notes*]. If so, than ask whether they have family or friends to support them during an extreme event. If not, they are put on DEO/ NAB list. **DEO** does not systematically note, comes out in conversation.		• Other responses included no one, unsure or God.	• How to define '*access*' or '*contacts*'? Established contacts vs. ability to cold call and find? Tricky to distinguish types of government.
Natural	23. **% of households with access to one or more natural resources (i.e. household garden, livestock and/or fisheries).**	What physical resources do you have access to (i.e. household garden, livestock, fisheries) [Q #28] Do you have a household veggie or herb garden? [Q # 23d,e]	• 14.4% (10 HHs) – veggie garden • 5.6% (4 HHs) – herb garden • 8.5% (6 HHs) – livestock • 32% (23 HHs) - fisheries as subsistence or livelihood	• On 2010 Census, Agricultural Dept placed a question on **gardening/ farms**. To date, **DEO** has been identifying vulnerable people. Mapping physical resources for the immediate aftermath of a disaster is next step, [i.e. # of chain saws]. If DEO was responsible for feeding program, existence of agricultural resources could be useful.	• CC – Could be useful as need to look at post-disaster period, to see how independent a family can be. Still need to develop protocol for surveys.		• What does access mean? In rural areas might want to consider family farm. • What does owning a garden show?
Financial	24. **% of households that have a variety of insurance [i.e. health, house (strong winds, flooding, high waves and fire), private, national insurance, govt pension].**	What types of insurance does your household have (i.e. home, health, or pension / National Insurance)? [Q #13]	• 26.8% (19 HHs) – Health • 33.8% (24 HHs) – Home insurance • 18.3% (13 HHs) – Private Pension • 56.3% (40 HHs) – pay into NIS	• FG recommended DEO. DEO asks whether home is insured and if not, encourages HHs to get it. Does not systematically note which HHs have it or not.	• CC thinks this information is very useful. Have not yet developed survey protocol.		
	25. % of households with accessibility to a variety of funds [*one or more types*]	Do you have access to funds other than your main source of income (i.e. bank loans, credit union, meeting turn/ 'sou-sou') [Q #12]	60.6% (43 HHs) have access to one or more type of funds • Commercial bank loan - 22.5% (16 HHs) • Credit Union Loan - 42.3% (30 HHs) • Meeting turn '*sou-sou'* - 8.5% (6 HHs).	• DEO doesn't collect.			

Determinant	Modified Indicators [not all applied in surveys, as also refined after survey execution]	Actual Question	Results from Household Surveys Executed in Oistins	Data being currently collected? If so, by whom, how often, what scale and what type?	Future Applicability? If so, possible organization(s) to collect	More specifics from Surveys in Oistins OR any Identified Thresholds	Additional comments from executing surveys/ future suggestions
Livelihood	**26. % of households taking *more than one* action (change to livelihood activities) in response to a climate-related event.**	If you've experienced a climate related event, did you take any of the following actions? *Options include*: reducing expenses, seeking help or engaging in new livelihood. [Q #39]	• 8 HHs (11%) took at least one action • 6 HHs (8%) took *one or more* actions • 5 took action Post Tomas	• FG recommended DEO and/ or CC. DEO does not ask, as not part of their mandate.	• No defined organization, though could be considered useful?	• Key actions included reducing household expenses, offering labour to others, improved infrastructure or efficiency of the house [MOST COMMON], buying insurance.	• Better to ask qualitatively?

C1. The CARIBSAVE Partnership's *Livelihoods, Gender, Poverty and Development (LGPD)* – Household Survey

Date	
Destination Community & Country	
Name of Interviewer	
Survey #	

A. DEMOGRAPHIC DATA

1. Biographical Data of Respondent

a. Is there a household head? Yes? No?		**f. Age**	
b. *If yes to a., gender of household head*		**g. Length of time in Community**	
c. *If female to b., number of years household head:*		**h. Highest level of education**	
d. If no distinct household head, or shared, gender of respondent		**i. Occupation**	
e. Marital status			

2. Other household members:

a. Relationship to Household head	**b. Age**	**c. Sex**	**d. Marital status**	**e. Highest level of education**	**f. Occupation**
i.					
ii.					
iii.					
iv.					
v.					
vi.					

B. ASSETS [ADAPTIVE CAPACITY] & SENSITIVITY

This section relates to the financial, social, human, physical and natural resources (assets) that your household has access to, that influence it's ability (capacity) to cope (adapt) to climate change. It also looks at any health, water and food issues that determine how your household might be affected by (is sensitive to) climate change

FINANCIAL ASSETS

3. a. Are you the main income earner in the household? Yes □ No □

b. If not, who in your household is?

____

4. a. Are you involved in an income-generating activity? Yes □ No □

b. If yes to 4a, is a tourism-related activity your main source (50% or more) of household activity? Yes □ No □

5. If yes to 4b, please explain which type of tourism related activity you or other family members are involved in?

Check all that apply	**a) Yourself**	**b) Other household members** *(please indicate by # as presented in section A, 2a.)*	**c) Any more details on the position?**
Taxi-drivers			
Tour operators *(i.e. diving or excursions)*			
Hotel workers *(i.e. managers, room attendants, waitresses, ground staff, bar tenders, entertainers)*			
Restaurant workers *(i.e. managers, cooks, servers)*			
Craft sellers or vendors *(i.e. work at fish-market or sell crafts)*			
Informal tour guides			
Independently owned tourism business *(i.e. Bay Garden VA)*			
Other *(i.e. fisher-person)*			

6. If you are not involved in a tourism-related activity (No to 4b), what is your main source of income (include any position(s) within organization (s)?

____

7.a. Does anyone in your household travel to a different community for tourism-related work? Yes □
No □

b. **If yes, which communities and for what type of employment?**

____
__

8. In case of an emergency (natural disaster or job loss), how long could your household financially support itself?

Check category that applies	
1 month	
2 months	
6 months	
One year	
Do not know	

9. a. **Do you *receive* financial support?** Yes □ No □

b. If yes, what kind do you receive (*could be more than one*)? Loan □ Grant □ Gift □

c. If yes, from whom (*could be more than one*)? Spouse □ a relative (home or abroad) □

a friend (home or abroad) □ The government (benefits) □ your religious organisation? □

10. a. **Do you *provide* financial support?** Yes □ No □

b. If yes, what kind do you provide *(could be more than one)*? Loan □ Grant □ Gift □

c. If yes, to who (*could be more than one*)? Spouse □ a relative (home or abroad) □

□ a friend (home or abroad) □ your religious organisation? □

11. In which category does your household's total monthly income fit [local currency]*?*

□ $0 - $1,000 □ $1,000-$2,500 □ >$2,500

12. a. **Do you have access to funds?** Yes □ No □

b. If yes, which ones? Bank loan □ Credit union □ Meeting turn'/'sou sou' □

13. Does your household have any of the following insurance?

a. Health insurance Yes □ No □
b. National insurance / social security Yes □ No □
c. Home insurance that covers:
- i. Strong winds (hurricane) damage Yes □ No □
- ii. Flooding Yes □ No □
- iii. High wave (storm surge) damage Yes □ No □
- iv. Fire Yes □ No □

d. Pension Yes □ No □

HEALTH

14. Does anyone in your household currently have any physical disabilities? Yes □ No □

15. a. Does anyone in your household currently have a serious (chronic) disease? Yes □ No □

b. If yes, please indicate which one(s):
□ asthma □ hypertension □ diabetes □ heart disease □ other

16. **a**. **Have the physical disabilities and/ or serious diseases of your family members meant that they have had to miss work or school in the past month?** Yes □ No □

b. If yes, which diseases have caused them to miss work or school in the past month?
□ asthma □ hypertension □ diabetes □ heart disease □ other

WATER & SANITATION:

17. a. Do you have easy access to water? Yes □ No □

b. Is the water clean? Yes □ No □
c. Is the water reliable? Yes □ No □

18. In the past years, have you heard about water conflicts in your community? Yes □ No □

19. Where do you collect water for your household? *[check all that apply]*

a. Running water supply in the house □
b. Community water supply from outside the house □
c. Own well □
d. Public well □
e. Creek or river □
f. Other *(please specify)* □

20. Do you have access to the following sanitation services?

a. liquid waste disposal like grease traps, soak-aways, wells Yes ◻ No ◻
b. water-flush toilets Yes ◻ No ◻
c. regular garbage collection Yes ◻ No ◻

FOOD:

21. Where does your household obtain most of its food? *[Check all that apply]*

a. Grown by family ◻
b. Bought (*grocery*) ◻
c. Bought (*market*) ◻
d. Barter ◻
e. Other (please specify):____

22. a. Does your household have adequate food throughout the whole year? Yes ◻ No ◻

b. If no, please elaborate
____

23. a. If involved in agriculture is your cultivated land rain-fed only or is there need for irrigation? __________

b. If you rely on irrigation, when do you irrigate?
____

c. If you rely on irrigation, has the water-source been reliable? Yes ◻ No ◻

SOCIAL ASSETS

24. Are you responsible for major decisions in:

a. the household Yes ◻ No ◻
b. community group or organization Yes ◻ No ◻
c. the community Yes ◻ No ◻

25. Membership in groups (social capital):

a. Are you an active member of any social groups (i.e. church or community club)? Yes ◻ No ◻

b. If yes, please fill out the table below:

A) Name of group	B) Member since?	C) # of members	D) Membership cost	E) Are you the leader?	F) Function/ description
i)					
ii)					
iii)					
iv)					

26. Range and scope of contacts (social capital) of Household:

a. If you need help, advice or assistance to take care of your household, who are you most likely to ask?

____

b. If no one was available within your family/ neighbourhood, is there anyone else you would approach for help, advice or assistance to take care of your household?

____

____

PHYSICAL ASSETS

27. **What sort of transportation do you have access to?**

a. Motorized private (i.e. car) ◻
b. Non-motorized private (i.e. bicycle) ◻
c. Shared with other family members ◻
d. Public ◻
e. None ◻

28. What kind of physical resources (assets) do you own?

a. house ◻
b. agricultural land, farming tools and equipment ◻
c. livestock (i.e., chickens, goats, cows) ◻
d. shop/stall ◻
e. tour bus ◻
f. boat ◻
g. other ____________________

29. What is the main material that your house is made of?

a. cement ◻
b. mud ◻
c. bricks ◻
d. wood (*on concrete blocks* or *cement* – please underline) ◻
e. Other (please specify) ____

30. Which communications systems are available to your household?

◻ Telephone ◻ internet ◻ radio ◻ television

NATURAL RESOURCES (ASSETS)

31. Do you use any of the following natural resources around you?

	a. Check those that are used	**b. For resources used, are they for subsistence or livelihood?**	**c. Rank top three resources used**
i) River / stream and fish			
ii) The sea and fish			
iii) Bush / forest			
iv) Wild animals			
v) Agricultural land			
vi) Mountains			
vii) Caves			
viii) Mangrove (plants/ trees/ fish/ other animals)			
ix) Coral reefs			
x) Other *(please specify)*			

32. Please comment on how your use of the following resources might have *changed* in the 10 years.
i). River / stream and fish ____

ii). **The sea and fish**
____

iii). Bush / forest
____

iv). Wild animals

v). **Agricultural land**

vi). Mountains

vii). Caves

viii). Mangrove (plants/tress/fish/other animals

ix). **Coral reefs**

x). **Other** (*please specify*)

HUMAN ASSETS

33. a. Are you familiar with the term 'climate change'? Yes □ No □,
b. If yes, please explain what you know (***do you think it is changing? If so, how?***):

c. If yes, how would you rate your knowledge about the following climate related events (hazards)?

	A) Poor = 1, Good = 2, Excellent = 3	**B) Any more details?**
i) Strong winds (hurricanes)		
ii) Flooding		
iii) High waves (storm surge)		
iv) Landslides		
v) Water shortage/ drought		

34. a. Do you think climate change poses a risk to your community? Yes □ No □ Don't know □

b. If yes, how so?

C. <u>EXPOSURE:</u>

This final section looks at how exposed your household might be to climate-related events (hazards such as strong winds, flooding, storm surge, landslides and water shortages/ drought).

35. Do you think you and your home are at *risk* from the following climate related events?

	a. Yes = 1, No = 2, Don't know = 3	**b. *If yes*, Low risk = 1, Medium risk = 2, High risk = 3**	**c. If at risk, what kind?**
i) Strong winds (hurricanes)			
ii) Flooding			
iii) High waves (storm surges)			
iv) Landslides			
v) Other (*please specify)*			

36. In the past 10 years, has your household been *physically* impacted by any of the following climate related events?

	a. Yes = 1, No = 2, Don't know = 3, Not applicable = 6	**b. *If yes*, Low impact = 1, Medium impact = 2, High impact = 3**	**c. *If yes*, how many times?**	**d. *If yes*, Warning? Yes =1, No = 2**	**e. If impacted, what kind?**
i) Strong winds (hurricanes)					
ii) Flooding					
iii) High waves (storm surges)					
iv) Landslides					
v) Water shortage/ drought					
vi) Other *(please specify)*					

37. In the past 10 years, has your household's *livelihood* been impacted by any of the following climate related events?

	a. Yes = 1, No = 2, Don't know = 3, Not Applicable = 6	**b. *If yes*, Low impact = 1, Medium impact = 2, High impact = 3**	**c. *If yes*, what kind of impact to your livelihood did you experience?** *(i.e. ruined beach, closed down hotel, lower food production)?*
i) Strong winds (hurricanes)			
ii) Flooding			
iii) Storm surge (storm surges)			
iv) Landslides			
v) Water shortage/ drought			
vi) Other *(please specify)*			

38. In the past 10 years, was anyone in your household injured from any of the following climate related events (hazards)?

	a. Yes = 1, No = 2, Don't know = 3, Not applicable = 6	**b. *If yes*, how many people?**
i) Strong winds (hurricanes)		
ii) Flooding		
iii) High waves (storm surges)		
iv) Landslides		
v) Other (*please specify)*		

39. For questions #35, 36, 37 or 38, if you answered *yes* for a particular climate related event, did you take any of the following actions in response? *Please check those that apply to any experienced events.*

	a) Strong winds	**b) Flooding**	**c) High waves**	**d) Landslides**	**e) Drought**
i) Selling assets					
ii) Borrowing money or food					
iii) Seeking help from other people					
iv) Reducing household expenses					
v) Household member moving away for another job					
vi) Offering labour to others					

vii) Starting a new livelihood activity (*please specify*)					
viii) Other *(please specify)*					

40. a. Have you made changes to your livelihood activities in order to better cope with climate related events should they happen again? Yes □ No □

b. If yes, please describe:

____

____

____

41. Have you or your community ever benefitted from disaster management efforts, such as?

	a. Yes = 1, No =2, Don't know = 3	**b. *If yes*, any more information?**
i) Relief Supplies		
ii) Evacuation and/or supplies		
iii) Infrastructural works to avoid damage from future events *(road works, drainage, etc.)?*		
iv) Information and assistance in how to protect your home and other assets you depend on?		

42. If you had to, are you sure that you would know what to do (without asking anyone) in case the following climate-related event affected your home or other resources you depend on?

	a. Yes = 1, No =2, Don't know = 3	**b. If yes, what do you think you would do?**
i) Hurricanes (high winds)		
ii) Flooding		
iii) High waves (storm surges)		
iv) Landslide		
v) Water shortage/ drought		

43. a. Do you think the management of climate-related events in your community can be improved?

Yes □ No □ Don't know □

b. If yes, how so?

____

44. In the next 10 years, what do you think will be the greatest risk to your economic livelihood? *(Could be anything, non-climate or non-tourism related).*

____

____

45. Is there anything else you would like to share with us?

____

____

Appendix D

Community-Based Vulnerability Assessment Guide

Date: ____

Name of Interviewer: _____________________________________, **Interview #:** ___________

<u>General Information:</u>

1. Profession:____ [*circle all that apply*]:

   Oistins Fish-Market: Food vendor, craft vendor, fisher-folk, small boat owner, jet ski/ pleasure boat operator, musician, *Neighbouring services*: lifeguard, beach vendors, hotel (guesthouse) manager, hotel (guesthouse) worker; *Decision-Maker* (Institutional): government, community group, tourism organization

2. How long have you worked in the XXXX as a XXX? ____________________

3. How do you currently carryout your work [enterprise]? _____________________________

   a. # of days work per week, # of hours per week:____________________________________
   b. # of staff employed (full-time, part time):____
   c. If mobile [*what % of your work do you carry out here?* ______________________________
   d. *Where else do you work?]*_________________

4. a. What is the approx weekly/ monthly revenue [gross amount] generated by your livelihood [enterprise]? ________ *[REMOVED LATER AS ACKWARD AND SOME FOUND DIFF TO ANSWER]*

   High Tourist Season: **Nov to April**: 0 -$500, $500 – 1000, $1000 +
   Low Tourist Season: May to Oct: 0 -$500, $500 – 1000, $1000 +

   b. What percent of your yearly services/ business do you think is related to tourist-related activity? ____

[For fisher-folk, ask 5h]

To Bay Garden Vendors [Manager of Stall]:

5. In a given year, what percent of your fish do you purchase from?
   a. Oistins fisher folk:_____________________
   b. Oistins fish vendors:_____________________
   c. Processors (ie. Morgans, local and imported…):_____________________

Could vary amongst high and low season…____________________________________

To Craft Vendors, Jet Ski operators, Lifeguards, Beach Vendors, Hotel Workers:

6. How many days per week do you work/ sell at XXXXX (% of yearly business)?
   ____

7. Do you also work/ sell elsewhere? ____

To Hotel Managers:

8. Capacity of Hotel (# of rooms):____

9. What are the main tourist activities that your clients engage in? (Fish-Market, Miami beach, Dover Beach, jet-skiing, St. Lawrence Gap + beyond)____________________________________

To *Fisher-Folk & Boat Owners:*

10. a. Are you a *fisher-person*, *small boat owner*, *captain* or all? ______________________________

    b. Is the Oistins fish-market your primary fish-landing site?________________ If yes, what % of your yearly catch is offloaded at the Oistins Fish Market? _____________________________

    c. Which other landing sites do you offload at?____________________________

    d. What sort of boat do you own or fish predominantly on (*could be more than one*)?
    - **Moses** (open boats for reef-fishing), 2 crew, **Iceboats** (pelagic, 5-10 days on water), 3 crew, **Dayboats** (flying fish, dolphin and albacore), **Long**-**liners** (pelagic, 7-14 days):
    ____

e. What type of fish do you predominantly catch? [Three main species…], high and low season…
In-shore reef (pot fish: grunts, squirrel, parrot or surgeon fish) and **off-shore reef** *(slope)* (i.e. red snapper, hinds, groupers, jacks). **Pelagics**: (flying fish, dolphin, shark, tuna, king fish, bill (sword) fish).

f. Where do you fish for reef [*in-shore* and *slope*] and off-shore *pelagic* fisheries? [*Present map]*

____

f. When do you fish (season, time of day)? [*Pelagic season (Nov to July)? Reef-fishing busy all year?]*

g. What is the *price* per fish?

h. In high seasons, over a year, what % of your fish do you sell to the:

BGVA _________, Fish-vendors_____ Processors_____________ Others (i.e. consumer) _______

Questions Pertaining to Exposures, Sensitivities and Adaptive Capacities

A. Current (and Past)-Exposure Sensitivities	**Prompts**
1. a. In the past 10 years, have you noticed any changes in the weather or natural environment that might make it difficult for you to work in?	• More storms, more severe (*particular category?)…* • Stronger winds (*particular strength stop fishing in?)* • Heavier rains, increased flooding • More heat ***Impacts:*** • Changes in **movement** and **harvest** of *in-shore reef* (pot fish: grunts, squirrel, parrot or surgeon fish), *slope* reef fisheries (i.e. red snapper, hinds, groupers, jacks) and/ or *pelagics* (i.e. flying fish, dolphin, shark, tuna, king fish, bill (sword) fish). • Changes in the coastal ecosystem (ex: sea-grass population, rates of erosion, rates of accretion) • Damage to infrastructure (i.e. stalls, boats, hotels)
b. Have there been any recent stresses? **Ex:** Tomasz, heavy rains in November, stormy weather in January… How did that affect you?	
c. What about smaller weather systems (changes)?	• *See 2 a.* •
2. In the past 10 years, have any social or economic conditions made it difficult for you to work in?	• Increased cost of living (i.e. food, supplies, rents, 2.5% VAT) • Higher fuel prices • Increased tourist activity (i.e. near the fishing pier) • Economic recession leading to decreased tourist activity (i.e. to the BGVA, hotels) • Air Passenger Duty (APD) Tax • Crime

B. Current (and Past) Adaptive Capacities	**Prompts**
1. What do you do when these environmental or social changes occur, so you can continue to work?	• Improve infrastructure (i.e. more weather-resistant boats or shops, changing gear) • Cease livelihood temporarily or permanently (i.e. close shop, stop fishing) • Carry out LH at another time or location (i.e. fish elsewhere, *if so where*) • Start a new LH activity (in addition to current or to replace… i.e. catering business, fish new species) • Sell asset***s*** • Seek help from other people (i.e. borrow money or food) • Reduce expenses [work or HH]
2. In particular, what types of resources (i.e. social, financial, physical, human, natural) and/or institutional support do you **have** to adapt? 3. Do you face any limits or constraints to adapt?	• *Social* – family, friends • *Financial* – savings (credit union), insurance (for shop or employee) • *Physical* – other businesses (i.e. catering), transportation • *Human* – Other Training • *Natural* – fisheries, farm land • *Institutional* **–** Infrastructure **i**nsurance [NIS, Min of Agr (boats, F.M.), NCC (BGVA), CCRIF], Pension, Content Insurance (BGVA), Membership in community groups (BGVA, OUC, OSBMO…) • *EMP* (DEO, OUC, OSBMO, NCC?, BHTA)
4. How effective have these efforts been?	
5. Would you do anything differently next time?	

C. Future Exposure Sensitivities	**Prompts**
By looking at models, scientists tell us that the climate might be changing due to increasing pollution: • *Long-term*: Increasing air and sea temperatures, changes in rainfall (decrease, increase), SLR • Increase in hurricane frequency and intensity leading to intense rainfall, floods, storm surges and/or landslides, resulting in beach erosion. 1. What do you think of these possibilities?	
2. Do you think these changes might affect the future well-being of your work [enterprise] (i.e.)?	• Impacts to natural environment (Changes in fisheries, beach) • Impacts to infrastructure • Decrease in business • Decrease in tourists
3. Do you think certain social or economic conditions might continue to change in the future?	• Cost of living increasing (food, fuel, VAT) • Govt push for increased tourism

D. Future Adaptive Capacities	**Prompts**
What do you think you would **need** to deal with any of these future changes and its effects on your livelihood [enterprise]? 1. In particular, what types of resources (i.e. social, f*inancial, phy*sical*, human, natur*al) and/or institutional support would you **need** to deal with these changes?	• *Social* – support from family or friends, reduce family size • *Financial* – savings (credit union), insurance (for shop or employee) • *Physical* – other businesses (i.e. catering), better infrastructure, transportation • *Human* – Other Training (i.e. fish-handling) • *Natural* – fisheries, farm land • *Institutional* **–** Infrastructure **i**nsurance [NIS, Min of Agr (boats, F.M.), NCC (BGVA), CCRIF], Pension, Content Insurance (BGVA), Membership in community groups (BGVA, OUC, OSBMO…) • *EMP* (DEO, OUC, OSBMO, NCC?, BHTA)
2. Do you face any limits or constraints to adapt?	•

At the End:

11. Gender____________ Age:___________________

12. Highest level of education:______________________________

13. Family size: ____________________ Household Head? : __________________

14. Do you reside in the town of Oistins? _________ If yes, in which neighbourhood and for how long have you been living there [Ashby Lands, Scarborough, Enterprise, ++]?
____

15. If no, in which parish do you reside? ____________________________________

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