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MASTER'S THESIS

Assessment of the Adaptive Capacity to Climate Change of the Tourism Sector in Small Island Developing States – A Case Study of Grenada

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List of abbreviations

ACW	Adaptive Capacity Wheel
BPOA	Barbados Programme of Action
CATIE	Centro agronómico tropical de investigación y enseñanza
CO_2	Carbon dioxide
CIAT	International Center for Tropical Agriculture
DSD of UN DESA	United Nations Division for Sustainable Development of the United Nations Department of Economic and Social Affairs
GCM	General Circulation Models
GDP	Gross Domestic Product
GHG	Greenhouse gases
GIZ	Deutsche Gesellschaft für International Zusammenarbeit (German Agency for International Cooperation)
IPCC	Intergovernmental Panel on Climate Change
IPCC AR	Intergovernmental Panel on Climate Change Assessment Report
RCM	Regional Climate Models
SES	Social-ecological systems
SIDS	Small Island Developing States
SLR	Sea level rise
UN	United Nations
UNCSD	United Nations Conference on Sustainable Development
UNDP	United Nations Development Program
UN DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environmental Program
US	United States
WTO	World Tourism Organization
XCD	East Caribbean Dollar

Part I: Theory on Adaptation to Climate Change

1. Introduction

1.1 Problem Definition and Research Question

Since the end of the 19th century, the increasing anthropogenic greenhouse gas emissions, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and halocarbons, in the atmosphere have had accelerating impacts on the natural greenhouse effect and thereby caused anthropogenic climate change. The largest contributor is the greenhouse gas CO_2, whose atmospheric concentration increased by 40% since pre-industrial times due to fossil fuel emissions and net land use change emissions (cf. IPCC 2013, pp. 11ff). Despite global efforts to mitigate greenhouse gas emissions, the concentration of emissions are still increasing and the CO_2 emission growth rate increased from 1.3% per year in the 1990s to 3.3% per year in the 2000s (cf. Scott et al. 2012a, p. 21). The uptake of these additional energy by the climate system caused an increase of the global average combined land and ocean surface temperature by 0.85° Celsius over the period 1880 to 2012 (cf. IPCC 2013, p. 5). This warming has caused losses in glacier mass and ice sheets as well as ocean thermal expansion, which has led to global mean sea level rise (cf. ibid., p. 9). Therefore, natural and human systems have to adapt to those and other negative current and future impacts. Adaptation can be implemented through technological options as well as through social, institutional and ecosystem-based measures. However, the uncertainty of long-term impacts and the effectiveness of adaptation options are just some of the barriers for successful adaptation to climate change (cf. IPCC 2014, pp. 4ff).

Especially small islands only contribute an insignificant portion to the global GHG emissions but belong to one of the most impacted groups; therefore, adaptation has been given priority. Small islands are vulnerable to current and future climate-related drivers of risk namely sea level rise, cyclones, increasing air and ocean surface temperature and changing rainfall pattern. Corresponding impacts on the ecological and social systems include shoreline changes, inundations, coral bleaching, changes in terrestrial biodiversity and decreasing rainfall and freshwater supply (cf. Nurse et al. 2014, pp. 1616ff). As opposed to this, some studies indicate that especially small island developing states (SIDS) possess a high natural resilience and showed strong social capacities to adapt to natural hazards climate issues since they have always been challenged by climate issues

(cf. Hay 2013, p. 311; cf. Adger et al. 2007, p. 728). However, the natural resilience and adaptive capacity of SIDS are nowadays additionally pressured by global change (e.g. resource extraction), development, livelihood and local issues (e.g. unsustainable fishery). Hence, vulnerability is not an inherent characteristics but can be interpreted as a social construct in which marginalized groups within SIDS are most vulnerable (cf. Hay 2013, p. 311; cf. Adger et al. 2003, p. 181; cf. Adger et al. 2007, p. 728).

Many SIDS rely on the tourism sector as the main economic activity (cf. Hay 2013, p. 319). Tourism and the climate system mutually influence each other. On the one hand, the tourism sector is very dependent on the attractiveness of natural ecosystems, which makes the sector weather and climate-sensitive and thus vulnerable to climate change (cf. Nurse et al. 2014, p. 1623). Particularly the coastal social and ecological systems that sustain the tourism sector are threatened by rising sea levels, which put settlements, infrastructures, ecosystem services and economic stability at risk (cf. IPCC 2014, p. 24). On the other hand, the building of tourism infrastructure places stresses on coastal and other ecosystems and exacerbates the vulnerability of coastal zones to climate change impacts (cf. Nurse et al. 2014, pp. 1623f). The global tourism industry contributes 5% to global CO_2 emissions, especially due to high transport volume and energy consumption (cf. Scott et al. 2012a, p. 100). Therefore, mitigation and adaptation needs and options are often interlinked in tourism infrastructure (cf. Nurse et al. 2014, pp. 1623f). Those synergies can be exploited especially due to the high potential of the tourism sector for mitigation measures, which are already part of good business practices and more widely spread than adaptation practices (cf. Becken et al. 2011, p. 79).

There is only a limited number of scientific studies on potential climate-related damages to the tourism sector (cf. Scott et al. 2012b, pp. 885ff). Additionally, there is only little knowledge about the adaptive capacity to accumulating and long-term climate and environmental impacts of the tourism sector in small island states (The CARIBSAVE Partnership 2012, p. 103). As a consequence, risk appraisal among tourism operators constitutes low awareness of climate change and does not include strategic planning and anticipation for potential climate risks. This compromises adaptive responses to the major threat of sea level rise and other climate-related impacts in small island tourism destinations (cf. Scott et al. 2012b, pp. 885ff). Long-term climate change impacts are given low priority in the tourism sector since short-term events, like external economic shocks, natural disasters or crime, have far more immediate impacts on the whole economy since they determine visitors' choice (cf. Scott, Becken 2010,

pp. 268ff). As Brooks and Adger (2004) suggest "a baseline analysis of adaptive capacity to cope with current climate" is a prerequisite to enhance adaptive capacity (Brooks, Adger 2004, p. 179). Public, private and civil tourism actors can possess and develop natural, technological, financial, human or social capacities to adapt to climate change impacts and thereby reduce vulnerability (cf. ibid, p. 168). In general, planned adaptation measures get more political attention but due to the dominance of the private sector in the tourism landscape, autonomous adaptation should be taken into stronger consideration (cf. Dubois, Ceron 2006, p. 404). Nevertheless, adaptive capacity cannot be directly measured quantitatively but rather be characterized by investigating possible changes of the sensitivity of human and ecological systems to climate (cf. Brooks, Adger 2004, p. 179). Moreover, mitigation measures in tourism businesses possess possibilities for integrating and mainstreaming adaptation, wherefore sustainable practices that have mitigating effects have the capacity to integrate adaptation actions (cf. Nurse et al. 2014, p. 1624). In order to contribute to the current state of research regarding climate change adaptation in the tourism sector in small island states, especially in developing states, the following research question was developed:

"What are the determinants of adaptive capacity to climate change of tourism actors in a small island developing state?"

In order to reveal a more comprehensive understanding of the determinants, their characteristics should be investigated in more detail. Hereby, indications for ways to enhance individual determinants can be given. Thus, a subsequent research question is:

"What are characteristics of the determinants of adaptive capacity?"

Some scientists have remarked that research on development, governance and management of tourism destinations from a resilience perspective was insufficient (cf. Luthe, Wyss 2014, p. 161). Therefore, this thesis discusses adaptive capacity to climate change also as an aspect of the resilience concept. Adaptive capacity can increase resilience and decrease vulnerability of a social-ecological system. A tourism destination can be seen as a social-ecological system whereby the reciprocity of climate and tourism is incorporated.

1.2 Structure

The research question will be approached by a theoretical overview on vulnerability, resilience and adaptation research. In chapter 2, different interpretations on vulnerability to climate change will be investigated and four approaches to assess vulnerability will

be explained. Thereafter, a wider context of the resilience of social-ecological systems will be drawn and the interaction with vulnerability and adaptive capacity will be outlined. Chapter 4 deals with adaptation and adaptive capacity to climate change by introducing characteristics of adaptation in chapter 4.1 and a conceptualization of adaptive capacity in chapter 4.2.1. In chapter 4.2.2, the author assesses determinants of adaptive capacity based on literature. The specific case for adaptive capacity of SIDS and the adaptation needs and capacity of an insular tourism system are emphasized in chapter 4.2.3 and 4.2.4. Barriers to adaptation will be laid out in chapter 4.3. This theory will be verified by an empirical case study research on the adaptive capacity of the tourism sector in the Caribbean small island state Grenada. In chapter 5, the methodology will be explained by discussing the case study selection and data collection technique, including the interview guideline and selection of interview partners. Afterwards, a critical reflection on the data basis and the interview guideline will be undertaken in chapter 5.2. In the following chapter 5.3, the chosen data evaluation method, the qualitative content analysis according to Mayring, will be elaborated and the system of categories will be explained. The data were collected by qualitative interviews with ten tourism stakeholders from the islands Grenada and Carriacou, which both form parts of the State of Grenada. Qualitative social research and the approach of the case study seem most adequate for answering the research question since they support the understanding of individual decisions and actions by considering the relevant context. Moreover, the island state of Grenada is a well definable system, which is important for case studies. Chapter 6 will give an overview on the case study background, which is composed of a country profile of Grenada and information on the exposure and sensitivity to climate change in Grenada. In chapter 7, the empirical results will be presented and interpreted according to the theoretical background and chosen methodical approach. In chapters 7.1.1 to 7.1.7, different determinants of adaptive capacity along with their sub-categories will be presented and discussed individually. Hereby, the adaptation process will be characterized and barriers for adaptation will be pointed out (cf. Brooks, Adger 2004, p. 179). Chapter 7.2 and 7.3 will show the influences of sustainable tourism practices on adaptive capacity and the enabling adaptive setting of the development of the tourism sector. The thesis will conclude with a summarizing evaluation and discussion of the results and will provide an outlook.

2. Vulnerability to Climate Change

Within the climate change field, researcher developed different interpretations of vulnerability.[1] O'Brien et al. (2004) state one conceptual distinction based on literature: they differentiate between vulnerability as an outcome and vulnerability as a contextual construct. The research in the outcome view of vulnerability, also called end-point, natural hazard approach or impact assessment (cf. Smit, Pilifosova 2003, p. 20), starts with projections of future greenhouse gas emission trends and investigates how they would change the mean climate and climatic hazards (climate stimulus). Researchers develop climate change scenarios, e.g. rise in temperature, and construct impact chains, e.g. decrease in crop cultivation.[2] Based on these impacts, they define suitable adaptation options. After adaptation has taken place, the vulnerability of the system is revealed as a qualitative or quantitative level of net impact. The knowledge on net impacts after adaptation contributes to policy decisions on cost-benefit analysis for mitigation measures or cost of climate impacts in relation to the cost of adaptation measures. Reducing greenhouse gas emissions or increasing mainly technical adaptation and adaptive capacity should reduce vulnerability within the outcome view (cf. O'Brien et al. 2004, pp. 2ff; cf. Agard, Schipper 2014, p. 1769). Here, vulnerability is understood as "a residual of climate change impact minus adaptation" (O'Brien et al. 2004, p. 1). By its reliance on emission scenarios and future climate impacts, adaptation strategies based on the end-point approach can become inappropriate if climate variability developed differently than assumed. Thus, typical technological adaptations turn into maladaptation and may increase vulnerability (cf. ibid., p. 5).[3] The left side in Figure 1 visualizes the end-point approach. It shows the climate change scenario analysis and consequences for the exposure unit, like an economic sector or a country, whereupon responses, like adaptation strategies, are developed and the outcome vulnerability is assessed.

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[1] The concept of vulnerability also exist in other disciplines like psychology, anthropology, and contexts like food-security, livelihoods etc., which use the term in different ways (cf. Füssel, Klein 2006, p. 302). This thesis focuses on vulnerability to climate change.

[2] The IPPC defines impact, consequences or outcomes as "effects on natural and human systems of extreme weather and climate events and of climate change." (Agard, Schipper 2014, p. 1767).

[3] Maladaptation describes actions that cause increased risk of adverse climate-related outcomes, increased vulnerability or decreased welfare (cf. Agard, Schipper 2014, p. 1769).

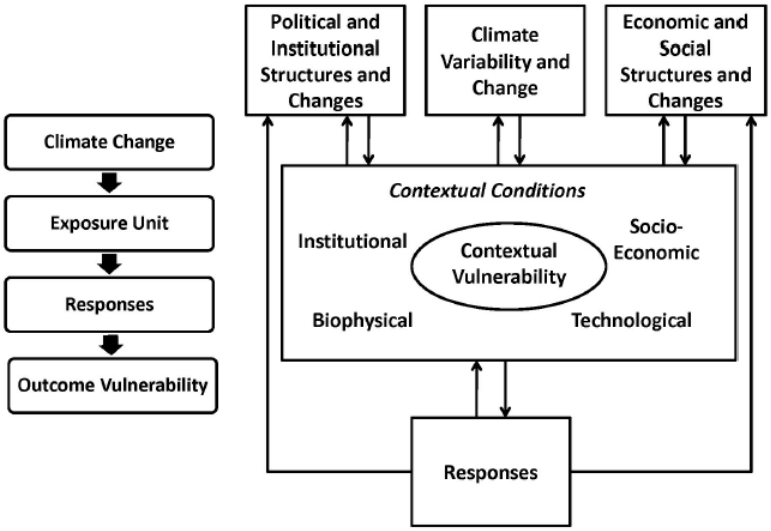

Figure 1: Two interpretations of vulnerability: left: outcome vulnerability; right: contextual vulnerability (Pielke et al. 2012, p. 351).

Inversely, contextual vulnerability regards vulnerability as a starting point. Certain environmental and social processes generate contextual vulnerability as a system characteristic, as the right side of Figure 1 represents. Thus, multiple stressors impact on the system and an understanding of the drivers that underlie the systematical vulnerability is crucial (cf. O'Brien et al. 2004, p. 12). In this case, the vulnerability assessment applies methods of vulnerability mapping and case studies and identifies impact causes and distribution (cf. ibid., p. 1). Hereby, researchers not only address present variability but also include long-term uncertainty (cf. ibid., p. 12). They analyze the system first on its vulnerabilities as a system property, like institutional, biophysical, socio-economic or technological conditions relative to climatic conditions, see right side in Figure 1 (cf. ibid., p. 3). Instead of diagnosing climate change as the main problem, contextual vulnerability sees the "inherent social and economic processes of marginalization and inequality" (ibid., p. 5) as the fundamental causes of vulnerability.

The difference between the two approaches can be found in the different disciplinary fields: The end-point approach, or top-down, is a descriptive and positive analysis undertaken within biophysical analysis with technical adaptation solutions for future natural hazards. Whereas the starting point, or bottom-up, approach investigates the social vulnerability to climate stimuli and underlying social and political structures in an explanatory and normative way (cf. O'Brien et al. 2004, p. 1; cf. Pielke et al. 2012, pp. 347ff).

As O'Brien et al. suggest, the Reports of the Intergovernmental Panel on Climate Change (IPCC) should develop an explicit definition of vulnerability. The vague definition of vulnerability in the latest IPCC Assessment Report (AR) 5 (2013) can be seen as

an indicator for the acknowledgment of different research fields with a tendency towards the starting-point approach, since vulnerability is defined as a

> „[…] propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt" (Agard, Schipper 2014, p. 1775)

and the authors make the remark: „reflecting process in science" (Agard, Schipper 2014, p. 1775). Additionally, they define contextual and outcome vulnerability. The definition of the Third and Fourth IPCC AR is more explicit by defining vulnerability as

> "The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (McCarthy et al. 2001; Parry et al. 2007, p. 883).

This definition presents a third way in comparison to the singular start- and end-point definitions since it tries to integrate both approaches. It incorporates the outcome vulnerability: "susceptible to […] adverse effect of climate change" and the contextual vulnerability by recognizing inability or ability to adapt: "unable to cope with, adverse effects of climate change" (ibid.). The scientific community adopted and quoted the three system properties exposure, sensitivity and adaptive capacity to a great extent (cf. Adger 2006, p. 269). Exposure is the degree to which a system is exposed to climatic stressors. The frequency, magnitude and duration of climate change impact triggered by anthropogenic and natural climate change and climate variability characterize exposure (cf. ibid, p. 270). The sensitivity to that exposure means the degree to which climate stressor or variability affects the system. For instance, the sensitivity is high when temperature change result in change in crop yield (direct) or sea level rise induced flooding causes damages (indirect) (cf. Parry et al. 2007, p. 881). Exposure and sensitivity of a system are dependent on the relevant climate stimulus, e.g. decreased precipitation. Moreover, the occupancy and livelihood characteristics of the system, e.g. settlement or land use, influence the sensitivity to the exposure of a climate stimulus (cf. Smit, Wandel 2006, p. 286). Since exposure and sensitivity are only limited manageable or reducible, the enhancement of adaptive capacity is regarded as the crucial influencing variable for reducing vulnerability. It describes the ability to deal with an exposure or risk and implies capacity for preparation, avoidance or moderation and recovery from exposure effects (cf. Smit, Pilifosova 2003, p. 22).[4]

[4] The concepts of risk and vulnerability are interlinked. Risk is often seen as the intersection of exposure, physical hazard and vulnerability (cf. Hay 2013, p. 313). The IPCC AR5 definition include

Due to the interdisciplinary vulnerability research and its political relevance, methodologies for vulnerability assessments and theoretical concepts differ according to the scientific context, research purpose, objective and policy implications (cf. Hinkel 2011, p. 199; cf. O'Brien et al. 2004, p. 1). However, as vulnerability is a theoretical concept that is not observable, it cannot be measured. Nevertheless, the use of indicators as measurable variables can operationalize the concept (cf. Hinkel 2011, p. 200). For example, indicators of biodiversity are used to describe the state of complex ecosystems. To define indicators, a social-ecological system framework can indicate necessary system boundaries, which will be discussed in chapter 3. Nonetheless, a lot of criticism remains concerning the conceptualization of vulnerability by means of indicators and the purpose of vulnerability assessments for policy and decision-making. Reasons are the restriction of indicators for capturing the complexity of the theoretical concept, the misuse of indicators for legitimizing political decisions and the unclear purpose of a vulnerability assessment (cf. ibid., p. 204).

Füssel and Klein (2006) distinguish four types of vulnerability assessments: The first one, impact assessment, is related to the end-point approach and does not take adaptive capacity into consideration. The second type, vulnerability assessment of the first generation, also considers the impact of non-climatic factors of exposure and vulnerability. The assessed vulnerability leads to potential adaptation options but ignores the feasibility of implementation. Those two types focus rather on mitigation policy. The second generation of vulnerability assessment includes feasible adaptation options based on the society's capacity to implement adaptations. Adaptation is one determinant of vulnerability; next to the impact that results from exposure and sensitivity. Therefore, the policy's focus is on the resource allocation for adaptation measures. The fourth type, adaptation policy assessment, provides recommendations for adaptation measures and enhancing adaptive capacities for specific regions, sectors and policy-makers. Füssel and Klein (2006) remark that the evolution of different kinds of vulnerability assessments reflects the increasingly interdisciplinary approach to climate change impacts and the integration of non-climatic drivers such as demography, economy or technology. Thus, the integration of social and natural science and the degree of stakeholder's involvement increases from low to medium and high among the four assessment types. However, each assessment type can be appropriated depending on the research or policy question

risk as "probability of occurrence of hazardous events or trends multiplied by the consequences if these events occur" (Agard, Schipper 2014, p. 1772).

addressed (cf. Füssel, Klein 2006, pp. 309ff). This research is leaned on the second generation of vulnerability assessments because the feasible adaptation options, the abilities to implement adaptation and impacts from exposure and sensitivity on a sector within a specific region, that is the tourism sector of Grenada, are analyzed.

Vulnerability can also be described as a property of the resilience of a system, which embeds the vulnerability concept into a wider frame (cf. Berkes 2007, p. 283). New approaches to vulnerability are regarded as necessary because the reliance on the three components exposure, sensitivity and adaptive capacity was criticized as being not adequate for the complex set of questions concerning vulnerability (cf. Hinkel 2011, p. 205). Moreover, the focus on the economic and technological dimensions provides a limited view on adaptive capacity (cf. Magnan 2010, p. 7). According to a project research consortium, the three elements of vulnerability constitute an incidence-related vulnerability analysis with the precondition of predictability of disturbances. The researchers highlight the limitations to predictability and the likeliness of surprises and non-linearity in complex dynamic systems. Therefore, a structural vulnerability analysis that concentrates on the processing capacities of a system, rather independently from the impacts, should accompany the incidence-oriented analysis. By using a resilience framework, they incorporate a system-oriented view that is capable of handling unexpected disturbances (cf. Gleich et al. 2010, pp. 38ff). The common elements of vulnerability and resilience research are the experienced shocks and stresses in a socio-ecological system and the response and adaptive capacity of the system (cf. Adger 2006, p. 269). Thus, the researchers propose the concepts of vulnerability and resilience as being complementary and not excludable (cf. Gleich et al. 2010, pp. 41ff). Therefore, this thesis takes both concepts into consideration in order to assess adaptive capacities.

3. Resilience of Social-Ecological Systems

Initially, the physical science developed the concept of resilience and the ecological science adopted it later on. Various other disciplines such as psychology, engineering, economic or social sciences use the term (cf. Bahadur et al. 2010, p. 4). In this thesis, resilience is explained by ecological science or ecosystem theory, wherein it describes a concept that helps to understand nonlinear dynamics in ecological systems. Important for this research is the fact that the ecological science developed a social-ecological systems approach (cf. Berkes et al. 2003, p. 13). Due to the fact that even within the ecological science the resilience discourse is fairly broad, the author focuses on the research done by Holling and the interdisciplinary research organization Resilience Alliance. The Resilience Alliance characterizes resilience as

> "[…] the amount of change the system can undergo and still retain the same controls on function and structure, the degree to which the system is capable of self-organization, the ability to build and increase the capacity for learning and adaptation" (The Resilience Alliance 2002).

The Fifth IPCC Report provides a similar definition:

> "The capacity of a social-ecological system to cope with a hazardous event or disturbance, responding or reorganizing in ways that maintain its essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (Agard, Schipper 2014, p. 1758).

The only remarkable difference is the consideration of the "transformation capacity" in the IPCC definition, which was, same as "learning capacity", newly integrated in the IPCC AR5.

Holling characterized resilience as a property of a system, which determines the persistence of the entities within the system (cf. Holling 1973). Thus, resilience is a behavioral aspect of a systems' absorption ability for changing variables. As systems are not static and do not remain in an equilibrium state, stability is seen as a second behavioral aspect of a system, indicating the pace of return to an equilibrium state after a disturbance (cf. ibid., p. 17). In a former definition, global stability around one specific equilibrium steady state was assumed. Here, resilience meant the amount of time for the system to return to this state after a perturbation had happened, like a natural or social disturbance in the form of a hurricane or economic crisis (cf. Gunderson 2003, p. 35). The system had predictable cause-and-effect relationships and the objective to maintain the efficiency of functions, also called "engineering resilience" (Holling, Gunderson 2002, p. 27). Examples in the field of climate adaptation for building engineering resilience are physical infrastructure against sea level rise or beach nourishment to meet coastal

erosion. These adjustments should keep the coastline in a static state. The engineering approach corresponds with the framing of vulnerability as an end point by O'Brien et al. (cf. Fünfgeld, McEvoy 2012, p. 326).[5]

The understanding of resilience developed towards an "ecosystem resilience" or "ecological resilience", which assumes a complex system view. Persistence, uncertainty, instability, dynamics and adaptiveness characterize it. The systems have a variety of equilibrium states and flip from one state to another, while maintaining the existence of functions (cf. Holling, Gunderson 2002, pp. 28f). The term "Nature Evolving" (Holling et al. 2002, p. 14) should express the evolutionary and adaptive system behavior. Holling et al. argue in favor of a non-collapse of the world due to the natural resilience of ecosystems, which maintain the integrity of functions under change, and the creativity and behavior of humans for adaptation (cf. ibid., p. 18). The predictability of a cause and effect relationship is no longer given. The emphasis is not on the resistance to disturbance but on the "disturbance that can be absorbed" (Berkes, Folke 2000, p. 12). A non-linear and self-organizing system under uncertain conditions has to be robust and possess buffering capacity in order to be resilient (cf. ibid., p. 12). Disturbance can be natural ones, in the form of forest fires as well as anthropogenic ones like resource use and pollution (cf. Berkes et al. 2003, p. 14). Here, the adaptive capacity of systems is assigned a stronger role than in the former resilience concept. Therefore, resilience has often been used as a concept in disaster and risk reduction strategies (cf. Davoudi 2012, p. 302), in adaptation planning and development policies (cf. Fünfgeld, McEvoy 2012, p. 325). However, resilience can be desirable or not, for example a resilient system of polluted water is undesirable, unlike to sustainability that is desirable as an overall goal (cf. Carpenter et al. 2001, p. 766).

The understanding of social-ecological systems (SES) as one interrelated entity constitutes a main element in the resilience concept and is retrieved in literature on vulnerability, resilience and adaptation concerning climatic and non-climatic hazards. The term social-ecological systems links the social and ecological systems towards one complex, integrated system in which humans are part of nature (cf. Berkes, Folke 2000, p. 9; cf. Berkes et al. 2003, p. 3; cf. Quinlan 2006). The social system can be an interconnected

[5] This concept relates to the classical utilitarian approach of resource management science, which was applied until the 1970s and isolated resources as discrete entities from other ecological and social systems. In this approach, an efficient utilization of resources should be accomplished by calculating output objectives as carrying capacity and maximum economic yield for resource systems as fishery or forestry (cf. Holling et al. 2000, p. 347).

part of social sub-systems, e.g. organizations, groups, institutions[6] and individuals (cf. Gößling-Reisemann et al. 2010, p. 53). Ecological systems are "[…] self-regulating communities of organisms interacting with one another and their environment" (Berkes et al. 2003, p. 3). The recognition of integrated social and ecological systems was based on the evidence that humans have increasingly dominated the earth. Interference in the natural environment, such as resource extraction and landscape modifications, resulted, among others, in biodiversity loss, emissions and other correlating changes, occurring on a faster scale than normally (cf. ibid., p. 1). Thus, social-ecological systems have multi-scale patterns in the spatial and temporal dimension of resource use (cf. Ostrom 2009, pp. 419f). Some scientists say that this state has been existing since the beginning of the Industrial Revolution (cf. Liu et al. 2007, p. 639). Others highlight the changes occurred since the end of the twentieth century, as the collapse of the Soviet Union, diffusion of the internet, emergence of novel diseases, global environmental changes and disasters (cf. Holling et al. 2002, p. 3). The problem causes are multiple and the results are therefore complex system problems that are non-linear in nature. The notion of coupled SES implicates that theories and attempts to decouple economic growth from resource depletion, environmental degradation and climatic impacts will not generate sustainable solutions (cf. Berkes, Folke 2000, pp. 9f; cf. Folke et al. 2002, p. 438).

Figure 2 provides a reduced image for the analysis of SES. It visualizes that ecological knowledge and understanding interlink local ecosystems and management practices, which are framed by wider ecosystems and institutions, respectively (cf. Berkes et al. 2003, p. 22). This research focuses on the adaptive capacity of the tourism sector as part of an insular ecosystem with regard to management practices and institutions.

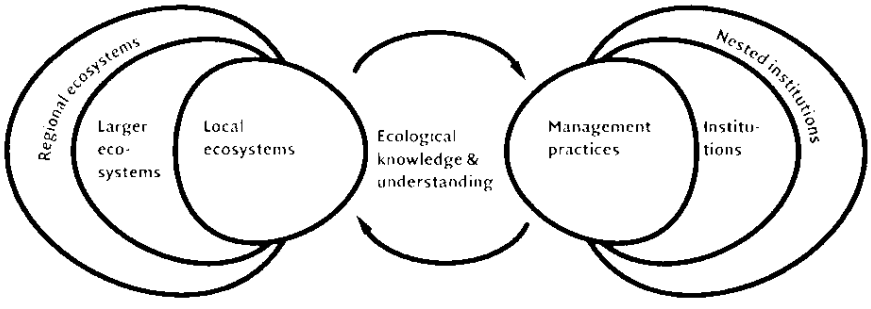

Figure 2: A conceptual framework for the analysis for linked social-ecological systems (Berkes et al. 2003, p. 22).

[6] Institutions can be defined as "systems of rules, decision-making procedures, and programs that give rise to social practices, assign roles to the participants in these practices, and guide interactions among the occupants of the relevant roles" (IDGEC Scientific Planning Committee 1999, p. 14).

4. Adaptation and Adaptive Capacity to Climate Change with a Focus on the Tourism Sector in Small Island Developing States

4.1 Characteristics of Adaptation

Alike to the concept of resilience, the concept of adaptation has its origin in natural sciences. In the evolutional theory, it describes the genetic or behavioral characteristics by which organisms can survive and reproduce under environmental change (cf. Smit, Wandel 2006, pp. 283f). Scientists have redefined adaptation in the climate change context and applied it widely to ecological and human systems. One definition is: "Adaptation to climate change refers to adjustments in ecological, social and economic systems in response to actual or expected climatic stimuli and their effects or impacts" (Smit, Pilifosova 2003, p. 9). The aim is to reduce vulnerability and prepare, moderate, avoid or recover from negative impacts (cf. Smit, Pilifosova 2003, pp. 9ff). It acknowledges the unavoidable impacts of climate change and is therefore the second policy response option to climate change, after mitigation, which aim at reducing the causes for anthropogenic climate change.[7]

The IPCC AR5 provides a similar but shorter definition of adaptation as „the process of adjustment to actual or expected climate and its effects" (Agard, Schipper 2014, p. 1758), but is rather vague as it is "a reflecting progress in science" (ibid.). In the AR5, a further distinction between two kinds of adaptation is made, by defining "incremental adaptation" as "Adaptation actions where the central aim is to maintain the essence and integrity of a system or process at a given scale" (ibid.). Transformational adaptation is defined as **"**Adaptation that changes the fundamental attributes of a system in response to climate and its effects" (ibid., p. 1758). Incremental adaptation is also known as "mainstreaming" (Smit, Wandel 2006, p. 289), meaning that decision-making processes, policies and programs relevant for environmental and resource management and social development incorporate climate change risks and adaptive actions. Thus, adaptation and vulnerability reduction are not stand-alone processes against climate change but rather become underlying criteria in all sectors and strategies to be effective (cf. ibid., pp. 286ff). For example, in order to maintain the functionality of the water system in case of frequent and severe droughts, adjustments in the water demand management

[7] Mitigation is defined as "a human intervention to reduce the source or enhance the sink of greenhouse gases" (Agard, Schipper 2014, p. 1769). Historically, mitigation has received more attention than adaptation as a climate change response due to a variety of reasons, such as measurability of impacts, effectiveness of methods, justice and responsibility for action. However, mitigation and adaptation can be seen as complementary (cf. Füssel 2007, pp. 265f).

strategies or disaster preparedness plans are made. Incremental adaptation possesses a high engineering resilience because it addresses the protection and stability of the water system. Contrarily, a transformational adaptation represents a system transformation, such as a switch in the main economic sector, e.g. from agriculture to tourism. This type of adaptation encompasses a lot of adaptive capacity and also high evolutionary resilience (cf. Nelson et al. 2007, p. 403).

Specific attributes can classify adaptation, such as time (anticipatory, concurrent, reactive), intent (autonomous, planned), spatial scope (local, widespread), temporal scope (short term, tactical), performance (cost, efficiency, effectiveness), function (retreat, accommodate, protect) and form (technological, behavioral, financial, institutional, informational) (cf. Smit, Pilifosova 2001, p. 884; cf. Smit, Wandel 2006, p. 288). Besides the dimensions time, intent, temporal and form, Füssel (2007) includes some more dimensions relevant to adaptation activities: adaptation in climate-sensitive domains (e.g. agriculture, forestry, water management, coastal protection), adaptation to the type of climate hazard (e.g. climate variability, climate extreme), predictability of climate changes, adaptation against a background of non-climate conditions (environmental, economic, political, cultural conditions) and actors involved in adaptation (people at different hierarchic levels in public and private organizations) (cf. Füssel 2007, pp. 266f).

At this point, the distinction between planned and autonomous adaptation is picked up briefly because adaptation in the tourism sector involves different stakeholders with different intents and interests. Planned adaptation uses “information about present and future climate change to review the suitability of current and planned practices, policies, and infrastructure” (ibid., p. 268). It is often done at the policy level and is linked to other governmental planning areas such as resource and water management, disaster preparedness, and it also considers non-climatic issues, like economic development plans or demographic changes (cf. ibid.). Planned adaptation initiatives often incorporate the concept of resilience (cf. Fünfgeld, McEvoy 2012, p. 325). In comparison, autonomous adaptation is often reactive, as a response to experienced climate and its effects. It occurs naturally, there is no explicit planning, neither is the adaptation consciously focused on addressing climate change (cf. Smit, Pilifosova 2001, p. 884; cf. Agard, Schipper 2014, p. 1759). Autonomous adaptation is regarded as private actor initiatives that are triggered by climate-induced market or welfare changes (cf. Smit, Pilifosova 2001, p. 884). For instance, when a hotel sees its water resources threatened,

which are fundamentally important for the business, water scarcity is a business risk that has to be avoided. Autonomous adaptation can also be proactive if actors perceive assets at risk and see benefits of their adaptive actions. This kind of adaptation to environmental changes has a long tradition throughout human society but may be not sufficient under current climate change (cf. Schause et al. 2014, pp. 3f). Füssel distinguishes the two forms by using an example of two farmers: the first one adjusts his practices in reaction to persistent climate change and adapt autonomously; and the other one adapts additionally in a planned adaptation way by using information on expected climate conditions to adjust proactively (cf. Füssel 2007, p. 269). However, the distinction between autonomous and planned adaptation should not obscure the interdependency between governmental policies and social processes. Planned adaptation can also cause barriers for individual adaptive capacities (cf. Adger 2003a, p. 31).

4.2 Adaptive Capacity

4.2.1 Significance and Conceptualization of Adaptive Capacity

The adaptive capacity is a precondition for adaptation, more specifically: it is the ability to adapt to disturbances. Adaptive capacity is a necessary condition for adaptation but not a sufficient one as it has to be activated and used. The IPCC AR5 defines adaptive capacity as "the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences" (Agard, Schipper 2014, p. 1758). Within the resilient literature, Carpenter defines adaptive capacity as "[…] a component of resilience that reflects the learning aspect of system behavior in response to disturbance" (Carpenter et al. 2001, p. 766).

In absence of adaptive capacity, the SES is unable to cope with the stimulus and crosses its thresholds, e.g. in case of a severe drought (cf. Nelson et al. 2007, p. 403). The system thresholds are the boundaries of the coping range, under which a system functions, accommodates, adapts to or recovers from (cf. Smit, Wandel 2006, p. 287). Outside the coping range the system is vulnerable, for instance if a long dry season results in a drought or intense rainfall causes erosion or landslides. With a shift in the average drought severity, the frequency and magnitude of those extreme events increase and the coping range has to be adapted (cf. Smit, Pilifosova 2003, p. 13). A switch from coping to adapting can be understood as a long-term adjustment. The coping range is not static and is also influenced by externalities, for instance population pressure or resource depletion on the climate system can narrow the coping range (cf. Smit, Wandel 2006, p. 287).

The conceptualization of adaptive capacity is still limited, even though different research purposes for assessing adaptation actions and measuring adaptive capacity exist. Smit and Wandel (2006) clustered them into four groups, which are summarized in Table 1. In the first approach, an analysis of adaptation measures is conducted in order to estimate the extent to which adaptation can moderate or offset negative climate change impacts. The effects of those hypothetical adaptations measures on the system are estimated relatively to the projected climate change impacts under a certain scenario. Hereby, the residual or net impact is the climate change impact minus net adaptation savings, similar to the end-point vulnerability approach. It has a top-down directive and is in accordance with the first generation of vulnerability assessment, described by Füssel and Klein (2006). In the second approach, the researchers select possible adaptation options for a specific system under a climate change stimuli, based on hypothesis, observation, modelling, deductive reasoning or others. They rank and rate those possibilities by using benefit-cost, cost effective or multiple-criteria methods in order to identify the best adaptation option. In contrast to the previous approaches, the third approach considers vulnerability as a starting-point (cf. O'Brien et al. 2004). The researcher selects specific criteria or variables and rates them in order to quantify and evaluate the relative adaptive capacity or vulnerability of countries, regions or communities (cf. Smit, Wandel 2006, pp. 284f). Researcher do not investigate the possible adaptation options but the needs to what, where and who has to adapt. The aim is to identify areas with least adaptive capacity in order to target adaptation accordingly. However, this type does not address processes and drivers for adaptive capacity and policy processes, which the fourth type, practical adaptation, incorporates. It deals with the implementation, therefore practical adaptation, and is often not categorized under the term "adaptation" research. Scientists study the adaptive capacity and adaptive needs of a region or community in order to identify adaptive measures or improvements tailored to the specific group. They target adaptive capacities towards the groups' experiences in changing climate conditions and integrate adaptation measures in the groups' decision-making structures. This approach generates the determinants for adaptive capacity, exposure and sensitivity from participatory, empirical research in the community (cf. Smit, Wandel 2006, p. 285).

Table 1: Research approaches to adaptation and adaptive capacity (author's own graphic).

Assessment approach	Focus	Procedure	Direction	Vulnerability understanding
1	Effects of hypothetical adaptation to reduce negative impacts on a broad scale	Theoretical estimation of hypothetical adaptation effects under climate change scenarios	Top-down	End-point approach
2	Utility of adaptation options to climate change stimuli for a particular system	Rating and ranking of possible adaptation options by using variables to select best adaptation option	Top-down	End-point approach
3	Relative adaptive capacity/vulnerability and needs of countries, regions, communities	Rating and comparing of specific determinants of adaptive capacity that were selected a priori	Bottom-up	Starting-point approach
4 "Practical adaptation"	Processes and drivers of adaptive capacity and needs of countries, regions, communities	Participatory, empirical research on determinants and variables for adaptive capacity, exposure, sensitivity	Bottom-up	Starting-point approach

The community-based vulnerability assessment contributes to the research of practical adaptation. It identifies current risks in form of exposure, sensitivity and assesses how people deal with those risks in form of adaptive capacity. Therefore it uses participatory methods, expert opinions, literature and other methods. Thereafter, consultations of scientists, decision-makers and policy analysts help identifying potential future exposure, sensitivity and adaptive capacity. The analysis is not limited to climate indicators alone but includes other stimuli, like political, cultural, and economical ones. This aims at revealing the nature of vulnerability and finding opportunities to reduce overall future vulnerability (cf. Smit, Wandel 2006, pp. 288f).

Good practices from disaster risk management, coastal management, resource management, spatial planning, urban planning, health and agriculture can guide adaptation strategies, as climate, environmental and social stress have always affected those sectors. However, anthropogenic climate change brings new aspects to those sectors, which are unprecedented climate conditions, rate of change, knowledge and methodical challenges, new actors and new measures (cf. Füssel 2007, p. 268). The practical adaptation approach addresses these issues as it incorporates climate change risks in existing programs, policies and decision-making processes of those sectors. Hereby, it mainstreams adaptation and enhances the adaptive capacity (cf. Smit, Wandel 2006, pp. 285f). One

important finding on practical adaptation is the fact that "adaptations are rarely undertaken in response to climate change effects alone, and certainly not to climatic variables that may be of importance to decision-makers" (ibid., p. 289). Hence, social, economic or political forces can influence adaptation much more than and the actual evidence from changing climate variables. Due to these forces, climate change adaptation on community level is about dealing with changing conditions within economic-social-political boundaries or changing those boundaries themselves (cf. ibid.). This circumstance seems especially relevant for the researched tourism sector as the local private industry strongly dominates the sector and has probably low priority of climate variables. Therefore, an intersection of the third and fourth adaptation research approach seems most appropriated for the case study of Grenada.

4.2.2 Determinants of Adaptive Capacity

The IPCC AR3 defined six determinants of adaptive capacity that are however specific to the system, sector, time and location: economic resources, technology, information and skills, infrastructure, institutions and equity (cf. Smit, Pilifosova 2001, p. 895). Based on these determinants Yohe and Tol (2002) expanded the list of determinants of adaptive capacity to:

- the range of available technological options for adaptation
- the availability of resources and their distribution across the population
- the structure of critical institutions, derivative allocation of decision-making authority and employed decision criteria
- human capital including education and personal security
- social capital including property rights
- the system's access to risk spreading processes
- the ability of decision-makers to manage information and the credibility of selected information and its decision-makers
- the public's perceived attribution of the source of stress and the significance of exposure to its local manifestation (cf. Yohe, Tol 2002, p. 26).

Even though the determinants operate on the macro-scale, their local micro-scale manifestation could vary depending on the location or adaptation form (cf. Yohe, Tol, p. 27). The United Nations Development Programme (UNDP) defines adaptive capacity as a set of resources available for adaptation and their effective usage within a system. Those resources include natural, financial, institutional, human resources, the access to ecosystems, information, expertise and social networks (cf. Brooks, Adger 2004, p. 168).

Since climate impact and vulnerability assessments introduced adaptive capacity assessments, these are often undertaken on national scale with a focus on tangible and

intangible assets and capital, like natural and physical capital or human and social capital, as the determinants of the IPCC AR3 and Yohe and Tol (2002) manifested (cf. Jones et al. 2010, p. 3). A distinctive feature of the adaptive capacities is dimension: capacities can be either directed to a macro-scale generic dimension (e.g. education, health, income) or directed to a specific climate change impact, such as droughts may relate to institutions and technology. Consequently, adaptive capacity is context-specific and varies across and within societies and nations (cf. Adger et al. 2007, pp. 727f). The recent IPCC AR5 shortly addresses the adaptive capacities: availability of research and development, knowledge, information, technology transfer and financial resources (cf. Noble et al. 2014, p. 844; Agard, Schipper 2014). The authors elaborate in more detail on adaptation options and organize them in three categories: structural/physical (engineered and built environment, technological, ecosystem-based, services), social (educational, informational, behavioral), institutional (economic, laws and regulations, government policies and programs) options (cf. Noble et al. 2014, p. 844).

Next to rather quantitative indicators such as technology and economic assets, the scientific community increasingly acknowledged qualitative indicators, like social factors, as important adaptive capacities (cf. Grothmann et al. 2013, p. 3370). On an individual basis, human capital can determine individual adaptive capacity. Skills, knowledge, expertise, labor, information on climate hazards and socio-economic systems and the political and cultural context (cf. Brooks, Adger 2004, p. 186), education and personal security shape human capital (cf. Yohe, Tol 2002, p. 26). Complementing to the individual basis, social capital describes the ability to act collectively, which can determine the societal capacity to adapt. Networks, relationships and interactions between persons and social groups can built social capital (cf. Brooks, Adger 2004, p. 168; cf. Adger 2003b, p. 36). Bonding social capital describes the relationships within a defined socioeconomic group, whereas networking or bridging social capital is the type of network with external social groups (cf. Adger 2003a, p. 36). Social capital can also explain how individuals use relationships with others for their individual purpose and well-being or for the collective purpose (cf. Adger 2003b, p. 389). Collective action of societies is especially important with regard to multiple property-rights regimes like natural resource management. For collective action and decision-making, a flow of information, formal and informal networks are necessary as well as trust, collaboration, reputation, exchange, shared values, norms, customs and traditions and common rules (cf. Brooks, Adger 2004, p. 168; cf. Adger 2003b, pp. 388f). The social acceptability of

adaptation options and the local and global institutional, economic and social circumstances for adaptation determine its effectiveness (cf. Adger 2003b, pp. 388ff).

For the assessment of institutional characteristics to stimulate adaptive capacity to climate change of a society, Gupta et al. (2010) developed a conceptual framework, named the Adaptive Capacity Wheel (ACW). Gupta et al. addressed the research gap in the potential of institutions to enhance the adaptive capacity of society from a local to a national level. To close this gap, they developed six dimensions with 22 criteria through which institutions can promote adaptive capacity (cf. Gupta et al. 2010, pp. 1ff).[8] Even though the ACW does not assess the dimensions technology and infrastructure, it includes all other dimensions of the IPCC AR3 and provides a much more differentiated categorization (cf. Grothmann et al. 2013, p. 3372). Grothmann et al. (2013) extended the ACW by two further psychological, subjective dimensions relevant for institutional adaptive capacity: (1) adaptation motivation to realize, support and/ or promote adaptation and (2) adaptation belief in the realization and effectiveness of adaptation measures (cf. ibid., p. 3369). The perception of risk and/ or chances of climate change and its potential impacts determine the adaptation motivation. Moreover, the political will manifests the motivation. The risk perception "expresses the perceived probability of being exposed to climate change impacts and to the appraisal of how harmful/useful these impacts would be to things that an actor values" (ibid., p. 3375). Adaptation belief means the belief in the realization and effectiveness of adaptation measures. It can be reflected in self-efficacy, the belief in themselves for conducting realizable adaptation measures, or outcome-efficacy, the belief in the availability of effective adaptation measures. Grothmann et al. claim that a deficit in adaptation motivations and beliefs can undermine the existing objective aspects of adaptive capacity, like resources. The two psychological factors are necessary but not sufficient for adaptation as other psychological barriers exist (cf. ibid., pp. 3375f). According to Grothmann et al., the elements of adaptive capacity should also capture the challenges to adaptation to climate change; identified by Prutsch et al. (2014) see chapter 4.3. Frameworks for analyzing adaptive capacity should address those challenges and come up with solutions for them.

The IPCC AR5 introduces ecosystem-based adaptation as an adaptation option that reflects the social-ecological system view. Ecosystem services and biodiversity are used for an overall adaptation strategy for the natural environment as well as for social sys-

[8] The six dimensions are variety, learning capacity, room for autonomous change, leadership, resources and fair governance.

tems (cf. Noble et al. 2014, pp. 846f). The most prominent example can be found in coastal adaptation, which uses mangrove forests, sea grass or salt marshes. Mangrove forests protect coastal communities and infrastructures by providing buffering capacity to storm surges and sea swells through their extensive root system and thereby stabilizing the coastlines. They also have biodiversity and mitigation co-benefits such as fish nursery, animal shelter and carbon sequestration. Coral nursery or artificial reefs can also be considered as ecosystem-based adaptation since coral reefs protect against storm surges and rising sea levels. However, ecosystem-based adaptation often has trade-offs with alternative land-use and is very complex to plan and implement due to the high amount of involved stakeholders (cf. Noble et al. 2014, pp. 846f; cf. Mercer et al. 2012, p. 1911). Ecosystem-based adaptation can also integrate local and external knowledge (cf. Mercer et al. 2012).

4.2.3 The Specific Case for Adaptive Capacity of Small Island Developing States

Small islands are especially vulnerable to current and future climate-related drivers of risk. The UN Conference on Environment and Development in 1992 firstly formally recognized the unique and special challenges that SIDS face in the context of sustainable development.[9] Those are small but growing populations, limited resources, remoteness, susceptibility to natural disasters, vulnerability to external shocks, excessive dependence on international trade and fragile environments (cf. Hay 2013, p. 310).[10] Moreover, high transportation and communication costs, disproportionately expensive public administration and infrastructure and little opportunity to create economics of scale often stymied development (cf. DSD of the UN DESA 2012, pp. 5f). By recognizing the constraints for SIDS in meeting these specific challenges, the international community agreed on co-operation and assistance for those countries on the first Global Conference of Small Island Developing States in 1994 (cf. Hay 2013, p. 310).[11]

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[9] The Brundtland Report defines sustainable development as: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED) 1987, p. 43).

[10] Despite this unifying challenges, SIDS differ geographically and politically, e.g. Papua New Guinea has with 462,849km² an area almost twice as large as New Zealand; Belize and Guyana are not islands per definition, Bahrain does not fall under "developing states" and the Netherlands Antilles are dependent territories instead of island states (cf. Kelman, West 2009, pp. 1f). Thus, there is no general accepted definition of SIDS. Currently, 52 states are listed as SIDS in the UN Department of Economic and Social Affairs. Self-selection defines membership (cf. Hay 2013, p. 310).

[11] The outcome was the Barbados Programme of Action (BPOA), which identified a programme of priority areas and actions (cf. Hay 2013, p. 310). Following conferences were held in Mauritius in 2005 and in Samoa in 2014 (cf. Hirano 2011, p. 11).

According to the IPCC AR5, current and future climate-related drivers of risk for islands include sea-level rise, increasing air and sea surface temperatures, an increase in the proportion of more intense storms like tropical and extratropical cyclones and changing rainfall patterns (cf. Nurse et al. 2014, p. 1616). Sea level rise, including sea flood and erosion risk, is one of the most widely recognized climate change threat to low-lying coastal areas on islands. Secondary effects of climate change threats are salt water intrusion in coastal aquifers, coral bleaching and reef degradation (cf. ibid.), ocean acidification, increased climate variability and weather extremes (cf. Hay 2013, p. 310). Most of the SIDS derive benefits from their natural ecosystems in form of tourism and are economically dependent on that sector. Therefore, sea level rise is indirectly also one of the major economic threats of climate change. The coastal island system and the social systems of the island are also highly vulnerable to non-climate stressors. These are pressures induced by global changes, livelihood, development and local issues, as Figure 3 visualizes and exemplifies (cf. Hay 2013, pp. 310f; cf. Kelman, West 2009, pp. 2ff).

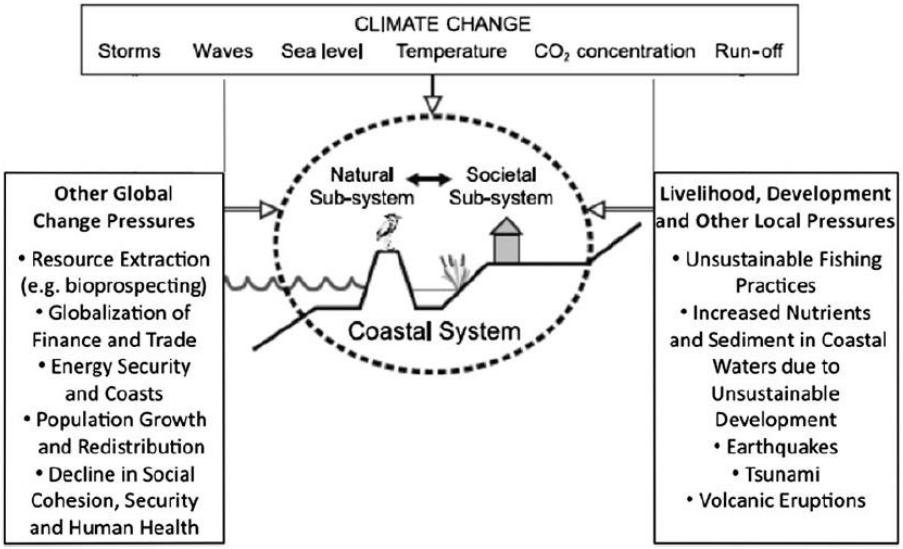

Figure 3: Impacts from climate change, global change factors, livelihood, development and local pressures on a coastal system (Hay 2013, p. 311).

The IPCC Assessment Reports and other scientists state that developing countries and especially SIDS are more vulnerable to climate change and natural hazards due to their greater exposure, sensitivity and limited adaptive capacity. According to this argumentation, they lack certain adaptive capacities, like institutional capacity, economic resources and human capital for implementing and coordinating technologies (cf. Smith et al. 2003, pp. 2f; cf. Dulal et al. 2009; cf. Nurse et al. 2014). Poorer countries and islands already face challenges in accessing resources, such as water, food, energy, which

climate change impacts, for instance more frequent droughts, can exacerbate. However, critics claim that the meaningfulness of the assessment of the relationship between high vulnerability and low adaptive capacity based on indicators of economic development and technology is limited. They question the assumption that poorer, less developed countries have less adaptive capacity and are therefore more vulnerable (cf. Magnan 2010, pp. 6f).

Actually, developing nations have demonstrated their adaptive capacity based on experiences and knowledge (cf. Adger 2006, p. 274) and have proven resilience to climate change, e.g. shown by smallholder farmers in Bangladesh and Vietnam (cf. Adger et al. 2003, p. 181). The IPCC AR4 states examples for high adaptive capacities of communities in forms of social capital, values, customs and others. For instance, non-monetary arrangements and social networks have been proven successful after storm damages in Samoa (cf. Adger et al. 2007, p. 728). Especially the coastal natural and societal systems of small islands demonstrate a high natural resilience to pressures from climate change, global change and livelihood because of their long history of coping with extreme climate events and variability (cf. Hay 2013, p. 311). Thus, a high level of exposure to natural hazards has created capacity to change and adapt. The constant struggle with natural hazards can also be a reason for the low level of development. However, this adaptation dimension is rather reactive than proactive and anticipatory (cf. Magnan 2010, pp. 7f). Moreover, colonization and globalization have reduced the resilience to change. As a result, increased infrastructure and tourism development degraded ecosystems and reduced their natural buffering capacity. The dependence on the tourism sector for economic growth and development has also increased the economic vulnerability of an island (cf. Hay 2013, pp. 319ff). A further counterargument to the low adaptive capacity of developing countries is that industrialized countries have also not remarkably adapted to environmental thresholds, which would have proven their high adaptive capacity (cf. Magnan 2010, p. 7). Especially recent climate events in Europe, the United States and Australia, e.g. heatwaves or droughts, have questioned the ability of developed nations to adapt to climate changes (cf. Moser, Ekstrom 2010, p. 22026).

Hence, the classification into degrees of vulnerability is justified on the level of groups, not on a country's development status in general (cf. Adger 2006, p. 273). Political ecology tradition argues that the unequal economic development and subsequent class differences and economic dependencies have created higher vulnerability of poorer and marginalized groups. Therefore, poor and disadvantaged groups often live in set-

tlements in exposed areas to natural hazards, have sensitive housing or are employed in vulnerable sectors (cf. Dulal et al. 2009, p. 365; cf. Adger 2003b, p. 388, 2006, p. 271). However, that might not always be the case and people living in vulnerable areas, such as low-lying coasts, may not be poor (cf. Nelson et al. 2008, p. 6). Accordingly, vulnerability can be called a "socially constructed phenomenon" (Adger et al. 2003, p. 181), or a "theoretical concept" (Hinkel 2011, p. 200). Institutional structures determine the vulnerability of a specific group because the group does not take part in decision-making processes and lacks access to power and resources, e.g. assets and capital (cf. Adger 2006, pp. 271ff; cf. Jones et al. 2010, p. 5).

4.2.4 Adaptation Needs and Adaptive Capacity of an Insular Tourism System

Tourism on small islands is very weather and climate-sensitive due to its dependence on the attractiveness of vulnerable natural ecosystems and visitors' choice (cf. Nurse et al. 2014, p. 1623). Therefore, adaptive capacity in this sector is important to reduce the overall vulnerability of a tourism dependent country. The understanding of tourism evolved from the perception of a tourism industry (businesses involved in providing tourism products and services) through a tourism sector (tourism industry plus governmental, environmental and societal impact) to a tourism system (cf. Becken, Hay 2007, pp. 10f). The meaning of "industry" and "sector" seemed not wide enough and comprehensive to cover the diverse range of all direct and indirect actors (cf. Conway 2004, p. 189). The constituting elements of the tourism system are the geographical nature, indirectly and directly involved humans and businesses as well as externalities to that system. Hence, in contrast to the sectoral view, the system is an open entity with responses to changes in its environment. This systematic view shows analogies with the complexity of ecosystems and complex adaptive systems. Non-linearity, self-organization and chaos can be attributed to tourism systems, for example caused by the impacts of a natural disaster (cf. Becken, Hay 2007, p. 11). The diversity of players and fragmented nature of the tourism system is one of the reasons why climate change adaptation strategies are challenging to plan and implement, which has been proven by studies in the Maldives (cf. Becken et al. 2011, p. 74). Becken proposed that a tourism destination can be an example of a socio-ecological system, whereby the destination is composed of institutions, activity sub-systems (e.g. nature based activities, accommodation, indoor attraction) and other players that are connected through networks, information flows and feedback. The destination constantly faces the climatic circumstances and influences them in the long-run (cf. Becken 6/27/2011). In the case of small islands,

the destination is a reflection of a system on a small and defined scale with clear demarcations, directly perceivable interactions of ecology, economy and society, being a "microcosm" (cf. DSD of the UN DESA 2012, pp. 2f).

Most adaptation needs for insular tourism systems are in the water sector and in coastal and marine ecosystems. According to the IPCC, resource degradation like coral bleaching and beach erosion adversely influences the perception of the destination and affects accommodation prices. Moreover, fresh water availability and quality, especially during droughts, have already impacted tourism operations (cf. Nurse et al. 2014, p. 1624). Figure 4 visualizes possible adaptation measure for an insular tourism system on direct and indirect climate consequences.

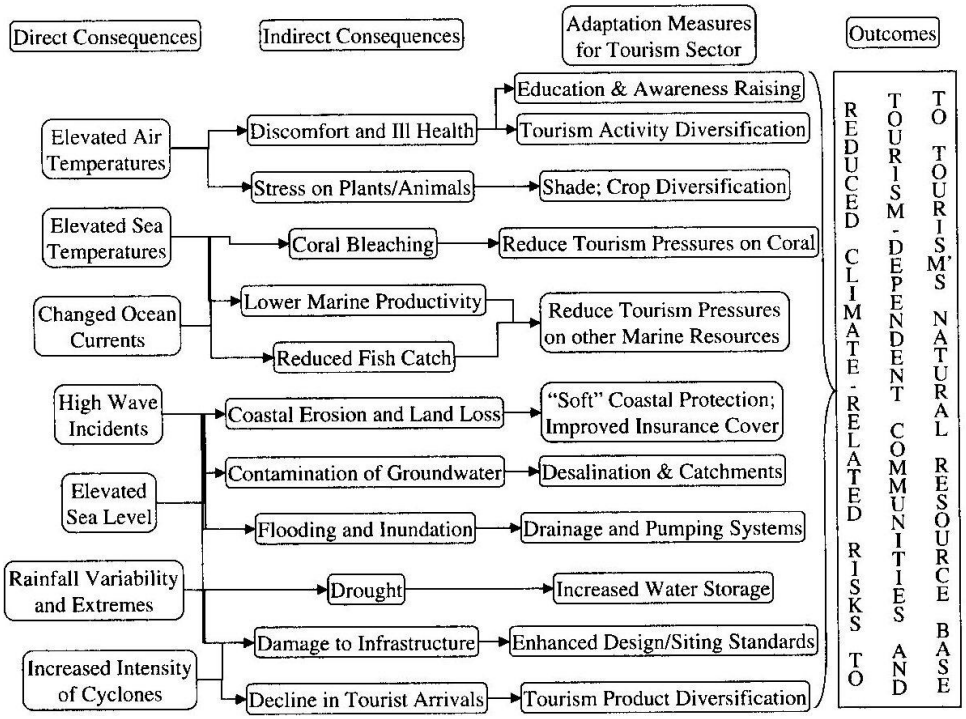

Figure 4: Direct and indirect consequences of climate change for tourism and adaptation measures for small island states (Becken, Hay 2007, p. 48).

Coastal and marine tourism planning on islands can adapt via "soft" protection measures such as enhancing ecosystem integrity and functionality (e.g. mangrove reforestation, coral nurseries, beach nourishment) or "hard" options (e.g. sea wall construction, boulders), which is similar to the engineering resilience. Precautionary construction-based and behavior-based measures can adapt the related tourism infrastructure (e.g. hotels, restaurants) (cf. Becken, Hay 2007, pp. 50ff). Another, rather complicated, adaptive response is the retreat of coastal properties to enable wider shorelines and pre-

vent coastal squeezing (cf. Scott et al. 2012b, p. 893).[12] Adaptation measures concerning rainfall variability are water storage, water reuse and desalination plants (cf. Nurse et al. 2014, pp. 1623, 1642).

Within this tourism system, the subsystems have different relative adaptive capacities. The tourist has the highest adaptive capacity since he/ she has a free choice on the tourism destination, depending on money, knowledge and time. The international tour operators and travel agents have also relatively high adaptive capacity. It was shown that under a very short-term planning time frame of 5-10 years, tour operators tend to change destination portfolios in case of climate damages, which can also be understood as an exit strategy instead of adaptation (cf. Becken et al. 2011, pp. 78f). The tourism-dependent communities, resorts and operators with immobile capital assets have the lowest capacity to adapt, visualized in Figure 5 (cf. Scott et al. 2012a, p. 271). Hence, financial resources, knowledge, planning timeframes and immobile capital determine adaptive capacity.

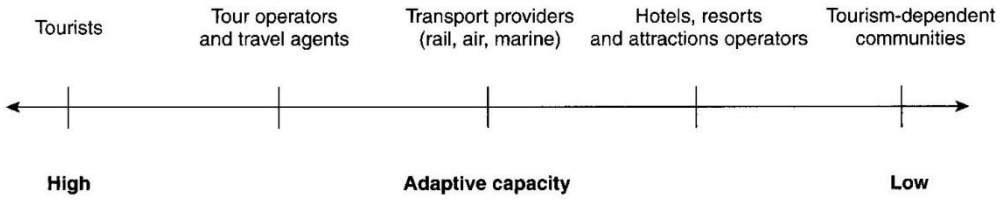

Figure 5: Relative adaptive capacity of the tourism subsectors (Scott et al. 2012a, p. 271).

A further determinant of the adaptive capacity is the adaptation motivation, which is influenced by risk perception, as explained in chapter 4.2.2. In general, the perception of risk differs strongly between the public and experts. The public underestimates the threat of slow-to-accumulate risks (e.g. sea level rise) and overestimate the threat of events with high magnitude and less frequency, like hurricanes (cf. Becken et al. 2011, pp. 77f). A study with tourism stakeholder in the Maldives revealed a high awareness of climate change but low concerns about its impact on Maldives tourism; whereby stakeholders saw other economic risks as more important. The interviewed government representatives showed more concern and knowledge compared to the interviewed persons from the private sector. A lack of knowledge among stakeholders was one reason for poor environmental practices. The actors had little knowledge concerning possible adaptive measures and addressed climate change impacts rather with mitigation

[12] The process of coastal squeeze describes a situation where physical infrastructure, like a sea wall or road, fixes the coastal margin in order to prevent landward migration of the coastline, beach or wetland. In situations of coastal squeeze, beach areas and coastal wetlands can be lost due to the creation of those boundaries (cf. Scott et al. 2012b, pp. 886ff).

measures in terms of reducing greenhouse gas emissions and environmental performance. Real investments in adaptation were not yet taken due to uncertainties of impacts (cf. Scott, Becken 2010, p. 293). Shorter-term climate change scenarios up to 20 years would reduce the discrepancy between the different timeframes of long-term climate change scenarios and tourism business planning. The government was assigned a key role in providing leadership, information sharing and responsibility for coordination (cf. ibid., pp. 78ff). For example by providing information on climate impacts and provision of hard adaptation options and facilitating adaptation by the industry (e.g. subsidies, planning and regulation). However, a study in the Caribbean showed that stakeholders perceive the governmental capacity to lead adaptation as limited (cf. Scott et al. 2012a, p. 280). Private stakeholders may see benefits in risk reduction and energy saving from investments in adaptation (cf. Scott, Becken 2010, pp. 288f). Private climate finance can also reduce public risk (cf. Noble et al. 2014, p. 844).

The historical development further determines the adaptive capacity of small islands. After the independence of many Caribbean islands around the 1960s, countries restructured their economic base from agriculture to tourism as being the main economic activity. Therefore, the islands still depend on the Western tourists' behavior and foreign currency exchange of the Western world. Dependency theory criticizes the tourism system for its reproduction of colonial and persistent power structures (cf. Duval, Wilkinson 2004, p. 68; cf. McElroy 2004, p. 41). From this perspective, colonial people and European travelers branded the Caribbean in the eighteenth and nineteenth century as "paradise" with an underlying understanding of pureness, exotic, tropical cultivation, romanticism and possessive attitude (cf. Sheller 2004). The post-colonial tourism has caused cultural commodification, environmental degradation, economic leakage, unequal societal structures and seasonal demand with fluctuating employment and income in some countries (cf. Gössling et al., p. 103).[13]

A balance of the economic, socio-cultural, environmental and natural dimensions in a destination, should be achieved by the widely applied concept of "sustainable tourism" as a catalyst for sustainable development (cf. Graci, Dodds 2010; cf. Hall 2010; cf. Scott et al. 2012a, p. 12; cf. UNEP, WTO 2005).[14] Principles and tools of sustainable tourism

[13] The topic of neo-colonialism and tourism, interlinked with climate justice opens a deeper discussion within dependency theory that will go beyond the research scope of this thesis. See further literature: Sheller 2004, McElroy 2004.

[14] A general definition of sustainable development is the Brundtland definition which is operationalized by the Triple Bottom Line of social, economic and ecological sustainability. The UNWTO defines

are based on a destination-centered approach and on an industrial level. The ecological dimension of the sustainable tourism concept is rather concerned with small scale environmental resource conservation and impacts than with the broad climate perspective. Accordingly, it does not take transportation in form of long-distance flights into account (cf. Mundt 2011, pp. 142f). However, the global tourism sector (transport, accommodation, activities) contributes 5% to the global CO_2 emissions and total GHG emissions have a share of 12.5% of all GHG emissions (cf. Scott et al. 2012a, pp. 100f). Ultimately, this contribution to climate change and resource consumption also affects the destination and its local tourism system and can set back adaptation measures. In contrast to the thematic perspective of sustainable tourism, sustainable development takes a global and holistic perspective (cf. UNEP, WTO 2005, p. 11; cf. Scott et al. 2012a, p. 10).[15]

Since tourism has the potential to mitigate GHG on a local scale and directly benefits from ecosystem services that need to be sustained for the survival of the industry, mitigation and adaptation measures can form synergies. The use and reliance of ecosystem services by the tourism operators can oblige them to reinvest in those ecosystems by terrestrial waste treatment, organic composting, water reuse and investments in renewable energy. Besides the benefit of climate change mitigation, the use of renewable energy sources is an independent energy supply that is not exposed to price volatility on the international market. Together with energy efficiency measures, renewable energies can reduce overall costs and emissions. However, islands face obstacles for implementing renewable energies because of a lack in research and development, historical commitment to fossil fuels and institutional barriers (cf. Nurse et al. 2014, pp. 1641f).

4.3 Barriers to Adaptation

In the IPCC, adaptation challenges are a synonym for adaptation barriers and constraints (cf. Klein et al. 2014), which are defined as “factors that make it harder to plan and implement adaptation actions or that restrict options” (Agard, Schipper 2014, p. 1758). The focus here is on planned adaptation to climate change. Prutsch et al. (2014) identify eight challenges to climate change adaptation. Those are a regional and local disparity of climate impacts, sector specific impacts and adaptation needs as well as cross-

sustainable tourism accordingly as "Tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities" (UNEP, WTO 2005, p. 12).

[15] Hall proposed one strategy to resolve this trade-off: steady-state tourism with qualitative development. This should be achieved by internalizing all external effects throughout the whole consumption and production of tourism activities (cf. Hall 2010, pp. 15f).

sectoral effects of adaptive measures. The inclusion of various levels of decision-making, from subnational to local level can cause structural challenges. Also, actors and stakeholders are affected in different ways and might have different interests in adaptation measures. Further barriers are imperfect knowledge and uncertainties on the projection of future greenhouse gases and non-climatic factors, such as human behavior and technology. The scientific knowledge on the climate system provides insufficient long-term data for downscaling impacts to the regional level. However, experienced climate change impacts (e.g. rising sea level, glacier melting) and projections justify adaptation actions. Long-term global projections and the large-scale nature of risk do not provide information for short-term decision-making or side-specific adaptation options. If non-climatic factors that play a big role in political decision-making, e.g. demography and economic development, are not incorporated, stand-alone adaptation actions will be challenging. Moreover, climate change affects regions, sectors and population groups differently, which calls for an ecological and social balance and justice in impacts and adaptation. Potential barriers, like financial, cognitive, behavioral, social, cultural ones have to be identified and overcome. Barriers can also hinder regulations, opposing political interest, impeding organizational or managerial structures, missing information or its exchange between science and policy, limited experience or lack of technology (cf. Prutsch et al. 2014, pp. 7ff).

Accordingly, Moser and Ekstrom (2010) developed a framework to diagnose barriers in planned climate change adaptation processes (Moser, Ekstrom 2010). Eisenack et al. (2014) focus on the actor perspective, since certain conditions imped actors differently, depending on their context. The actors are also capable of reducing or overcoming those barriers (cf. Eisenack et al. 2014, p. 868). Even though the objective of this research is not the identification of barriers to adaptation, those are likely to be revealed automatically as they can be a reason for low or for non-executed adaptive capacity (cf. ibid., p. 867). Those actor-centered barriers to adaptation can explain the reasons and circumstances, under which adaptation is undertaken or not (cf. ibid., p. 870).

Part II: Empirical Assessment of Adaptive Capacity

5. Methodical approach

5.1 Case Study Selection and Data Collection Technique

The theoretical considerations of the former chapter guided the process of data collection and directed the data analysis (cf. Yin 2009, p. 36). Case studies can either be understood as an "approach" as they subsume different data collection methods of social sciences (cf. Witzel 1982, p. 78) or they are understood as a single research method (cf. Yin 2009). The qualitative social research approach seems adequate for answering the research question because it aims at understanding the individual action within its complex interaction with the environment (cf. Mayring 2010, p. 19). The underlying determinants of adaptive capacity of the tourism sector within the socio-economic and ecologic environment characterize this individual action, which will be investigated in the case of Grenada.

Case studies "[try] to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result" (Schramm 1971, p. 6). In the case of Grenada, the determinants of the adaptive capacity guide the decision for adaptation action or inaction. The case study has a rather exploratory purpose since there is little knowledge and research on the types of adaptive capacities and the possibly resulting adaptive actions in the Grenadian tourism sector. Exploratory case studies are done because even though there is extensive literature on the theoretical background of the research topic, there is little knowledge directly concerned with the investigated case. However, the author will also reveal some explanatory findings in order to give indications for the reasoning ("why") and manner ("how") of how adaptive capacities were built or enhanced (cf. Yin 2009, pp. 8ff). The case study design is an embedded single case study, whereby the case is the tourism system in Grenada and the single units of analysis are subunits of the tourism system, also called sectors, as the government, public institutions and private stakeholders (cf. ibid., p. 50). Two rationales for the single case are the theory testing ability and the representative function for other small island developing states (cf. ibid., p. 48). Even though adaptive capacities are context specific, the authors assumes a representative role of this case for other small island developing states.

The geographical location of the case study was selected on basis of the relevance for the scientific research topic, which is adaptive capacity of SIDS, and access to and availability of data. The author had the possibility to generate data on the ground in Grenada through an internship in the project "Integrated Climate Change Adaptation Strategies in Grenada", implemented by the German Agency for International Cooperation (GIZ), United Nations Development Program (UNDP) and the Ministry of Agriculture, Forestry, Fisheries and Environment of Grenada. The author chose tourism as the field of investigation because of the economic relevance of the sector in Grenada as well as its strong interdependence with the climate and environmental system. The scientific interest and research gap concerning tourism and climate change adaptation were already explained in the introduction.

The applied method is based on a data triangulation of multiple sources of evidence: reports and document analysis and interviews. The analysis of reports and documents reveals the background information concerning the country and climatic impacts of exposure and sensitivity in Grenada. Thereby, it investigates the contextual conditions for vulnerability. It is important to integrate the contemporary phenomenon of adaptation in the real life contextual conditions of the country because adaptive capacities are highly context specific (cf. Yin 2009, p. 18). The reports and documents used are governmental reports and policies as well as climate assessments for Grenada and the Caribbean region from international organizations.[16] The author chose these documents because of their information density, political relevance and topicality. The interviews deal with the explicit experiences of actors in the Ministry of Tourism, Civil Aviation & Culture (henceforth referred to as the Ministry of Tourism), the private tourism sector (hotel resorts, dive shop, tour operators) and a non-profit community-based tourism organiza-

[16] Documents and reports:
- DSD of the UN DESA (2012): Climate Change Adaptation in Grenada: Water Resources, Coastal Ecosystem and Renewable Energy.
- DSD of the UN DESA (2012): Road Map on Building a Green Economy for Sustainable Development in Carriacou and Petite Martinique, Grenada.
- Felician, Melissa; Joseph-Brown, Lynette (2012): Third International Conference on Small Island Developing States: Grenada National Report.
- Government of Grenada (2000): Grenada's Initial Communication to the UNFCCC.
- Government of Grenada (2002): Workshop Report and Plan of Action: Adaptation to Climate Change in the Caribbean Tourism Sector Workshop Grenada.
- Government of Grenada: Grenada National Climate Change Policy and Action Plan 2007-2011.
- Henry, André Vincent PhD (2013): The Marine and Yachting Sector in Grenada.
- Simpson, M.C.; Clarke, J.F.; Scott, D.J. (2012): CARIBSAVE Climate Change Risk Atlas (CCCRA) – Grenada.
- World Bank, CIAT, CATIE (2014): Climate-Smart Agriculture in Grenada.
- World Travel & Tourism Council (2015): Travel & Tourism Economic Impact 2015 Grenada.

tion. Whereas the document and report analysis focuses on the country specific background and climate impacts, the interviews only partly deal with perceived impacts and mainly with adaptation actions and adaptive capacity, sustainable tourism practices and the wider setting of the tourism sector development. Since there are no good records regarding the adaptive capacity of the tourism sector in Grenada, the interviews will be the only source of evidence for the adaptive capacity. This segmentation seems reasonable for answering the research question and adequate for the scope of this thesis. Therefore, the full advantages of triangulation, like content variety and additional construction of validity, are not appreciated to the full extent (cf. Yin 2009, pp. 116f).

The interviews were conducted based on a semi-standardized interview guideline referring to the methodical approach of Gläser and Laudel (2010). The author developed the guiding questions from the theoretical background as the theory can be seen as a "blueprint" that explains the real processes and their causes by using abstractions (Yin 2009, p. 36). Semi-standardized interviews provide the best basis for the interviewer to adhere to preset topics and guiding questions, which provide orientation and assure comparability between the interviews, but still have a flexible and conservation-like talk with possibilities for changes in the sequence of questions, further explanations and spontaneous questions (cf. Gläser, Laudel 2010, pp. 41f). The author pre-tested the interview guideline once with the first interview. Afterwards, she changed the sequence of questions slightly, so that the third question was put to the end of the interview. However, the first interview could not be used for the analysis as the interview partner did not permit to record the interview. The interview minutes were insufficient and did not assure comparability with the other interviews. Without the pretest, the author conducted ten interviews with the adjusted interview guideline and used all of them for the data evaluation. All of the interviews were conducted by the author herself and without the presence of a third party: Six of the interviews took place in the office of the interview partners, two interviews were conducted in the office of the interviewer, one interview was done in a public place and one via skype.

The interview guideline (see appendix II) started with an introductory question to get to know the interview partner and make him/ her feel comfortable. The following thematic questions were composed out of a guiding question and up to three further questions in order to explain the guiding questions or encourage a more detailed answer. Firstly, the interview addressed the perceived vulnerability to climate change for the Grenadian tourism system and for the specific business operation/ organization. The

ministry representatives were only asked for the vulnerability of the tourism system since they do not have a business. Thereby the climate stimuli towards the sector feels most impacted and the section of impact (coast, water etc.) for the country or the business/organization and adaptation needs were revealed. Hence, risk perception, exposure and sensitivity should be indicated. The second and main part of the interview dealt with the adaptation actions and adaptive capacity of the interview partners' institution. The interviewer asked about the relevance of adaptation to climate change in the ministry/business/organization, in order to assess the adaptation motivation. Even though risk perception can be assessed as high, the willingness to adapt can be low. Afterwards, the interviewer wanted to know about adaptations or adjustments to climate change that have been implemented already and about their goals. This should assess former and current adaptive actions and their scope within the ministry/ business/ organization. Then, the interviewer asked about the reasoning and decision-making for the adjustment and about possible triggers for adaptations. The next question was concerned with the resources needed for the adjustments and it was asked, if barriers for adaptation measures existed. In case the interview partner did not plan or implement any adaptations, a hypothetical question on desired or needed adaptation was asked. Moreover, the interviewer addressed specific adaptive capacities (e.g. finance, technology, human capital, social capital, institutions and governance) by asking about the role the following aspects have for climate change adaptation: financial resources, technological innovations, handling of environmental and climate related information, interaction with other tourism actors concerning climate change, knowledge of organizations dealing with climate change and participation in policy processes. If the interview partners have already conducted adaptation actions, these aspects were only addressed if they have not been covered before. The last question on adaptation was concerned with future adaptation plans, which should again indicate the risk perception and risk anticipation of the interview partner and give additional indications for adaptive capacities. The last topic of the interview guideline addressed the general setting of the tourism sector by asking for experienced changes regarding the environmental-tourism interface during the last 10-30 years in Grenada. Finally, the interviewer asked if there were any other relevant aspects the interview partner wanted to mention. It has been evaluated that adaptation actions might not be perceived as climate change adaptation and are often integrated in wider environmental actions or in response to other issues disregarding climatic variables (cf. Smit, Wandel 2006, p. 289). Therefore, the interviewer also asked for environ-

mental protection and related issues. This has also the potential to reveal synergies between mitigation and adaptation.

The selection of interview partners was based on two criteria: firstly, they should be either from a private tourism business, Ministry of Tourism or tourism related non-profit organization; and secondly, the businesses were selected because of their existing good environmental practices and their size.[17] This selection of positive examples provided some certainty that the assessment of adaptive capacity will reveal some findings and can exemplarily be undertaken. In five businesses, the author interviewed the owners (who have also the function of general manager), in one case the general manager and in another case the person responsible for environmental topics. The author chose the two interview partners from the Ministry of Tourism because of their position in the intersection of climate and environmental issues. The non-profit organization was chosen because of their work in environmental and community tourism and because it is the largest and best known organization in this field in the country.

5.2 Critical reflection of the Data Basis and Interview Guideline

The chosen documents and reports could distort the data basis for the country profile and exposure and sensitivity. A main criticism to the interview conception is that the interviewer had two different roles: the temporary role as an independent interviewer and the permanent role as an employee of the GIZ, working with the Grenada Ministry of Agriculture, Lands, Forestry, Fisheries and Environment. Therefore, some of the interview partners had known the interviewer beforehand from the professional context and could have had difficulties in separating those two roles. The answers of the interview partners could have been influenced or distorted, for instance, due to sympathy, or if they doubt the independency of the interviewer and fear that their answers might be used for governmental purposes or one could question the anonymity of the interviews. It might have been for that reason that one interview partner did not allow recording the interview. Another disadvantage of an existing acquaintance was that some interview partners could feel that the interviewer already knew about their situation and adaptation actions and holds back in explanations during the interview. Besides, the origin, age, sex or behavior of the interviewer could have distorted the situation and answers.

[17] Two hotels are certified under the Green Globe sustainability certification for tourism businesses and two hotels and the dive shop had environmental projects in place. The tour operators were chosen based on their size as they were among the largest on both islands. In general, tour operators are not many on the islands, so that the choice was limited.

The applied method of the interview can be criticized for overemphasizing the relevance of the discussed topic by the interview partner due to the execution of the interview. Also, the interview partner can reframe other problems and general concerns under the topic of climate change. Furthermore, the respondents might not want to disclose their vulnerability or risks to climate change impacts because it can show weakness, can be a reputational risk or is unofficial, confident information (cf. Grothmann et al. 2013, p. 3378). In case comprehensive adaptation measures have been implemented, people tend to represent assurance and functionality of the measures.

Especially in the case of tour operators, the author could not reveal specific 'best practices', wherefore she chose the size of the company as selection criterion. This decision was taken under the assumption that larger operators might have more capacities and could have some adaptation action within their portfolio. However, there could have been a better example without the author's knowledge. The criterion 'positive example' can distort the results, wherefore they are not applicable to the sector in general to the full extent.

Another factor to be mentioned is that four out of eight interview partners from the private sector were expatriates. Since the number of tourism businesses owned or operated by expatriates (most of them have the Grenadian passport) is rather high in Grenada, this is not unusual. However, their native cultural background can influence their reflection and judgement within the Grenadian context. Also, knowledge on the Grenadian political, economic, ecological and social context might differ between locals and expatriates.

5.3 Qualitative Content Analysis According to Mayring as Evaluation Method

The first step of the data analysis was the transcription of all recorded interviews. The data evaluation was conducted by using the qualitative content analysis according to Mayring (2010). Therefore, the author applied a mixture of the structural and summarizing content analysis, which is legitimate because the research question and material require those two techniques (cf. Mayring 2010, p. 65). By using the structural content analysis, deductively generated predefined categories form a system of categories, which was used as framework for evaluation. The categories were chosen based on the preliminary theoretical considerations. Firstly, the author analyzed four interviews on their coherence with the predefined categories and assigned the material accordingly. In the following summarizing content analysis, she paraphrased the relevant text passages, abstracted and reduced them to the essential content by selection and grouping in order

to define inductive subcategories under the predefined categories. Due to the high amount of data, those steps were done collectively. Thereafter, the author analyzed the remaining interviews accordingly to the inductive subcategories and eventually added additional subcategories (cf. Mayring 2010, pp. 65ff). Hereby, the whole system of categories and the codings were revised. In the end, all interviews were assessed a second time in order to determine missing codings or additional subcategories. The author used the qualitative data analysis software MAXQDA for the coding of the material. Even though this is a qualitative analysis, some quantifications in terms of the frequency of categories, were integrated in order to strengthen the relevance of the qualitative categories (cf. Mayring 2010, p. 51). The documents and reports were analyzed regarding to the country profile, exposure and sensitivity by a summarizing content analysis as they only provide background information. The following categories were developed based on the theoretical background:

- *Exposure and sensitivity*: The assessment of exposure and sensitivity, with special focus on the impacts on the tourism sector, creates the vulnerability context in which adaptive capacity can reduce vulnerability. The interview material on subjectively perceived exposure and sensitivity was generated as supplement to the document and report analysis.
- *Determinants of adaptive capacities*: This category is the main part of the analysis. The author selected seven determinants of adaptive capacities based on their frequent occurrence, important role in the literature and relevance to the case, as described in chapter 4.2.2. Those are:
    - *Psychological determinants: adaptive motivation* and *adaptive belief* based on Grothmann et al. (2013)
    - *Natural resources*
    - *Technological resources*
    - *Financial resources*
    - *Human capital*
    - *Social capital*
    - *Governmental institutions*

Other evaluated determinants derived from literature, like institutions or governance, can be subsumed under one of the abovementioned determinants and will eventually form subcategories.

- *Sustainable tourism practices* form another category because they are very widespread, easier to grasp, implementable, manageable and provide more direct benefits for the tourism industry than adaptation measures. The tourism sector is supposed to have a short-term planning timeframe, limited and uncertain information on climate change impacts and limited access to holistic adaptation measures, wherefore general sustainable practices like energy and waste management might dominate over adaptation practices, as described in chapter 4.2.4. Sustainable practices can trigger or facilitate adaptation actions even though there is no direct adaptation motive or it is not linked to climate change effects (cf. Smit, Wandel 2006, p. 289). Hence, sustainable practices can be an adaptive capacity per se because they provide the capacity to become more climate-sensitive.
- *Tourism sector development* is a rather generic dimension of adaptive capacity. The past and potential sector development is considered in order to create a more holistic framework for adaptive capacity in the tourism sector. The dependence on the tourism sector and on Western tourists' choices can limit individual adaptive capacity, as described in chapter 4.2.4.

All of the determinants should reflect the full range of adaptive capacity and thereby also capture adaptation barriers, as suggested by Grothmann (2013).

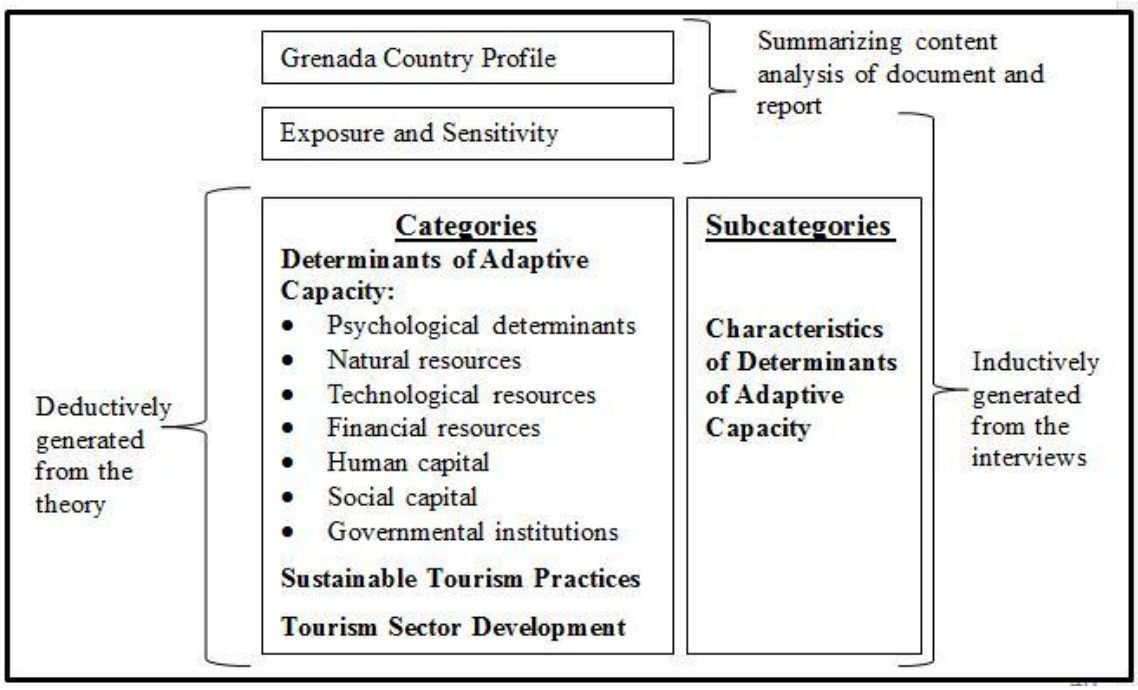

Figure 6: Methodology and System of Categories (author's own graphic).

6. Case Study Background

The presentation of the setting of the case study aims at clarifying the preconditions and circumstances for the empirical assessment of adaptive capacity. The country profile focuses on climatic and environmental conditions and the tourism sector. Thereafter, the author identifies exposure and sensitivity to climate change impacts based on document and report research as well as generated by empirical findings from the interviews.

6.1 Country Profile Grenada

Figure 7: Map of Grenada (Encyclopedia Britannica 1998).

The State of Grenada is a Caribbean island state that consists of the three inhabited islands of Grenada, Carriacou and Petit Martinique and six uninhabited islands. It is of volcanic origin and located in the south of the Caribbean and belongs geographically to the Windward Islands. After the initial French settlement in the 17th century, the British conquered the island in 1783. Grenada reached independence in 1974 but still forms part of the British Commonwealth. In 1983, a US-led invasion was the reaction to the overthrow of the government by a Marxist-Leninist group, whereupon the old governance structure was reestablished (cf. DSD of the UN DESA 2012, pp. 7f). The tri-island state has about 110,000 residents and is sized 345 km², whereby most of the population lives on the main island Grenada. It is the biggest island with a length of 34 km and a width of 18 km. Grenada has mountainous terrain in the inland and beaches, coral reefs, sea grass beds and mangrove swamps at its coastal zone. The highest mountain is Mount St. Catherine with its top at 833 m above sea level (cf. Felician, Joseph-Brown

2012, p. 5). 3% of the land area is at sea level, where most of the major towns, including the capital St. George's, are located, with the most population and socio-economic activity in the Southwest (cf. Simpson et al. 2012, p. 4; cf. Government of Grenada 2000, p. 1). With a humid tropical climate, the average temperature is 26°C and wet and dry seasons exist. Wet season is from June to December and the annual rainfall was 750 – 1400 mm over the last decades. The southern edge of the Atlantic hurricane belt touches Grenada and the country is vulnerable to occasional hurricanes, tropical storms and storm surges (cf. Government of Grenada 2000, pp. 4f). In September 2004 hurricane Ivan, one of the late extreme weather events occurred. It was rated as a category 4 hurricane and had a wind speed of approximately 140 mph. Only one year later, the devastating hurricane Emily hit Grenada, which was categorized as a category 5 hurricane (cf. ibid., p. 5, cf. Felician, Joseph-Brown 2012, p. 5). The occurrences of El Niño or La Niña phenomena influence the frequency of hurricanes.[18]

The main economic sectors are tourism, agriculture, construction, banking and insurance services (cf. Simpson et al. 2012, p. 7). Since the 1970s a transformation from the agriculture to the service sector has occurred and the GDP contribution from agriculture, including fishery, decreased from 20% (1970) to 5.2% (2011) but is still an important source of income for the rural area as it employs 13% of the economically active population (cf. DSD of the UN DESA 2012, pp. 8f; cf. World Bank, CIAT, CATIE 2014, p. 1). Prior to the two hurricanes, the country expected an economic growth rate of 5.7% (cf. Becken, Hay 2007, p. 49) and approached the achievement of several Millennium Development Goals (cf. Felician, Joseph-Brown 2012, p. 5). As a result of the hurricane destructions, unemployment rate increased from 13% to 25% in 2008 and the poverty rate was 37.7% in 2008 (cf. Simpson et al. 2012, pp. 8f).[19] The increasing oil and fuel prices in 2006 and the global financial crisis in 2008 hit Grenada's economy severely. The financial crisis especially impacted the tourism and construction industry (cf. Felician, Joseph-Brown 2012, pp. 5f). After the decline in stay-overs arrivals by 11.6% in 2009 and by 3.0% in 2010 (cf. DSD of the UN DESA 2012, p. 9), the tourism sector recovered and arrivals increased by 7.1% in 2011 (cf. Caribbean Tourism Organization 2013, p. 2). In 2014, the direct contribution from travel and tourism to the national GDP was 7% (XCD 154.4 mn) with 6.4% of total employment (3,000) directly employed in

[18] El Niño Southern Oscillation describes the warming of the tropical Pacific Ocean east of the dateline in association with a fluctuation of a tropical and subtropical surface pressure pattern on global scale. See more information Agard, Schipper 2014.

[19] A more detailed explanation on the hurricane impacts is undertaken in the next chapter 6.2.

tourism. The direct contribution reflects the internal spending (e.g. accommodation, activities) on travel and tourism plus individual spending by the government (e.g. culture, natural parks). The total contribution to the GDP from travel and tourism was 24.2% (XCD 531.9 mn) with 22.1% of employment (10,500) indirectly linked to tourism. Total contribution includes the indirect (e.g. investment spending, government collective spending, purchases from supplies) and induced contribution (e.g. spending of indirect and direct employees). The spending of visitors accounts for exports, which were 47.8% of total exports in 2014. All those tourism indicators have increased until 2014 and are forecasted to rise or remain stable in 2015 (World Travel & Tourism Council 2015, pp. 1f).

Most tourism activities are concentrated around the capital St. George's on the southwest coast, where the harbor, airport and most beach resorts are located. Grenada is one of the cruise ship destinations in the Caribbean, with 235,140 cruise ship passengers in 2014, which is almost twice as much as the 133,521 stay over visitors (cf. Caribbean Tourism Organization 2015, pp. 2ff). Economically, stay over tourists are more valuable to the national economy as their expenditure is higher than day visitors from cruises (cf. The CARIBSAVE Partnership 2012, p. 10). The marine and yachting sector is another important source of income. It was calculated that its net impact on the GDP is with XCD 130.4 mn comparable with the resort tourism segment (cf. Henry, André Vincent PhD 2013, p. 7). The tourism related emissions are estimated to be 59% of national CO_2 emissions, whereby aviation (59%) an accommodation (22%) are the highest energy consumers and GHG emitters, excluding the cruise ship sector (cf. The CARIBSAVE Partnership 2012, pp. xxvf).

Since January 2014, the island aims at becoming a geotourism destination and launched a new destination brand "Pure Grenada" (cf. Grenada Tourism Authority 2014). The Center for Sustainable Destinations of the magazine National Geographic coined the term 'Geotourism'. The director Jonathan B. Tourtellot defined geotourism as "tourism that sustains or enhances the geographical character of a place – its environment, culture, aesthetics, heritage, and the well-being of its residents" (National Geographic 2010).

6.2 Exposure and Sensitivity to Climate Change in Grenada

In the following, the scientific results of significant current and anticipated climate projections on Grenada will be evaluated and supplemented with the results of the interviews. The following abbreviations are used for the interview partners:

MoT 1, 2	Ministry of Tourism, Civil Aviation & Culture
H 1, 2, 3, 4	Hotel
DS	Dive Shop
TO 1, 2	Tour Operator
NPO	Non-profit environmental and community tourism organization

The Caribsave Climate Change Risk Atlas is the main source of evidence concerning prospected regional and national climate change impact. Caribsave is a regional not-for-profit organization dedicated to climate change and sustainable development projects (cf. INTASAVE-CARIBSAVE 2014). The Climate Change Risk Atlas was conducted for 15 countries and assesses climate change risks, vulnerabilities and adaptive capacities "through the lens of the tourism sector" (The CARIBSAVE Partnership 2012, p. xi). The information is based on the IPCC emission scenarios A2, A1B, B1 on General Circulation Models (GCM) and Regional Climate Models (RCM) (cf. The CARIBSAVE Partnership 2012, p. 12).[20] Due to these evidences, the Risk Atlas was evaluated as the most recent, reliable and useful information source for the research objective. However, information from the documents and reports as well as interview results complement the findings, as explained in chapter 5.3.

Temperature increase

Average temperature is subjected to increase between 0.7°C and 2.2°C by the 2050s and 1°C and 3.7°C by the 2080s under the GCM and 2.4°C and 3.2°C under RCM (cf. The CARIBSAVE Partnership 2012, p. 13). The earliest temperature threshold of 1.5°C will be crossed under the high emission scenario in 2023. Even under low emissions, this threshold will be crossed in 2027, see Figure 8. Implications for the tourism sector in Grenada are increasing operating cost for hotels due to higher water consumption and energy consumption for air conditioning, which already have been experienced in the past. A demand shift due to higher temperatures in the tourism source markets and their regions could also have negative implications for tourism demand in the Caribbean (cf. Government of Grenada 2000, p. 34).

[20] Scenario A2 is considered as high emissions scenario, A1B is a medium high scenario, B1 is a low emission scenario. For further explanations of IPCC emissions scenarios and GCM and RCM, see Stocker et al. 2013.

SRES Scenario	1.5°C Threshold		2.0°C Threshold		2.5°C Threshold	
	Earliest	Latest	Earliest	Latest	Earliest	Latest
A1B	2023	2050	2038	2070	2053	Later than 2100
A2	2024	2043	2043	2060	2056	2077
B1	2027	2073	2049	Later than 2100	2068	Later than 2100

Figure 8: Temperature thresholds under three scenarios (The CARIBSAVE Partnership 2012, p. 13).

None of the interviewees mentioned increasing temperatures. Even though some mentioned high water consumption as an issue, they discussed water as a constraint resource, which is rather pressured by less rainfall, than by increasing temperatures (Interview TO1, H1, MoT1). The interviewees saw high energy consumption as problematically due to the generally high electricity costs and political barriers for the installation of renewable energy power plants in Grenada. However, they did not link increased energy consumption to higher temperatures (Interview H1, H4, H2).

Precipitation

Annual rainfall is projected to decrease up to -40 mm and increase to +7 mm per month by the 2080s, which is -66% to +12% of the precipitation in 2012 (cf. The CARIBSAVE Partnership 2012, p. 15). The decrease in precipitation will be felt by shorter rainy seasons and precipitation in shorter duration. Also, an increase in consecutive dry days, leading to an increase in periods of droughts, is expected. The availability of sufficient water and adequate water quality is therefore a critical issue for the tourism system. During dry season, high tourist season and thus increased water demand exacerbate the water scarcity. The last severe droughts were in 1992 with an economic loss of 40% and in 2009/ 2010 with up to 65% reduction in water production. One trickle-down effect related to droughts is a reduction of soil moisture, which can cause bush fires. The fire service then affects water catchments by increasing potential surface erosion and reducing water quality. In general, watersheds from permanent rivers, groundwater, rainwater and desalination supply fresh water. In Grenada, groundwater recharge contributes to 10-15% of water demand and is especially sourced during dry season. In case of decreasing groundwater recharge due to over abstraction and low precipitation and sea level rise, seawater intrusion threatens coastal aquifer (cf. The CARIBSAVE Partnership 2012, pp. 31ff). Carriacou and Petite Martinique have no groundwater reservoirs and the islands are totally dependent on rainwater harvesting. During the drought in 2010 water was imported from the mainland Grenada to Carriacou (cf. DSD of the UN DESA 2012, p. 55). Even though total precipitation is decreasing, the

frequency and intensity of storm events with heavy rainfall is projected to increase. This can cause flooding, soil erosion or negatively impact water quality or contaminate groundwater (cf. The CARIBSAVE Partnership 2012, p. 36). However, the trends for rainfall extremes are wide-ranging from decrease to increase (cf. The CARIBSAVE Partnership 2012, p. 24).

Three of ten interview partners in Grenada experienced less rainfall and perceived water supply as a corresponding problem and drought as the "major impact" (Interview MoT1, line 74) and "biggest impact of climate change" (Interview H1, line 17). Two private businesses felt a direct impact for their business operations. The tour operator was concerned about the natural environment: "We take them [the tourists] to natural features like waterfalls and river, the waterfalls and rivers are becoming smaller" (Interview TO2, line 51). An hotelier experienced the drought in 2010 as an "eye-opener" (Interview H1, line 20) and stated that water shortage "will be the most difficult thing for us to combat" (Interview H1, line 22). The public awareness for rainfall changes was perceived as too low, since a drought accumulates over time and is only noticed "until it is too late" (Interview H1, line 20). One statement contradicts with the empirical evidence of the drought in 2010, since the person said that a drought situation was not experienced "for a long time" (Interview H3, line 65). Thus, water supply "has not been an issue for the last four years" (Interview H3, line 72) and the person trusted in the national water supply system. Four interview partners experienced a change in seasons. Contradictory to the projections, two persons referred to an extended wet season that "carried on to the dry season" (Interview TO2, line 31) or even as "the dry season has just become the rainy season" (Interview H3, line 66). Two other persons mentioned the unpredictability of rainfall as a change but do not derive any consequences for the water supply: "So I would say the whole weather pattern is not there anymore" (Interview H2, line 21),

> "In terms of the changing weather patterns, obviously in the past, you could have come to Grenada at a particular point in time and almost guarantee a particular weather pattern. Now that is no longer the case, you know" (Interview MoT1, line 10).

Since the population in Carriacou relies totally on rainfall, both interview partners showed a high awareness for the scare resource. Only one explicitly referred to less rainfall and less heavy rainfall and remembered the water import during the drought in 2010 (Interview TO1). However, the drought hadn't had an impact on the accommodation sector as the "guesthouses would keep getting water" (Interview TO1, line 157).

Another person regarded water as an essential resource for development and investment from abroad (Interview H4).

Sea surface temperature

An increase in sea surface temperature between +0.9°C and +3.1°C is projected by the 2080s (cf. The CARIBSAVE Partnership 2012, pp. 21f). Together with sea level rise, coral bleaching and reef degradation, this will threaten the coral reef ecosystem services with negative consequences for island livelihoods, as they provide coastal protection, subsistence fishery, recreation and tourism services (cf. Nurse et al. 2014, p. 1616). One interview partner reported on rising ocean temperatures and a corresponding change in marine biodiversity (Interview MoT2). He related the reef degradation to increased storm surges, viruses and algae and ocean acidification instead of connecting it to rising sea surface temperature (Interview DS).

Sea level rise and coastal erosion

Sea level is expected to rise due to thermal expansion and ice-sheet, ice-cap and glacier melt, whereby thermal expansion accounts for 70-75% of total sea level rise. For the Caribbean, the mean projected sea level rise (SLR) by 2100 relative to 1980-1999 ranges between 0.13 and 0.56 m depending on the scenario (cf. The CARIBSAVE Partnership 2012, pp. 28f). Consequences are floods, coastal erosion, degradation of fresh ground water through wave over-wash and degradation of coral reefs. Sea level rise is particularly a threat to the low-lying coastal areas on the island, especially to the 3% of land area laying at sea level (cf. The CARIBSAVE Partnership 2012, p. 4). By a 1 m rise of the sea level, 73% of all major tourism resorts are at risk and 50m erosion 95% of the resorts are at risk and the beach will have disappeared, see Figure 9 (cf. The CARIBSAVE Partnership 2012, p. 82).

		Tourism Attractions		Transportation Infrastructure		
		Major Tourism Resorts	Sea Turtle Nesting Sites	Airport Lands	Major Road Networks	Seaport Lands
SLR	1.0 m	73%	44%	50%	4%	40%
	2.0 m	86%	60%	-	6%	-
Erosion	50 m	95%	100%	-	-	-
	100 m	100%	-	-	-	-

Figure 9: Impacts associated with 1m and 2m SLR and 50m and 100m beach erosion in Grenada (The CARIBSAVE Partnership 2012, p. 82).

Even if SLR does not affect the infrastructure, tourism assets like beaches will be damaged. By 0.5 m SLR, 4% of Grand Anse beach is lost, increasing to 22%, 77% and 100% in case of 1.0 m, 2.0 m and 3.0 m, respectively. The two other threatened beaches, Marquis Beach and Soubise Beach will experience a 100% beach loss already at 0.5 m SLR (cf. The CARIBSAVE Partnership 2012, pp. 81ff). When erosion effects are included, even 55%-75% of Grand Anse Beach could disappear under 0.5 m of the SLR scenario. The Carenage, a coastal strip in the capital of St. George's with important buildings like the Financial Complex, Sports Complex, harbor, is less than 0.2 m above sea level and would lose 18 hectares of land due to inundation by 1 m SLR (cf. Government of Grenada 2007, p. 3).

Seven of the interview partners in Grenada mentioned sea level rise as an impact of climate change (Interview TO2, MoT2, MoT1, H3, H2, H1, NPO). One person reported that the Atlantic east side of Grenada lost about eight miles (12.8 km) of landmass in the last centuries and is more affected by land loss than the Caribbean west side, which lost about 2 miles (3.2 km) (Interview MoT2). One interviewee described impacts on tourism places and infrastructure with "the Carenage will go, the airport may be cut off by the end of the century" (Interview TO2, line 8).

Two persons assessed beach erosion as a problem (Interview NPO, MoT1). Sea level rise, sea swells together with coastal erosion have already had impacts on the beaches and coastline and made especially the coastal tourism infrastructure vulnerable (Interview MoT1). Due to the increased risk of damages to coastal properties, the destination becomes less attractive to investors since insurance costs will increase (Interview MoT1). One person reported on a "lot more depth to Grand Anse Beach" (Interview H3, line 20) 15 years ago and experienced rising sea level himself three times a year: "We do have unprecedented high tides, which now are becoming a factor have we have to take into consideration when dealing with the day to day operations of the hotel" (Interview H3, line 6). Three persons saw sea swells as another threat to the coastline and the properties there, especially since parts of the coral reef outside of Grand Anse Beach have been lost (Interview H3, H1, MoT1), apparently by a hurricane in 1999 (Interview H3). One person said that sea level rise plus the beach degradation and beach loss at Bathway Beach in the north caused an invasion of species to the coast, like sharks and dolphins that were washed ashore (Interview NPO). The coast is also susceptible to landslides and rock falls in case of excessive rainfall (Interview MoT1).

Tropical storms and hurricanes

The intensity of tropical storms and hurricanes are probably increasing, as it has been the case during the last 30 years. Increased sea surface temperature over 26°C is a necessary but not sufficient condition for the formation, development and intensity of a tropical storm or hurricane (cf. The CARIBSAVE Partnership 2012, pp. 26f).

The climate extreme of hurricane Ivan in 2004 resulted in severe impacts: 28 persons were killed, 90% of housing stock damaged, 90% of hotel rooms damaged or destroyed (economic value of US$ 108 million[21], equals 29% of the GDP), heavy damages to ecotourism and cultural heritage sites (60% of jobs in this sector were lost), telecommunication loss, electricity damage, school damages, losses in the agricultural sector (equals 10% of the GDP, the main export products nutmeg and cocoa were expected to make no contribution to the GDP for 6-8 years). The overall damage was considered to be US$ 824 million, which was twice the GDP at that time (2004) (cf. Becken, Hay 2007, p. 49). One year later in 2005, another hurricane with category 5, Emily, hit the country and exacerbated the damages (cf. Felician, Joseph-Brown 2012, p. 5).

Only one person saw increased damages from storm surges and hurricanes but did not explicitly relate that to climate change. Storm surges "are causing more damage on more regular basis" to the coral reef (Interview DS, line 11). Because the reefs have become weaker due to diseases and virus, they are not able to bounce back from storm surges and hurricanes as they were 100 years ago. Another consequence of diseases and virus is that "coral die back" and allow algae growth, which hinder the regeneration of the corals (Interview DS, line 53). Furthermore, ocean acidification due to higher CO_2 in the atmosphere was said to have already impacted the coral reefs (Interview DS).

Non-climatic factors

Non-climatic factors that increase the vulnerability to climate change impacts can be summarized under unsustainable livelihood and development practices. In Grenada, those include absence of adequate agricultural soil and water conservation practices, uncontrolled and poorly managed exploration of the coral reefs by divers, sand mining on the beaches, mangrove harvesting for firewood, use of sensitive land and marine areas for development purposes without necessary safeguards (cf. Government of Grenada 2007, pp. 4f).

[21] All prices are in 2004 US$.

One interviewee mentioned sand mining at the northern beaches of Levera and Bathway and insufficient safeguard as serious issues (Interview NPO). Another interviewee from Carriacou said that mangrove harvesting for tourism development (marina) was a problem (Interview TO1). One person criticizes the use of sensitive land for infrastructural development, for instance tourism infrastructure at Grand Anse beach was developed on sensitive land, which was a wetland area previously and is therefore now susceptible to flooding (Interview MoT2). Additionally, run-off from the mountains, called "range to reef" (Interview MoT2, line 37) down to the coast and dry forest causes a lot of silt (Interview MoT2). Much reef fishing in Grenada caused stronger algae growth on the reefs, which contributes to the coral dying (Interview DS). Three interviewees spoke about the problem of missing national waste recycling systems and adequate disposal opportunities for hazardous substances (Interview H2, H3, TO2). Despite private recycling companies, there is no possibility for glass recycling (Interview H2, H3). Waste is directly delivered to a landfill, which is susceptible to climate change impacts from storms, heavy rainfall and erosion that can spread the waste around the island and ultimately affect the marine and land based ecosystems and human health (cf. The CARIBSAVE Partnership 2012, p. 66).

7. Results of the Adaptive Capacity Assessment

In chapter 7.1, the author presents the results of the empirical research on the specific determinants of adaptive capacity of tourism stakeholders in Grenada. She summarizes each determinant and its characteristics and discusses them individually. Chapter 7.2 explains the sustainable practices of the tourism sector and demonstrates analogies to climate change adaptation. The following chapter 7.3 describes the enabling adaptive setting of the tourism sector development, which is a rather generic category. In some interviews, the author noticed a low risk perception for climate change impacts and took a stronger focus on environmental issues or climate change mitigation. In these cases, capacities were assessed for potential adaptation to climate impacts and hazards as well as capacities for environmental practices as both can be complementary and the determinants are applicable to both. Thereby, the needs and capacities of the investigated sector guided the research rather than imposed predefined determinants.

7.1 Determinants of Adaptive Capacity of Tourism Actors in Grenada

7.1.1 Psychological Determinants

7.1.1.1 Adaptation Motivation

Risk perception:[22] Only two persons showed limited knowledge about climate change impacts since they requested more information on specific impacts. They were only aware of the climate impact that was relevant to them, like stronger sea swells and heavy rainfall (Interview H3, H2). Furthermore, the distinction between 'climate' and 'weather' was not clear as they mentioned the unreliability of weather forecasts (Interview H3) and "don't feel the whole weather is sort of a problem" (Interview H2, line 27). Three persons did not personally perceive climate change impacts (Interview H3, H4, TO2). Climate change impacts were rather seen as a future threat: "I have been told that sea level change is a certainty" (Interview TO2, line 7). One person stated: "I wouldn't really say […] that climate change itself has any impact on Carriacou […] No, actually, no, climate change hasn't really had an impact on my operations" (Interview H4, line 6, 15) and another one in Grenada responded similar: "[…] I don't think it has yet impacted on the island, which we represent and I don't think it's particular impacted on the guests who come here" (Interview TO2, line 39). Even though some respondents

[22] In the following, the italicized subheadings are the inductively generated subcategories; the characteristics of the determinants.

did not perceive climate change impacts as risks, the general climatic, topographic and geographic circumstances required physical adaptation and adaptive infrastructure. This resulted in unknown and proactive adaptation to climate change impacts, such as water saving measures, waste water recycling, building standards and disaster preparedness plans (Interview H2, H3). Thus, the challenging environment created the imperative for adjusted infrastructure:

> "There is no groundwater in Carriacou, so everybody has adapted to that situation since beginning of time. […] So when we designed the hotel, we designed it out of those measures" (Interview H4, line 19, 65).

When respondents had already perceived specific climate change impacts or natural hazards that had threatened their business, they showed high risk perception. In comparison, they had rather low risk perception for just probable impacts. In the case of two hotels, a hurricane has destroyed buildings, a drought has resulted in serious water supply problems and high tides have created problems for beach front suites (Interview H1, H3). Those experienced impacts triggered adaptation measures, like hurricane-resistant building codes and the construction of sand barriers (Interview H1, H3). The dive operator had also high risk perception because he experiences climate-induced coral reef degradation, wherefore he felt his and other scuba dive businesses threatened (Interview DS). Persons had also recognized climate change impacts and environmental changes even without the awareness of climate change and without knowledge on coping strategies (Interview NPO). The representatives of the Ministry of Tourism were also aware of climate change impacts like less rainfall, sea level rise and erosion. They were the only ones that mentioned the extraordinary responsibility for ecosystems that are impacted by climate change, not only for impacted tourism infrastructure (Interview MoT1). Even though the Ministry representative is aware of climate change impacts, adaptation has no relevance (Interview MoT1, MoT2). One Ministry representative summarized the perception and action towards climate change as: "climate change, probably is like the elephant in the room, globally, I mean" (Interview MoT1, line 132), which indicates an unmentioned and ignored risk that everybody is aware of but nobody addresses.

In general, little knowledge on climate change impacts, no experience with impacts and general climatic risk perception characterized low risk perception. Half of the respondents were aware of or experienced climate change impacts and therefore showed higher risk perception.

Time perception: Especially the private sector directly addressed the time discrepancy of climate change impacts and tourism planning (Interview H1, H2, H3). They had limited power of imagination and understanding of the process and manner of climate change impacts: "I just can't imagine that, you know, all of a sudden the water will become one meter higher […]" (Interview H2, line 8), "I mean climate change is such a slow thing that you have got some time to deal with it" (Interview H1, line 184). Three persons spoke about the lower prioritization of climate change in comparison to other factors and constituted this as a problem (Interview H1, H2, MoT1):

> "And you know, because you come from a perspective where you, ok, 10 years, 15 years, of course, with climate change. I have to solve problems which are right now […]. You know, it's very difficult to change always from this day-to-day thing to the longer thing" (Interview H2, line 297).

The main reason for this prioritization is that economic and financial impacts, crime or terrorism have a greater risk than climate change impacts as they are "immediate and is felt across the border right away" (Interview MoT1, line 38). However, one respondent perceived climate change impacts as being more devastating in the end (Interview MoT1). An hotelier pointed out:

> "I mean the real problem with climate impact is that it is really long term. Short term economic impacts have far gradual impacts on tourism. I mean you only have to have one murder on the island and you've lost your business (laughing). So crime is probably a far greater risk. […] If it is a shortage of oil, we will suffer. If it is a catastrophe in the United States like 9/11, you know, if the United States catches a cold, we get the flu. So, the economic impacts are far more serious on a short term basis" (Interview H1, line 48, 53).

The dive shop was the only private actor that had an anticipatory risk perception for climate change impacts: "[…] before the tipping point we have to intervene" (Interview DS, line 113) and sought long-term solutions: "hopefully, in 50 years' time this is still going" (Interview DS, line 97). Only one person assessed his adaptation actions as sufficient in order to address current impacts and did not take responsibility for long-term adjustments (Interview H3).

Market incentive: Five respondents claimed market incentives as motive for dealing with climate or environmental topics and adaptation measures (Interview H2, H3, H4, MoT1, NPO). Protecting the attractiveness and survival of the own tourism product as well as responding to market pressure to conform to environmental practices were a strong motivation for a hotel to adapt (Interview H3). The existence of a market niche was also a motivation for implementing environmental measures (Interview H2). For two businesses, the ability to market or brand the business as green and sustainable was

a motivation: “All of a sudden reading some marketing books, I realized that this going green is actually something, which can be put out there in the market” (Interview H2, line 83), “our aim is to be completely sustainable and to work on that as our major factor to bring tourist to our place” (Interview H4, line 203). The adaptation to tourists’ desires or demands for sustainable travel reinforced this motivation (Interview H4). Moreover, a sustainable destination branding is beneficial for a sustainable business strategy (Interview H2). The realization of the marketing promises of a ‘sustainable’ destination also requires adaptation: “The perception of ‘Pure Grenada’ is a pristine environment, clean environment, natural intact and so on. It’s a bigger challenge to offer that kind of product with the challenge of global warming” (Interview MoT1, line 25). In one case, government incentive for forming a community group triggered individual voluntary adaptation motivation (Interview NPO). The market could also be a disincentive and barrier for adaptation motivation because adaptation options were more expensive; however, this did not prevent the implementation of adaptation action (Interview H4).

Inspiration from good practices: Four persons mentioned adaptation measures on other small island developing states or in industrialized countries as inspiration for their actions or future adaptation planning (Interview TO1, H2, H3, DS). They did not assess different preconditions or levels of development in those countries as obstacles for the implementation in Grenada (Interview DS, H2). Moreover, one person hoped that his adaptation measures will be an inspiration for somebody else (Interview DS).

Discussion:

The following characteristics of the adaptation motivation to realize, support or promote adaptation were revealed:

- Risk perception
- Time perception
- Market incentive
- Inspiration from good practices

Even though a lot of respondents knew about the exposure and sensitivity of the islands, especially regarding sea level rise and precipitation change, not all of them appraised those current and future impacts as harmful for the tourism products, their business or the sector in general. These results for risk perception are in accord with the findings of a study in the Maldives, see chapter 4.2.4. As long as the tourists and businesses have not yet been impacted and have low or no concerns for the potential occurrence of haz-

ardous events and impacts, businesses have a low adaptive motivation. The concerns and risk perception increase if actors have already experienced climate change impacts or natural hazards to things that they value or form part of the basis of their business. The personal experiences triggered autonomous adaptation actions to protect the business. This learning process in response to disturbance is an aspect of adaptive capacity that contributes to resilience, as described in chapter 4.2.1. Thus, adaptation motivation is released rather reactively than proactively, which confirms the argumentation in chapter 4.2.3. Experienced climate change impacts can therefore decrease the adaptation barrier of imperfect knowledge and uncertainty of projections, as said in chapter 4.3. Actors with low risk perception of climate change impacts, who were challenged by climate variability, adapted their infrastructure proactively but without the motive of climate change adaptation. As resumed in chapter 4.2.3, people benefit from their experience in coping with extreme climate variability, which the interviews confirm. They verify that a high level of exposure naturally created adaptive capacity and natural resilience. In another case, some persons perceived impacts and risks but did not know the causes and coping strategies for it. Thus, risk perception alone will not lead to adaptation motivation if individuals are not aware of the possibilities to adapt or do not have the means to adapt. Low risk perception can also be attributed to a societal ignorance of climate change, wherefore possible impacts and adaptation options are not sufficiently distributed within society.

The risk perception for long-term climate change impacts can be low because of a short-term planning horizon. Tourism stakeholders were aware of the discrepancy between their planning and climate change timeframes and constituted this as a problem. Long-term impacts do not provide guidance for short-term decision-making and moderated the acuteness of the problem and necessity for proactive adaptation motivations, which was described in chapter 4.3. Additionally, long-term adaptation to climate change can be regarded as beyond reach for the tourism sector. The tourism actors prioritize the economic vulnerability of the sector to immediate and serious damages higher than climate change impacts, which confirms the findings of the Maldives study. This confirms also the high dependency of the tourism sector on external shocks from the global economy, both described in chapter 4.2.4.

Whereas risk and time perception are internally, market incentives and inspirations from good practices are external triggers for adaptation motivation. Sustainable branding as one market incentive does not per se include adaptation but can increase envi-

ronmental awareness and thus adaptation motivation. Market mechanisms and incentives can be a powerful instrument for motivating environmental and adaptation action. The image of a sustainable destination or business requires the fulfillment of these promises and can increase the relevance of environmental and climate related topics. However, it is questionable that a marketing-based motivation without a comprehensive problem understanding will lead to holistic and coordinated action to address the underlying problem. This can also increase the risk of maladaptation. Market structures can also disincentivize adaptation motivations and be a barrier for adaptation, as described in chapter 4.3.

7.1.1.2 Adaptation Belief

Self-efficacy: One person felt incapable of any adaptation actions and at the mercy of the socioeconomic environment (Interview TO2), whereas four persons were convinced of their ability to realize adaptation measures (Interview H1, H2, DS, NPO). The strong belief in self-efficacy can be related to a strong personality, self-confidence and conviction, which developed from professional experience and over time. This can result in an obsession, which demands specific self-sacrifice:

> "I have to be very self-confident about it, that has something to do with my experience, with my age, with my position […] You have to have a certain level of obsession and I think I am in an age that I can have the luxury of being obsessed with something" (Interview H2, line 214, 291).

Next to the individual level, three persons emphasized their belief in the human nature to be effective (Interview H1, DS, NPO). One person said:

> "I know I needed to do something. And I felt that everybody has the ability to do something. And you don't have to be rich, necessarily; you don't have to be highly intellectual to be able to do small changes. And I see that we have to assist Mother Nature sometimes. You know, to put back, you know, what industrialization of the world has done" (Interview DS, line 65).

Self-efficacy is also characterized by a strong indestructible conviction, innovative thinking and the preparedness to take risk (Interview H1, DS). Minor successes satisfied one interviewee and affirmed his adaptation motivation:

> "Even if this isn't a big success, if I've managed to light a light in some child's head about becoming a political leader, about becoming a conversationalist, about becoming a marine biologist, an environmentalist, my job is done" (Interview DS, line 324).

Philanthropic and environmental conviction: Four respondents showed a strong philanthropic or environmental conviction for environmental and climate protection and adaptation measures, which guide their business operations (Interview H1, H2, H4, DS), like one person said:

> "My wife and me, we have always been concerned about the environment. So starting a business and building it up, it's been difficult because of economic circumstances, but we always tried to keep that in the back of our minds" (Interview H1, line 120).

"A philanthropic kind of thing that I wanted to give back to Grenada" (Interview DS, line 147) also motivated adaptation action. Similar to self-efficacy, a strong persistence and dedication of time and effort determined the execution of one's conviction: "So when I am convinced to go the whole mile, I have to be ready to work more" (Interview H2, line 115):

> "I am always advocating for sustainable tourism and the environment. I strongly believe this is the way forwards and I know it is the way forward, but it's a very, very difficult task to get that message across. […] So in my struggle to spread the word, I meet not so many people that would agree with me and believe in what I believe in. They would say most likely 'Yes, that's very fine, but it is bad business' " (Interview H4, line 114, 128).

Outcome-efficacy: The outcome-efficacy of the respondents was rather low. One person did not "see what alternatives there are. […] How can we adapt to that?" (Interview TO2, line 51). Even though one person had no belief in outcome-efficacy, he took adaptation measures: "Well, obviously after Ivan we made substantial changes to our building code. But I always think that building to survive hurricanes is an impossibility" (Interview H1, line 87). One person has already experienced adaptation successes even though the outcome had been very uncertain in the beginning: "I would have no idea whether this worked or not" (Interview DS, line 78). Moreover, he expected a small outcome: "It is a very sort of small step and embryonic step in what can we do to help the reef regenerate" (Interview DS, line 31). One person also acknowledged the limited effectiveness of short-term autonomous adaptation action and the need for governmental adaptation planning for long-term solutions (Interview H3).

Discussion:

Adaptation beliefs can be differentiated into the following forms:

- Self-efficacy
- Philanthropic and environmental conviction
- Outcome-efficacy

Human capital, in form of knowledge, personal background, education, experience, expertise and special information on climate hazards, influences adaptation beliefs. In chapter 4.2.4, a lack of knowledge on available adaptation measures or best practices in the tourism sector was indicated, which can be a reason for low outcome-efficacy or a deterministic view on outcome and self-efficacy. On the other side, a strong self-efficacy and conviction for environmental topics dominated even if the decision was

uneconomically, negative feedback was expected and included more workload and commitment. Next to the own self-efficacy, a strong self-efficacy for humans and societies in general strengthens adaptive beliefs. It assumes a belief in the power of people and in a cultural change. The strong self-efficacy indicates a high level of autonomous adaptation, whereas planned adaptation policies could achieve a higher outcome-efficacy. The high rate in self-efficacy and philanthropic and environmental conviction can also be related to the fact that the study considered mostly positive examples and most of the interviewed businesses were entrepreneurs, who have a strong self-efficacy in general due to their occupation.

7.1.2 Natural Resources

Five actors used natural resources to respond to climate change impacts (Interview TO1, NPO, H1, H3, DS). Four of them used ecosystem-based adaptation approaches in form of mangrove planting, mahogany planting and the construction of artificial reefs (Interview TO1, NPO, H1, DS). In three cases, this was part of the tourism product or linked to the tourism business, for example through a carbon-offset tour where people plant mangroves or via snorkeling tours to visit an artificial reef (Interview TO1, NPO, DS). Thereby, the ecosystem adaptation created co-benefits to the tourism business in form of an additional product. In two cases, changes in the beach through sea level rise, sea swells, sand mining and others made landscape adjustments necessary in order to protect the tourism product (Interview H1, NPO). For instance, people constructed a new pathway on the beach: “we lost so much of the beach that we end up making a new path” (Interview NPO, line 80). In the other case, a beach resort built up sand “to create a barrier right along the beach in order to prevent the water from coming over into the property” (Interview H3, line 10). An alternative to the sand barricades could be crops, but the resort did not plan such an investment in the near future (Interview H3).

Discussion:

The use of natural resources and ecosystems for adaptation requires ecological knowledge and understanding, as the framework for analyzing linked social-ecological systems showed, see chapter 3. It can contribute directly to the protection of tourism assets that are of value for the actor, such as beach resorts, coral reefs or a beach walking path. Moreover, those ecosystem-based adaptation measures can become a new tourist attraction and incentivize business participation.

7.1.3 Technological Resources

Six persons had high awareness for technological adaptation options that secure water supply during the dry seasons or help in dealing with strong rainfall (Interview TO1, MoT2, H1, H2, H3, H4). Three businesses installed individual water conservation measures like rainwater harvesting, water saving technologies and wastewater recycling: "we collect rainwater in cisterns […] we have the special toilets that doesn't use much water at all, we separate the gray water from the black water and we recycle the gray water to use it in the garden for irrigation" (Interview H4, line 21), or created additional fresh water supply through desalination: "We have our own reverse osmosis plant" (Interview H3, line 79), or other water supply measures: "We have a water maker […] we have got a wheel […] and we were getting water from our rivers and trucking in" (Interview H1, line 24, 44). Two persons mentioned infrastructural adaptation measures for the protection of the beach and coastal infrastructure (Interview H1, H4). The manager of the beach resort showed technical expertise in possible coastal adaptation options by mentioning walls, batteries, boulders and groynes (Interview H3). One business changed its buildings standards after the hurricane Ivan in 2004: "we built the roofs differently, we tend to build steeper pitch roofs, we use different laths on the roof" (Interview H1, line 85). Another business used environmentally friendly technology to combat the breeding places of mosquitos. Hereby, it reacted to the increase in vector borne diseases, which can be caused by increasing temperatures (Interview H2).

Discussion:

Seven persons noticed changing rainfall patterns, as described in chapter 6.2. This experience in changing rainfall and uncertainty in precipitation patterns might have encouraged technical adaptation for securing water supply. Adaptation measures like rainwater harvesting and storage have low entry barriers, high autonomy in implementation and manageable implementation cost and efforts. Therefore, they are favorable compared to other more complex adaptation needs for sea level rise or similar coastal adaptation. This technological adaptive capacity is based on an engineering resilience approach that maintains the efficiency of functions.

7.1.4 Financial Resources

Private adaptation finance: Five respondents from the private sector financed their adaptation measures themselves and did not regard small investments or extra costs as a strong barrier (Interview H1, H2, H3, H4, DS). However, three of them reported on fi-

nancial constraints for implementing more comprehensive adaptation measures, which discouraged the implementation or enhancement of adaptive practices (Interview H3, H4, DS). One person complained that adaptation strategies, like community-based tourism are economically not viable: "it wouldn't bring us any money" (Interview TO2, line 62). Additionally, the tourism sector as such is not very profitable and one hotelier said that "it's very, very difficult to run a business and make a profit" (Interview H4, line 117). Institutional settings like import regulations created additional cost for imported technological adaptation options, which one person faced (Interview H4). The willingness and ability to invest privately in the protection of public goods was given up to a specific point: "it is just what we do as level of commandment to safe ourselves, we just protect what we can protect at our end" (Interview H3, line 58) but "long term option […] is not something a single ownership property could do, it must to have government involved into" (Interview H3, line 52).

Public adaptation finance: Three persons received external funding for the implementation of adaptation measures, one from the Grenadian government (Interview NPO) and two from an international fund, which was dedicated to mitigation measures in energy efficiency and renewable energies in the tourism sector (Interview H1, H2). All of them judged those supportive measures as helpful. Two persons mentioned structural and cognitive barriers on national level to access international climate funding for the whole economy as well as for the tourism sector (Interview MoT1, NPO):

> "In a general sense, not just to tourism, I think Grenada needs to sensitize itself some more, to educate itself some more, so that it can access a lot of the funding and resources and opportunities that are there in climate finance and so on" (Interview MoT1, line 133).

One respondent reported that the government received a grant for building a desalination plant in Carriacou. However, the person evaluated public climate finance and investments as well as the private sector's access to finance mechanisms as low due to the limited water resources on the island (Interview TO1).

Discussion:

Two subcategories for financial resources were established:

- Private adaptation finance
- Public adaptation finance

For small scale tourism businesses it is extremely difficult to invest in adaptation measures because the business construct is not prepared to account for the protection of a public good, even though the business takes advantages of it. Therefore, private adap-

tation finance is only undertaken as risk reduction or as investment for expected saving in the long-term. However, there are financial barriers for importing some technical adaptation solutions, which can hinder private sector investments. The assessed public adaptation financing options had a focus on mitigating measures and not on adaptation. The access of international funding depends on the governmental capability, structures and the political will to be able to apply for international adaptation finance.

7.1.5 Human Capital

Learning and knowledge of decision-makers: Five persons emphasized their learning process about choosing and implementing the right adaptation measures (Interview NPO, MoT2, H2, H4, DS). The learning process took place through formal education via workshops, trainings, university studies or through informal learning by self-education. The Ministry and non-profit organization received formal education on climate change and adaptation through workshops and training. An hotelier "took a couple of courses in the university in sustainable development" (Interview H4, line 213) and wanted to utilize his knowledge for local consultancy work. In the absence of a formal structure and support, self-education and implementation take "a lot of time and a lot of thinking ahead" (Interview H2, line 174). A second person confirms this: "after a lot of soil searching and designing and going […]" (Interview DS, line 72). Two people had no experience with climatic and environmental issues: "we did not know anything, so we had to begin from scratch and learn" (Interview NPO, line 30) and in one case, imperfect knowledge and expertise hold back adaptation options, e.g. for accessing adaptation financing (Interview NPO). Also, unfamiliar topics challenged small businesses, which are already busy with multitasking and their day-to-day work:

> "So I would say I'm aware […] I wouldn't say that I am able to realize everything at the right time. […] So, in a small business you have to cover much more different areas than in a bigger business, you would have an officer for this and an officer for this" (Interview H2, line 193, 208).

Scientific evidence on the effectiveness of adaptation action backs up the adaptive action and creates reliability and assurance to the public (Interview DS).

Internal education and training: The respondents praised environmental education as "key" (Interview TO1, line 114) and "critical" (Interview H1, line 105). Four persons emphasized the importance of internal education and the inclusion of employees in adaptive action and environmental management (Interview NPO, H1, H2, H3). They appraised the people of Grenada as "our greatest resource" and "very unique" (Interview MoT1, line 108). The respondent highlighted awareness-raising methods as pow-

erful tools to change the attitude of the people employed in the tourism sector and the general public: "I don't think that it's always first about money. I think it's always first about the people and that they realize what it's all about" (Interview H2, line 181), and:

> "But the more awareness we bring to the people in the hospitality industry in particular and to the people on the island, the more aware they become and the more likely we are to at least reduce some of our pollution effect" (Interview H1, line 65).

This awareness can be brought from the outside to the tourism industry or can be circulated within the industry: The NPO raised awareness among tourism stakeholders by the means of workshops on climate change and hotels raised awareness by internal meetings or trainings (Interview NPO). Three hotels had environmental meetings or committees and two of them had internal training for their staff on environmental topics and undertook different activities with them (Interview H1, H2, H3). In one hotel, the environmental committee is responsible for the Green Globe certification and is staffed with employees from different departments: "house-keeping, maintenance, front desk, kitchen, food and beverage, spa and the management. So everybody is part of that environmental committee" (Interview H3, line 108). In another hotel, a "Green Team" (Interview H1, line 96) was constituted and is trained on 'green' topics: "We are training them so they can go out to schools and speak about environmental issues […] Most people are not aware and they are taking this on, amazingly" (Interview H1, line 97). The third hotel raised awareness among the whole staff by environmental and food awareness weeks, during which information were distributed in an entertaining and playful way (Interview H2). Moreover, the hotel encouraged their employees to transfer the business environmental practices, like reducing and replacing plastic bags, to their private life: "So, it's a whole awareness process with our staff, that even when they are private (…) everyone got a bag, which can be reused to break the habit to get for everything a plastic bag" (Interview H2, line 72). Also the NPO involved all of their members in their educational work: "all members […] have been exposed to some level on workshops on climate change" (Interview NPO, line 199), but the workload was seen as a constraint for an increase in educational efforts. Two persons confirmed the high workload and difficulties in dealing with additional environmental topics (Interview H2, H3).

External education and public awareness: Half of the respondents complained on the limited public awareness and knowledge concerning environmental and climate issues, which cause environmental damages and are a reason for missed environmental improvement, adaptation opportunities or capacity enhancement in finance (Interview MoT1, NPO, H1, H2, DS). Four persons were engaged in public awareness activities

that addressed community members and the general public (Interview NPO, H2, H4, DS). The NPO rated public awareness as "our big thing" (Interview NPO, line 43). It is executed by

> "climate change awareness activities all over [the parish] St. Patrick's with different groups. […] And we primary looked at how is climate change affecting you, as a farmer, as a student, as a business person, as a church" (Interview NPO, line 62, 65).

The person underlined the importance of community education for the effectiveness of policies: "I'm a firm believer that unless the message does not go down on the ground […] you can have whatever policies up there" (Interview NPO, line 119). One hotel set up a glass recycling project for "Young Entrepreneur[s]" (Interview H2, line 63) in order to create public awareness beyond the hotel business and solve an environmental problem. On a professional level, one hotelier wanted to use his expertise to consult governments or other stakeholders (Interview H4). Two persons used the media like television and radio to promote their adaptation and environmental work. This publicity "served our awareness program" (Interview NPO, line 186) and was used as a "marketing tool to say '[name of the hotel] is going green'" (Interview H2, line 150). Two persons used billboards with information on threatened places and protection opportunities at beaches visited by locals as well as tourists (Interview NPO).

Four persons stressed especially the education of children (Interview TO1, H1, H4, DS), because "the children are our future" (Interview DS, line 96). Two persons expressed the easier adaptability of children "if you get the kids and talk about pollution and where does your garbage end up, that's much easier to deal with. Then as adults, they not gonna litter" (Interview TO1, line 117) and learning and changing capacity of kids: "educate maybe anybody over 25 is nearly wasting your time" (Interview DS, line 98). Two private businesses have plans to become actively involved with the education of children: "what we want to do next is go out to schools and talk to kids about Styrofoam" (Interview H1, line 105). The dive shops plans to give presentations in schools on marine biodiversity and ecosystems and take them out snorkeling on the natural and artificial reef and do conservation activities (Interview DS).

Two private businesses said explicitly that they try to raise awareness for environmental and climate topics among their guests (Interview TO1, H4): "We try very hard to tell people not to destroy nature, not to leave garbage behind, be mindful of it and you wanna leave it either the way you met it or better" (Interview TO1, line 63). One person advises the guests from overseas to stay at least two weeks on the island but did not see its business in the responsibility to propose flight compensation to the guests (Interview

H4). Two hotels reported on standard environmental advices to the guests regarding air conditioning and towel reuse opportunities in their properties (Interview H2, H3). One of those hotels plus another business published positively on their adaptation measure in the form of a hurricane preparedness plan and via an interpretation board and social media for the artificial reef project (Interview H2, DS). However, one person reported on a resistance or ignorance of other businesses to give instructions for environmentally friendly behavior:

> "I don't think that guesthouses and the hotels do a good enough job explaining to the visitors to not be wasteful with water […] or sometimes you have air conditioning in the room but they don't tell the visitors you must close the window, don't leave it running" (Interview TO1, line 16).

There was a reservation in giving a lot of negative details: "you don't wanna lie to your customers, but sometimes the truth is not always pretty either" (Interview TO1, line 53).

Discussion:

Following properties for human capital were evaluated:

- Knowledge and learning of decision-makers
- Internal education and training
- External education and public awareness

Knowledge is a necessary and important property for the development of natural, financial and technological resources as well as for psychological aspects, which were already discussed as determinants of adaptive capacity. Without the specific knowledge on climate change impacts and good adaptation practices, one does not know to what to adapt and how to adapt. Thus, the property knowledge and learning of decision-makers have strong influence on other adaptation capacities. The willingness and motivation for informal learning and self-education can be a result of a strong self-efficacy of people. The demands for informal and formal learning reflect an interest, relevance and motivation for the issue of climate change and the environment. However, the problem framing concerning climate change, natural resources and environmental impacts can be overwhelming and limited knowledge seems also a big barrier for implementing adaptation measures and for the support of the community, as figured out in chapter 4.3.

For a majority of the respondents, it is also important to distribute learning opportunities and knowledge on primarily environmental and partly climate issues among the people and employees in the tourism sector. Thereby, they realize a kind of mainstreaming or incremental approach throughout all tourism segments (hotels, Ministry and NPO). The hotels provide environmental learning and activities to all departments,

which can be called a horizontal approach because the topic is mainstreamed throughout the whole business and not just applied to one specific entity. Since 6.4% of total employment in Grenada is directly linked to tourism and 22.1% of jobs are indirectly linked to tourism, employees can be a multiplier for information and practices and serve as a role model for certain behavior. The businesses use their employees to diffuse the ideas in schools, their families and communities with the objective for a cultural change, which will be discussed in more detail in the next chapter: social capital. Additionally, most interviewees perceived public awareness and engagement beyond the tourism sector that target the community, youth and especially children as very important. They used different instruments like media, social media and youth projects, which partly also served marketing purposes. The tourism actors dedicated a specific role to the children as future decision-makers and responsible adults. Children should be actively involved in adaptation and conservation measures to build the country in an environmentally friendly way.

Most of the sector's representatives have perceived a stronger responsibility for Grenadians than for tourists to educate them on environmental and climatic topics. Some felt that information on environmental and climatic circumstances made available to tourists is insufficient. However, a few businesses promote their good adaptation practices to tourists. One person absolved his business from the responsibility to educate tourists on their individual climate impact. Thus, the tourism sector rather excludes tourists from behavioral adaptation activities that go beyond the standard environmental business practices, like towel reuse. The resistance in raising awareness for negative climate change impacts among tourists can be explained by their limited interaction with the country as such and their role as customers. Here, the dependence on the mostly Western tourists' appraisal and behavior is partly confirmed, as described in chapter 4.2.4.

7.1.6 Social Capital

Collaboration and networks: Five respondents had some kind of bilateral collaboration with other institutions for implementing adaptive measures (Interview TO2, TO1, NPO, H2, DS). Three persons underlined the interaction with the community for adaptive actions (Interview TO2, NPO, DS). Community-based tourism is one adaptation option that also requires a lot of social capital. The NPO "would like to see tourism develop through the community" (Interview NPO, line 27) and a tour operator said it was "suggested to us as an adaptation, was we were going for community tourism, which means

[…] let them integrate into a village for a day" (Interview TO2, line 54), but even though this person was in favor of the idea, the company refused it because it was uneconomically. A third person aimed at acting collectively: "make it more of a community thing and a more communal, where we are sharing the information and we are sharing what we are doing" (Interview DS, line 243). Another person emphasized the benefit of being on the Board of Directors of the Grenada Hotel and Tourism Association. Thereby, this person learned about an adaptation strategy for dealing with mosquitos, which another hotel already had implemented (Interview H2). Due to the size of the island, a bilateral relationship can lead to path dependency, as one hotel illustrated concerning its recycling measures:

> "It's depending on if on the island someone else is speaking up the next chain of the whole thing. Because when this company […] breaks down, I have to stop my collecting" (Interview H2, line 107).

Another business faced the same problem (Interview H4). On the other hand, the size of the island facilitated the development of social networks (Interview TO1, H4): "As Carriacou is small and businesses are not so many, I know everybody and we meet as friends" (Interview H4, line 135).

The NPO reported on good collaboration with the Ministry of Agriculture that gave them a mandate and supports them in their activities: "So we do have the best of cooperation with [the Ministry of] Environment, Agriculture, Fisheries, in particular" (Interview NPO, line 143). Four persons complained about a constrained networking with governmental institutions. These limitations resulted out of own time and human capacity restrictions, missing tradition in collaboration, political indifferences or missing coordinating mechanism (Interview TO2, NPO, H3, DS). The Ministry regarded the networking and collaboration within the ministries concerning environmental issues and climate change impacts also as low: "But there has not been established any specific coordinating mechanism specific to climate change that I know" (Interview MoT1, line 87) and insufficient:

> "So the collaboration and networking of the ministries and between on the question of environment and particular on the impacts of climate change, I don't think, is strong enough, at the ground level, level of their staff" (Interview NPO, line 262).

Nonetheless, tourism stakeholders desire to work closer together with and within the government and undertook corresponding efforts (Interview H2, NPO, DS).

Customs and culture: Customs in the hospitality and service industry can contradict environmental management practices, especially resource conservation, and can hinder the success of adaptation measures. For example, water saving measures in a hotel will

not be successful if towel changes are done daily even though the guests did not indicated so (Interview H3). One hotel reported on the comfort of big side-by-side fridges in villas, which consume a lot of energy (Interview H2). Three persons claimed a low environmental awareness of the people in Grenada and the employees in the tourism sector and two of them relate that to the culture (Interview TO2, H2, DS). Missing ecological understanding can be one reason for cultural habits: "the trouble is because; it's a cultural thing in Grenada, where they don't really understand the ocean, apart from a few fishermen" (Interview DS, line 302). Behavioral norms can be another restriction for a change to environmentally friendly actions: "they are behaving not very responsible […] the culture in Grenada, people don't say, don't like to expose themselves in this way, they can't say 'no', they don't like conflicts" (Interview H2, line 166, 263). One person stated a deterministic religious view, which also hinders adaptive capacities: "I know I've been surprised if it doesn't rain, but on the whole I think that's god's choice, so we will get over it" (Interview TO2, line 42).

Behavior of tourists: Since visitors greatly contribute to the number of persons on the islands, their behavior and action influence the overall social capital to act collectively. The respondents perceived the tourists' behavior mostly as positive. Three persons experienced consciousness, understanding, interest and support of tourists for climate and environmental topics:

> "There is an increase in conscious travelers, responsible travelers that take all of these issues into concern when they choose where to go to and how they travel" (Interview H4, line 180),
>
> "[…] but the guests are on board. People are no longer in the mood of saying 'Oh, I paid a lot of money to come here, turn on the air conditioning'" (Interview H3, line 174),
>
> "You find the visitors are passionate about topics to keep the place clean. […] So, you see that the visitors, they wanna be involved and they wanna feel as if they are part of it. Part of the process to fix it" (Interview TO1, line 121).

The consciousness of guests is also an indirect control of the business: "you are more, a little more on the radar when you are able to confirm that you adhere to a lot of the best practices. If you don't, you get flagged for it" (Interview H3, line 161). However, it is a two way interaction between the industry and the tourists, whereby businesses were assigned the responsibility to make tourists aware and get their support in adaptation measures in the tourism sector:

> "When visitors come, sometimes they don't understand that and they let the taps run […]. If you don't tell people they leave it [the air conditioning] running when they are on the beach all day" (Interview TO1, line 10, 145).

The role of external education and awareness-raising for tourists in this context was already discussed in the previous determinant.

Discussion:

Three characteristics for social capital were elaborated:

- Collaboration and networks
- Customs and culture
- Behavior of tourists

The formal collaborations within the private sector and between private and public sector have led to adaptation measures in recycling, community-based tourism and health protection. However, social networks between businesses and communities are economically unviable and could not be revealed. Hence, individual interests rather than a general necessity guided most of the collaboration and networking. Also, the interactions within and with the government and governmental institutions were limited. The different types of collaboration and networking reflect the fragmented nature of the tourism system. The size of the island provides advantages for collaboration, like the ease of social networks, and disadvantages, like path dependency due to missing alternatives.

It can be constituted that the respondents perceived a low societal environmental awareness and understanding as well as behavioral norms that are not favoring environmentally friendly practices. It is very likely that this perception contributed to their motivation to raise environmental awareness by internal and external education. Hence, education and training do not only contribute to human capital; they also increase social capital because they aim at a cultural change and the social acceptability of adaptive measures. Hereby, human capital can have a trickle-down effect on the sociocultural environment to change customs and cultures to more environmentally and climate friendly behavior and habits. Besides the societal customs, professional industry standards and customs in the service sector can be barriers for successful adaptive measures and good environmental practices.

Tourists can function as destructive factor or as supporter, trigger or supervisory body for environmental or adaptive practices in the industry. In order to gain understanding and support from tourists, businesses want to make their climate or environmental adjustment transparent and understandable to their guests, especially if it impacts a quality standard. The inclusion of tourists in the implementation of business-related adaptation measures is important to receive social acceptability. Businesses perceived a strong consciousness, interest and support from the tourists' side in environmental and

climate issues. Visitors who are interested in environmental issues can make those to a selection criterion for travel choices and desire additional information and recommendations on adaptation options. Therefore, it is counterproductive that the tourism sector does not provide information on climate change impacts and general adaptation options, including behavioral ones, to tourists, as figured out in the last chapter 7.1.5.

The overall ability to act collectively is difficult to establish because of the variety of stakeholders and collaborative partners. Interview partners reported on a discrepancy in environmental values between decision-makers and the society, which hinders collective action. Therefore, the interviewees undertake a lot of effort to build human capital, which can enhance social capital and collective action. The fact that four interview partners have another cultural background than the Grenadian could influence the negative view on cultural habits and lead to misinterpretations of certain behavior or habits.

7.1.7 Governmental institutions

Governmental structures: Three persons said that governmental structures, especially in the Ministry of Tourism, are not adequate for addressing climate or environmental topics from a tourism perspective (Interview NPO, MoT2, MoT1). The Ministry itself does not rate climate change impacts on the tourism system as high and thus, adaptation did not have a high relevance: "We haven't got strong guidelines, we haven't got strong laws" (Interview MoT2, line 55). The responsibility for climate change issues was assigned to other units:

> "I don't believe that we focus on climate change impact as a Ministry. I believe that as a government we rely on the unit that is responsible for climate change issues to lead in that regards. And issues that are in the tourism sector that has that issue, they would deal with it" (Interview MoT1, line 79).

The designation and legislation assigns the Ministry a limited responsibility and decision-making function:

> "Because [the Ministry of] Tourism is a facilitator. Because the resource base is within either heritage organization, agriculture, lands and properties and so forth. Tourism addresses authority or help to coordinate or give out information. […] But Tourism can't manage and interpret the resource. […] Hence you need to rearrange. But for our political construct you have those things because tourism is a nice and catchy thing (…)" (Interview MoT2, line 76, 96).

These constructs lead to multi-governed resources, where different ministries managed different aspects of one resource. It was said that this results in a situation where "five or six entities finance second appraises and so you need to harmonize those things" (Interview MoT2, line 117). The Ministry of Tourism could not be officially included in a program to mainstream adaptation to climate change throughout the ministries because

it does not have a planning officer (Interview MoT1). However, there were some "little bits and pieces here and there" (Interview MoT2, line 136) concerning environmental issues. One person reported that a governmental mandates from the Fisheries division enabled the foundation of the community-based tourism organization (Interview NPO). However, one respondent criticized the networking within the ministries, as described in the previous chapter, and felt the missing continuity of Tourism Ministers as a barrier for good cooperation with the Ministry (Interview NPO).

Governmental decision-making: Eight persons perceived governmental decision-making concerning climate and environmental topics as non-transparent and weak (Interview TO2, TO1, MoT1, MoT2, NPO, H1, H4). They felt governmental decision-making as "hypocritical" (Interview TO1, line 58) and questioned the "interest of a democratic government to respond to environmental threats" (Interview TO2, line 136). Three persons assigned the government ignorance for the value of the environment and the threats towards it (Interview H1, NPO, DS): "It's not sinking in. You just saw the prime ministers speech about; did you hear anything about the environment, about climate change?" (Interview DS, line 313). Planned adaptation actions were implemented incompletely and slow (Interview H4, DS): "But I think they wait for the government to put a water reservoir […]. And of course the government hasn't done that so it's standing there, fully operational but not operating" (Interview H4, line 28). Two persons criticized the omission and delay in distributing information (Interview To1, DS): "you might hear about it in the mainland Grenada but the time you hear about it on Carriacou it's happened already" (Interview TO1, line 104). Also, signed international treaties and commitments on environmental protection can obscure the reality and are not expected to bring any real change:

> "But what my worry is that we keep signing up for the, Grenada will have 25% of its marine area is protected 2025 or something, but these are all words on a political level and to me it's a veneer, and if you look underneath it, there is nothing there" (Interview DS, line 294).

For the future, one hotelier desired more policy making that is in favor of environmentally and adaptive measures in the tourism sector and facilitates its implementation and make it "economical viable" (Interview H4, line 131). There is a need for more engagement of the Ministry of Tourism: "I think tourism could do much more, working with the Ministry of Environment to work closer on this whole question of the impact of climate change" (Interview NPO, line 246).

The Ministry of Tourism itself showed a lack of knowledge on decision-making concerning climate issues:

> "But I am not too certain whether we have yet signed a charter on sustainable development, so that we will have a policy where we will have more green of on the sites and space what tourism development" (Interview MoT2, line 59).

Still, the Ministry representatives wished for some mainstreaming: "the development in the tourism sector should go through that kind of rigor to safeguard against, to make it climate resilient" (Interview MoT1, line 59).

Participation in policy process: Four persons proactively addressed the government on climate and environmental issues and tried to participate or influence policy processes by constructive input (Interview NPO, H1, H4, DS). The feedback was perceived as negative and strongly delayed: "And I wrote them and I told them, at least, put the words in, you know. […] But I never get any feedback on that" (Interview H4, line 151). One person describes his interaction with the government as follows:

> "I've been out and screaming and shouting about all sorts of stuff for decades, literally. […] But politicians are really just not interested but you go and keep trying" (Interview H1, line 173, 177).

Three persons talked about business-related specific problems concerning sea level rise, waste disposal and land management, wherefore they got in touch with the government or plan to do so (Interview H2, H3, DS). However, two private businesses said that many participation possibilities are challenging to take part in because of time constraints (Interview H2, DS). The NPO "get invited to a lot of these policies. And we really try to go" (Interview NPO, line 213). They use their collaboration with government to raise awareness on environmental problems or unsustainable practices, like sand mining or land degradation, and thereby try to influence policy making.

Discussion:

The following subcategories for governmental institutions were evaluated:

- Governmental structures
- Governmental decision-making
- Participation in policy processes

The structures and decision-making of the Ministry of Tourism and the government in general are not beneficial for addressing climate change impacts and giving rise to adaptation in the tourism sector. The Ministry does not give guidance nor has policies concerning climate change impacts and adaptation. The overall governmental construct, in which climate change falls under the Ministry of Environment, explains this circum-

stance. The Ministry of Tourism depicted its role and legislative responsibilities as a facilitator, who has constraint shaping skills and decision-making authority regarding climate and environmental issues. Hence, this Ministry cannot trigger climate change adaptation. It was revealed that the head of state does not create the necessary enabling environment for climate change adaptation or environmental protection. This indicates weak governmental institutions concerning those topics. Tourism stakeholders were dissatisfied with governmental decision-making and had low expectations, trust and belief in climate and environmentally sensitive policy making. In spite of this, or especially because of it, private and non-profit actors strongly participated in policy making and showed a strong self-efficacy even though they were disappointed with the feedback from the government. In general, the interviews did not confirm governmental leadership in facilitating and supporting adaptation and information sharing, as generated in chapter 4.2.4. The mentioned study in the Caribbean, which revealed limited governmental capacity for leadership from the private business perspective, can be confirmed.

7.2 Sustainable tourism practices

Energy management: Three private businesses reported on their implementation of energy efficiency measures (Interview H1, H2, H3). All of them switched to more efficient air conditioning units. Other measures included wall insulation of buildings, the introduction of LED lights and retrofitting kitchen appliances by replacing walk-in freezers, chillers and side-by-side fridges with smaller fridges. The same hotels have introduced renewable energy plants by installing solar water heaters and solar panels. The motivations for energy management were diverse. For one hotel, financial aspects were determinative: "I mean definitely, the thing that the electricity is so expensive pushes us to find ways on reducing it" (Interview H2, line 248). Another hotel mentioned general environmental protection: "[…] bearing in mind the environment […] a lot of it has to do with investment in environmentally friendly systems" (Interview H3, line 95, 139). The third hotel specified its energy management as mitigation actions:

> "We are doing our level best to reduce our consumption of electricity and that really is mitigating to climate change as well. If we can reduce our carbon footprint, we will do it" (Interview H1, line 94).

For the implementation of renewable energy plants, a coordinating mechanism with the governmentally owned energy supplier Grenlec is necessary. On Carriacou, the feed-in of renewable energy to the grid is restricted and an hotelier described the situation as:

> "Grenlec changed now their policy that they don't allow any more private investment. […] They don't allow you to connect to the grid in Carriacou. Because the aim is actually that Carriacou will be 100% renewable energy, they are doing a couple of wind mills, they are doing some solar plants and eventually that is gonna support the whole island, which is fantastic" (Interview H4, line 82).

On Grenada, the energy supplier has strong regulations for autonomous renewable energy generation: "I am not allowed to generate, all that electricity I have to give it to Grenlec. And then I have to buy it back, it's just dumb, it's insane, it does not make any sense whatsoever" (Interview H1, line 140).

Waste management: Waste management is established in all four interviewed hotels (Interview H1, H2, H3, H4). Within the waste management process, different measures exist: material reduction, reuse, recycling, upcycling as well as disposal. A change in hotel amenities led to material reduction: "from these little pieces where you have a lot of packaging, we changed to dispensers […] minimize plastic bags as much as possible" (Interview H2, line 68, 77). Another hotel "[discouraged] the use and selling of bottled water because bottled water is in plastic bottles" (Interview H1, line 161). One hotel reported on a material reuse method: "we are replacing our garbage bin […] we put in a plastic mesh which can be cleaned all the time" (Interview H2, line 74). Recycling is an important issue for three hotels that prefer products in recyclable packaging (Interview H1, H2, H4). One hotel collects PET, cart board, cans and aluminum separately and gives it to a recycling company on the island (Interview H2). Another hotel sells old scrap metal (Interview H3). However, two persons criticized that there is no opportunity on the island for the recovery of glass (Interview H2, H3). Therefore, one hotel developed an upcycling project for glass: "So that's why I came up with this Grenada Young Entrepreneur Project, which is actually a project to upcycle glass bottles, so to develop new product like glasses, vases, light fixtures and so on" (Interview H2, line 63). Two hotels talked about their handling with hazardous substances and chose chemicals without hard bleach and non-toxic cleaning material (Interview H2, H3). A tour operator mentioned the disposal of hazardous materials as problematic:

> "There is no arrangement on the island for disposal of mercury […]. There is no arrangement on the island really for disposal of vehicle batteries. I don't even want to know, though I should, what happens to oil that is changed in vehicles" (Interview TO2, line 99).

The problem of waste disposal becomes severe because the landfill on the island is already full and "they are now digging a second landfill" (Interview H2, line 276).

Local supply chain: Five persons talked about the link between the tourism sector and the local economy, especially the agriculture sector (Interview TO2, MoT1, H1, H3, H4). The Ministry representative perceived

> "[…] a greater recognition to link tourism to other sectors in order to benefit more from the tourists that are coming here. So you link to agriculture, you link to culture or performing arts […] In other words, there is a need to ensure, that the tourist has opportunity to spend, to leave as much dollars as possible here, when they come here. So that also, we don't have to import everything to feed them and everything to sell to them" (Interview MoT1, line 100).

In the tourism sector, local products can be sold via intermediates like hotels and restaurants or directly to the tourists themselves. Despite the positive opinion of the Ministry, three businesses said that the purchasing policy of some hotels is not favoring local products. One reason is that imported products can be cheaper (Interview H1, H4). Tax concessions for foreign owned businesses reduce the expenses on imports further (Interview H1). Two persons knew that a new five star hotel will import their food because: "we can't produce our own food here" (Interview H1, line 212) and "because the farmers aren't reliable, because the weather isn't reliable" (Interview TO2, line 130). So, the price, reliability and quantity of the local agriculture were said to be reasons for hotels to import food instead of buying it locally. Two hotels offer organic food: "we have our own organic garden" (Interview H3, line 96), "our organic burgers, we do everything local" (Interview H4, line 171).

Guidelines: Three types of regulations support adaptation to climate change: certifications, natural disaster management and international conventions. Three persons mentioned the tourism certification Green Globe. One person saw the certification as an obligation to "reduce our carbon footprint" (Interview H3, line 85) and to have an environmental policy and committee in place. Another hotelier saw the benefits of the Green Globe rather as a "support for branding" (Interview H4, line 102) which is exclusive to big hotels that can afford the certification costs and not for "small places like us and others that actually comply with all these rules or obligations" (Interview H4, line 105). Two hotels reported on natural disaster plans; including a hurricane plan and one hotel will have tsunami training (H2, H3). The NPO assessed the declaration of the mangrove habitat Levera pond as Ramsar site[23] as beneficial.

[23] The Ramsar Convention is the international Convention on Wetlands that provides a framework for conservation and use of wetlands and their resources (cf. The Ramsar Convention Secretariat 2015).

Discussion:

Sustainable tourism practices, including mitigation measures, can facilitate or indirectly contribute to adaptation to climate change. Four categories of those practices could be revealed:

- Energy management
- Waste management
- Local supply chain
- Guidelines

Energy management includes energy efficiency measures and the use of renewable energy sources. Hotels implemented both due to financial, environmental or climatic reasons. However, the local energy supply regulations restrict the ability of individuals to use the full advantages of renewable energy technologies, which confirms the institutional barriers for renewable energies that was revealed in chapter 4.2.4. The empirical findings confirmed the results of other studies on adaptation the tourism sector: stakeholders tend to talk about mitigations measures in the energy consumption primarily, as described in chapter 4.2.4.

Good waste management can be part of adaptation to climate change since it reduces the amount of waste going to the landfill, which is susceptible to climate change impacts. A strong awareness for the problem of waste was found among the respondents. Waste management of tourism stakeholders on the islands included reducing, reusing, recycling, upcycling and disposal. The state provided only limited capacities for material recycling and disposal of hazardous material. Therefore, some private recycling companies were founded and one interviewed actor developed innovative glass upcycling methods.

The purchase of local products, especially agricultural products, aims at supporting the local economy and reducing imports. However, the local agriculture is very vulnerable to climate change. Unreliable weather patterns due to climate change impacts make the local food supply unreliable, which is a reason for businesses to source their food from the international market than from the local market. Moreover, the quantity of agricultural production is limited and it is questionable if the local production can meet potential demand from new hotels. A strong local economy is not directly an adaptive capacity or does contribute to adaptation. Nonetheless, it decreases the dependency on international trade and external shocks to which SIDS and the tourism sector are subjected to. A climate-resilient local agriculture contributes to overall adaptive capacity.

Regulations were evaluated as having a beneficial impact on climate change adaptation. Even though hotels did not choose regulations like certification or disaster management with the climate change lens, they feature benefits for adaptation, for example in case of in natural disasters. Those regulations were taken voluntarily, whereas a site declaration as conservation area was done on the governmental level.

All respondents were aware and motivated for some aspects of the four areas of sustainable tourism practices. They had greater knowledge on the direct reasoning and benefits of good energy and waste management as well as for local purchasing compared to the knowledge on specific climate change adaptation measures. This can be explained by the fact that those mitigation measures are more visible and available for tourism stakeholders and benefits in cost and material reduction are felt immediately and act as trigger. Moreover, mitigation measures and environmental practices are already part of a good business practice and have a longer history than adaptation, which is rather new as outlined in the theory and by the first generation of vulnerability assessments, see chapter 2. The synergies between mitigation and adaptation options as well as the obstacles for implementing renewable energies, outlined in the IPCC, see chapter 4.2.4, have been confirmed.

7.3 Tourism Sector Development

Tourism growth and diversification: Three persons appraised the current growth in the tourism sector as positive (Interview TO1, H4, MoT1), whereas two persons had a rather critical view on economic growth (Interview H1, TO2). The increase in visitor arrivals was seen as "sign […] that the economy is getting better" (Interview TO1, line 133) and has made the importance of tourism more obvious in Carriacou (Interview H4). The Ministry representative confirms the important role of tourism:

> "the tourism sector is the one bright spot in the Grenada economy for the last few years and it continuous to be so and the outlook is very good because we have a couple of hotels are in the stage of construction, we have good news in terms of the additional airlift coming in, you know from Germany. We have a new airline starting from the US starting later this year and additional flights from existing other airlines. So it's looking bright, the future is looking very good for tourism. It will continue I believe to lead the economy of the country" (Interview MoT1, line 115).

Three persons criticized exactly this development. They ascribed the tourism directive a mass tourism style, which does only focus on growth (Interview TO2, H1, H4). It was said that growth in tourism infrastructure and visitors "will be good if there is a slight increase and I think absolutely devastating if there is a big increase" (Interview TO2, line 127). Another person questioned the growth paradigm in general:

> "Growth is, that's the danger. Sustainable growth is what we you should always be talking about, how could you grow your economy in a sustainable way? […] I hope that tourism doesn't develop as fast in Grenada. […] I believe that tourism destroys countries […]" (Interview H1, line 79, 194).

A limiting factor for growth is the carrying capacity, which the interviewees assessed differently. One person said: "And there is capacity, although our overall carrying capacity would be small because you know, and we don't want to overburden our resources" (Interview MoT1, line 127), whereas a second person saw the carrying capacity already exceeded: "there isn't enough water already. There are being consuming more electricity and the beach is already threatened" (Interview H1, line 222). Though, the Ministry representatives mentioned the importance of a product diversification for the tourism industry. Even though one person said that "there has been a recognition that we need to diversify" (Interview MoT1, line 107), another person stated that this process has not received much attention as yet (Interview MoT2).

Dependency on tourists' behavior: Four persons stressed the adaptive capacity and power of the tourists within the tourism system in Grenada (Interview TO2, TO1, H1, H4). Two respondents saw climate change impacts as influencing factor for future tourism demand: "I mean if people believe and visitors are fearful that there is no water in a place, they may not wanna come" (Interview TO1, line 36). Ultimately, this affects the tourism businesses survival:

> "The destination is vulnerable and if tourists see an impoverished product, there is no much point in coming here […]. If the sea level changes, the Carenage will go, the airport may be cut off by the end of this century, that means that [name of tour operator] is affectively going to lose its business because if tourists can't come here, we can't show them around" (Interview TO2, line 4, 8).

The preferences of tourists in their decision on a holiday destination are determinative for the destinations survival:

> "I think that the European tourist in five years' time will only travel to places where there is some kind of attend, there is some kind of thought or some kind of certificate or something because otherwise they wouldn't even travel" (Interview H4, line 159).

One person addressed cultural commodification as a problem of the tourism economy: "You bring in a lot of foreigners onto the island and you have to adapt to their way, they won't adapt to your ways, so you start getting McDonald" (Interview H1, line 196).

Discussion:

The tourism sector development is influenced by

- Tourism growth and diversification
- Dependency on tourists' behavior

The interviewed stakeholders had several points of opinions on the growth of the tourism sector. The improvement of the economic situation of the country after the strong decline due to the international financial crisis can be related to the increase in tourists and tourism development. Accordingly, some persons saw tourism as a driver of economic growth as positively. Other criticized the growth in the tourism infrastructure and tourists arrivals because it overburdens the carrying capacity, contributes to resource scarcity, pressure on ecosystems and landscape degradation, which is exacerbated by climate change impacts. Structural tourism development does not prioritize adaptation and neglects the interaction between tourism development and climate change impacts. Product diversification is one way to allocate increasing tourism pressure more throughout the country but is still in its infancy. The interviewees confirm the dependency of the tourism industry on the attractiveness of the natural environment. Climate change impacts on natural tourism assets possess a great threat to the industry since they can reduce visitors' demand and arrivals. This also confirms the power imbalance between Western tourists and the destination, as described in chapter 4.2.4. Tourists have a decision-making function in choosing a destination and demanding a certain standard, whose fulfillment can modify a country according to their needs. Hence, the setting for tourism development does not enable innovative adaptive action as the sector continues to grow in a traditional way and under stable dependency on foreign visitors.

This also indicates a low resilience of the tourism sector, which has low coping, responding or reorganization capacity and maintains function, identity and structures, as defined in chapter 3. The respondents, who criticized the tourism development, showed a social-ecological system understanding because they assessed the direct impact of humans and human-made infrastructure as destructible for a country, its ecosystems, resources and culture.

8. Summarizing Evaluation of the Results and Outlook

The starting points of this thesis were the unavoidable impacts of anthropogenic climate change, which specifically small island developing states already experience. Hence, ecological and social systems have to adapt to current and expected impacts in order to prevent destructive climate change effects. A necessary condition for adaptation is the capacity to adapt to disturbances. Adaptive capacity can reduce vulnerability and enhance resilience of social-ecological systems. Especially the tourism sector on small island developing states requires adaptive capacity in order to be able to adjust to potential damages in the natural environment and tourism infrastructure, on which the sector depends. This thesis revealed the determinants of adaptive capacity and their underlying characteristics of the tourism sector in Small Island Developing States by using qualitative data. Therefore, the author chose the Caribbean island state Grenada as a case study and interviewed ten tourism actors from the private, public and civil sector.

The private and public knowledge on exposure and sensibility to climate change impacts was diverse and backed up with experienced climatic changes or general climate challenges, especially for precipitation changes and sea level rise. The sector has learned to cope with natural climate variability and has not experienced severe impacts from slow accumulating climate changes on tourism products and services as yet. It has been revealed that private tourism actors, who have experienced climate change impacts, possess high risk perception and a lot of capacity for autonomous adaptation to climate change. However, some tourism actors have not yet been impacted and therefore have low concerns for the potential occurrence of hazardous climate impacts and possess low adaptive motivation. Even though some actors undertook reactive adaptation, most persons had a rather low anticipatory risk perception for long-term impacts, which can be explained by a short-term planning horizon of the tourism sector. Powerful instruments for triggering adaptation measures and protecting natural tourism assets are market incentives, like sustainable positioning and branding, and pressure to confirm to environmental standards. Adaptive beliefs, including a tough self-efficacy and a philanthropic and environmental conviction of stakeholders, reinforced the adaptation motivation. Tourism actors applied physical adaptation action, such as the use of natural resources like mangroves and corals for ecosystem-based adaptation, which offers co-benefits for the development of innovative tourism products. Furthermore, they implemented technological innovations to secure freshwater availability, e.g. by rainwater

harvesting or desalination, and to protect the coastal zones, for instance with sand barriers. Private investments up to a certain size and quality of adaptation actions facilitated autonomous adaptation. The capacity for public investments in the tourism sector was rather available for mitigation measures than for adaptation. Decision-makers are motivated to spread their environmental conviction and knowledge and therefore foster environmental education opportunities for tourism employees, the community and children and partly for tourists. The interviewees regard employees in the tourism sector as multipliers for knowledge and behavior on good environmental and adaptive activities. The tourism sector as a whole can be a role model since many other sectors and jobs are indirectly linked to tourism. Most respondents had a special affinity for the education of children, which can contribute to an inter-generational change. They perceived shortcoming in environmentally friendly behaviors and cultural habits in the society, which motivated them to invest in human and social capital. However, industry standards in tourism can hinder sustainable production and consumption methods. Even though the tourism stakeholders assigned tourists a strong understanding, interest and support in environmental topics and conservation efforts, most of the interviewees excluded tourists from human capacity building. Since governmental structures and decision-making in general and within the relevant Ministry do not possess great capacities for nurturing or assisting adaptation in the tourism sector, adaptation planning can take advantages of the experience from autonomous adaptation and the diverse psychological, human and social capacities. This supports adaptive actions on the ground. Particularly the high participation in policy processes and engagement of the private sector open possibilities for collectively planned adaptation strategies.

The interview partner grasped and implemented sustainable tourism practices in energy and waste management, local supply chains and sector guidelines easier than adaptive actions. Immediately perceived benefits, visibility of effectiveness and autonomy in decision-making encouraged the implementation of those measures. Traditional growth strategies in tourists' arrivals and infrastructure do not yet incorporate adaptive measures to climate change. In contrast to governmental representatives, the private sector representatives had a critical attitude towards growth and feared the adaptive behavior of tourists, which can become apparent by decreasing visitor arrivals.

Some results confirm the research results in the field of adaptation to climate change in the tourism sector. For example Becken et al. (2011) revealed similar results regarding the divergence between climate change awareness and risk perception and the dif-

ferences in private and public sector understanding. Scott and Becken (2010) indicated that mitigation has a higher relevance than adaptation due to risk and cost reduction benefits. Moreover, they found that tourism actors had constraint knowledge about impacts and coping strategies concerning slow accumulating and long-term climate impacts. The IPCC AR5 (2014) proposes that the tourism sector is an example for achieving synergies between mitigation and adaptation and for demonstrating their complementary components. Hay (2013) argued that the climate pressure and other factors have contributed to a natural resilience of coastal ecological and social systems but tourism dependent economic structures increased the economic vulnerability of an island. Duval, Wilkinson (2004) and McElroy (2004) defined tourism as reproduced north-south dependency structure. However, tourism resorts in Grenada showed a higher adaptive capacity than indicated in the literature by Scott et al. (2012a).

The chosen determinants provided an adequate framework for defining the underlying characteristics that formed the subcategories. These subcategories as well as the influencing sustainable practices and sector development provide a more differentiated and detailed view on the standard categories of adaptive capacity and are transferable to other cases. Hence, the methodical approach of the qualitative content analysis was suitable for answering the research question. In reality, however, the determinants cannot always be separated that precisely due to the complex decision-making processes and reciprocity in action. The case study focused on positive examples for adaptive capacity, wherefore the results are very diverse and manifold but not representative for the whole island. Nonetheless, the results show examples of the sector which are applicable to similar small island states or comparable tourism dependent countries. This confirms the representative function of case studies. Still, other actors and actors within different geographical, political or social contexts would reveal different aspects of the determinants due to the context-specific adaptive capacities. The professional occupancy of the interviewer during that time and her personal characteristics could have influenced the process of data collection. Furthermore, the substantial focus on adaptation to climate change of the interview could have caused problem reframing and distorted the answers. For instance, a lot of interview partners emphasized their actions towards environmental protection and conservation, including mitigation measures. Since there can be synergies between mitigation and adaptation, the author took these answers into consideration in the evaluation. However, the risk of maladaptation also exists. The direct questions regarding vulnerability could have provoked disclosure of vulnerable areas and ques-

tions concerning adaptive action could have led to a promotional framing of certain activities, as explained in chapter 5.2. The fact that four interview partners were European expatriates and had a different cultural background under which they assessed the Grenadian culture could have influenced the mainly negative results regarding customs and culture.

Based on this research, the author can develop some guidance. Tourism stakeholders need clear information on the occurrence and extent of expected impacts, their economic risk as well as the correlating advantages of adaptation. This information is usually not provided by uncertain, large scale and long-term climate change scenarios. Therefore, medium-term impact scenarios and the economic valuation of ecosystem services are important for the sector and can support decision-making for adaptation and correlating investments. The politics should utilize the strong psychological capacities regarding self-efficacy, environmental conviction and market incentives of tourism actors and gear them towards more comprehensive adaptive actions. Hereby, the time discrepancy between tourism planning and adaptation planning should be overcome. Together with the extensive human and social capital, tourism actors can take the role as multipliers in the society. Nonetheless, political structures and decision-making have to facilitate and support adaptive action and guide capacities in the right direction. Therefore, the political will is crucial for adaptive action. More advantages can be taken from good environmental and sustainable tourism practices in order to exploit synergies with adaptation measures. These practices should incorporate adaptive measures and become "climate-proofed" in order to mainstream adaptation in existing sustainable practices and avoid maladaptation. This holds also true for existing coping strategies with respect to natural climatic variability that have not yet considered climate change impacts. An understanding of SES can integrate environmental and adaptive action in the tourism sector, contribute to climate-resilience and provide a vision of tourism development beyond the traditional growth strategy. For further research, it would be interesting to evaluate the adaptive capacities of tourism actor within a context where climate change adaptation has become a political imperative for all sectors. Moreover, an analysis of the demand side; hence, the opinion of the tourists, would reveal more information on their adaptive capacity. This could give guidance on the appropriated communication of climate change issues and offer possibilities for integrating tourists in the adaptation process.

For Grenada, more guidance and support from the government and the Ministry of Tourism or Environment are necessary. The public sector can also better inform decision-makers on medium to long-term climate change impacts and adaptation strategies in order to increase the relevance of adaptation. Since the interviewed persons had limited knowledge on the design and outcome of adaptation actions, specific cause and effect relationships have to be established and communicated. This impacts and adaptations have to be customized to the tourism sector and should emphasize the economic risks of climate change. The politics should take advantage of the strong environmental and adaptation motivation and belief of the private and civil sector, for instance by incentivize them to implement adaptation measures. This aims at taking collective actions, which will benefit all stakeholders, for example in the case of coastal protection. Instruments and incentives for adaptation can be linked to or integrated in the sustainable destination strategy 'Pure Grenada'. Moreover, the private sectors' environmental education and training for its staff, kids and the communities testify their social responsibility. A stronger networking and public guidance can create collective action and more coordinated measures towards awareness-raising for adaptation. The overall good environmental practices by hotels and the dive shop provide excellent opportunities to integrate adaptive elements. As most actors are highly motivated to conserve the environment, the climate change issues should be brought more in detail to their attention. Thereby, the sector has also the potential to differentiate itself in the market. Tourism actors in Grenada should rate climate change adaptation as high as general environmental protection measures, e.g. in waste and energy management. Therefore, more technical understanding of the causes and impacts and feasible adaptation measures are necessary. Finally, the manifold adaptive capacities of the tourism sector have to be stronger activated in order to result in adaptation action.

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Appendices

I. System of Categories

Exposure and sensitivity	Temperature increase	
	Precipitation	
	Se surface temperature	
	Sea level rise and coastal erosion	
	Tropical storms and hurricanes	
	Non-climatic factors	
Determinants of adaptive capacity		
Psychological determinants	Adaptive motivation	Risk perception
		Time perception
		Market incentive
		Inspiration from good practices
	Adaptive belief	Self-efficacy
		Philanthropic and environmental conviction
		Outcome-efficacy
Natural resources		
Technological resources		
Financial resources	Private adaptation finance	
	Public adaptation finance	
Human capital	Knowledge and learning of decision-makers	
	Internal education and training	
	External education and public awareness	
Social capital	Collaboration and networks	
	Customs and culture	
	Behavior of tourists	
Governmental institutions	Governmental structures	
	Governmental decision-making	
	Participation in policy processes	
Sustainable tourism practices	Energy management	
	Waste management	
	Local supply chain	
	Guidelines	
Tourism sector development	Tourism growth and diversification	
	Dependency on tourists' behavior	

II. Interview Guideline

Topic	Important aspects	Guiding question	Further questions
Module 0: Introductory question	Get to know interview partner	What is your position in the business?	
Module 1.A: General vulnerability to climate change of country *Question for government, GTA*	Risk perception/knowledge of/interest in climate change, general understanding of vulnerability: conceptual: contextual as starting point, impact as end-point (sensitivity, exposure, ac)?	In how far is the Grenadian tourism system vulnerable towards climate change?	How **important** would you rate climate change impacts to Grenada's tourism sector in comparison with other impacts?
	Climate stimuli towards the system feel most impact (are sensitive/exposed) (SST, SLR, hurricane...)		Which **climate change impact is the most serious**, dangerous for the Grenadian tourism system? Which climate condition **already affected** Grenada's tourism in a negative way?
	Section of impact (infrastructure, beach…), relevant ecosystem, business dependency on ecosystems		Which **natural tourism resources** are most threatened by climate change?
Module 1.B: Specific vulnerability (exposure, sensitivity) of actors *Question for private businesses*	Risk perception (adaptation motivation), Anticipated risks, impacts	In how far is your business operation vulnerable towards climate change?	How **important** would you rate climate change impacts to your business in comparison with other impacts?
	Climate stimuli towards the system feel most impact (are sensitive/exposed) (SST, SLR, hurricane...)		Which **climate impact is the most serious, dangerous** for your business operations? Which climate condition already affected your business in a negative way? E.g. sea level rise, temperature increase, droughts
	Section of impact (infrastructure, beach…), relevant ecosystem, business dependency on ecosystems		Which **natural resources** are crucial for your business? (e.g. beaches, corals) Do you see any of them threatened by climate change?
Module 2.A: Adaptation motivation	Willingness to adapt, adaptation motivation	Which **relevance** does adaptation to climate change currently have in your business?	
Module 2.B: current adaptation measures	Current adaptive measures, reactions	Tell me something about the **adjustments you implemented** towards changing climate conditions or even impacts (e.g. hurricane Ivan 2004). What did you want to **achieve** by those changes? *Or adjustments that have in some way a relation towards climate change* *If no adjustments so far:* What actions would you take in order to cope with climate impact?	Which **department** implemented adjustments? (energy, water, marketing, pr…)
	Incremental or transformative adaptation		How **profound** were these changes? To what extend were **other departments influenced**? Were these departments also **involved** in these changes?

Module 2.C: Adaptation reasons	trigger for adaptation action, circumstances	**Why** did you decide to implement those adjustments?	Was there any **trigger** from inside or outside your operations that influenced your **decision**? (Incentive? Collaboration opportunity?)
			Were there any **circumstances** inside or outside your business that eased the **implementation** of adjustment?
	learning in response to disturbance		Bearing in mind the **climate changes and climate events of the last years**, how did the significance of climate impacts changed your operations/decision making?
Module 2.D: Adaptation means	Available assets for adaptation	For executing these actions, what kind of **resources**/assets did you require?	How did you get **access** to this asset?
	Assets needed		Was there any **adaptation measure you could not undertake** - due to missing economic resources, infrastructure, technical equipment etc.?
	Barriers for adaptation		Was there anything that **complicated** your adjustments or hindered planned adjustments?
Module 2.E: Adaptive capacity that have not resulted into adaptive actions: *Questions on hold, only relevant if aspects were not answered from the previous questions*	Financial resources	What role do **financial** resources play in your adaptation to climate change?	Do you know any financial instrument for adaptation measures? Do you have access to them?
	Technology, know-how	What role do **technical** innovations play in your adaptation to climate change?	Do you know any technological innovation/adaptation means? Do you have access to them?
	Infrastructure		
	Human capital (knowledge, education, information, expertise)	How do you deal with climate and environmental-related **information**/news?	Do you have a specific entity that is responsible for climate/environmental planning, management? Do you have experts in this field?
	Social capital (trust, reciprocity, exchange, common rules, social networks, property rights, manage information, act collectively, values, perceptions, customs, traditions), *learning capacity*	In how far do you **interact** with other actors of the tourism sector concerning climate-related issues?	(Meetings, organisations, exchange information, collaborative activities, traditional links)
	Institutions	Do you know any **organization** or **agreement** that is concerned with adaptation to climate change, you could seek advice from, if needed?	
	Governance, transparent decision-making	Tell me about your **participation in policy processes** in influencing decision-making concerning climate/environmental policy.	
Module 2.F: Future adaptation measures	Risk anticipation	Do you **plan** any adjustments that meet climate change impacts in the future?	Do you **prepare** your business/sector for future climate impacts?
Module 3.A: Resilience	Coping strategy, reorganization	In what direction did the tourism operations concerning the natural environment change during the last 10-30 years in Grenada?	Did the tourism infrastructure and activities remain the same over years?
	Retain of control on functions/structure/identity		
	Engineering resilience/evolutionary resilience		
Final question		Are there other important aspects you would like to mention concerning your approach to climate adaptation?	

Abschließende Erklärung

Hiermit versichere ich, dass ich diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt habe. Außerdem versichere ich, dass ich die allgemeinen Prinzipien wissenschaftlicher Arbeit und Veröffentlichung, wie sie in den Leitlinien guter wissenschaftlicher Praxis der Carl von Ossietzky Universität Oldenburg festgelegt sind, befolgt habe.

Oldenburg, den 19.06.2015

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