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*Climate Change in the Dominican Republic:  
Coastal Resources and Communities*

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Mat Rosa & Hilary Lohmann

This publication is the result of the authors' participation in the Fellows GFDD Program. Mr. Rosa participated between January and February 2014, and Ms. Lohmann participated between June and July of 2014.

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***Climate Change Adaptation in the  
Dominican Republic: Impact on  
Coastal Resources and Communities***

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# Table of Contents

Foreword .....	ix
Preface .....	xi
Acknowledgements .....	xv
Mat Rosa.....	xv
Hilary Lohmann.....	xvi
 <b>Coastal Resource Climate Change Adaptation in the Dominican Republic by Mat Rosa</b>	
Abstract.....	3
Key Words .....	3
Acronyms .....	3
Table of Figures.....	4
I. Introduction .....	5
Introducing Concepts.....	7
II. Assembling a Governance Baseline Profile.....	11
First Order Enabling Conditions .....	12
Case Study: Santo Domingo, Dominican Republic.....	14
III. Methods .....	16
Literature Review .....	16
Interview Instrument.....	17
IV. Findings .....	21
Vulnerable Coastal Resources in the DR: Fisheries; Coastline; Seaports; Reefs .....	21
Sources of Governance: Government; Civil Society; Markets.....	26
Government: National; Regional; Local .....	26
Enabling Conditions .....	32
V. Limitations.....	36
VI. Discussion.....	36
VII. Recommendations .....	37

VIII. Conclusion.....	38
References .....	40
Appendices.....	43
Appendix 1: Historical analysis of DR coastal management .....	43
Appendix 2: Detailed Analysis- La Caleta Underwater National Park.....	45
Appendix 3: Respondent Recruitment Letter.....	49
Appendix 4: Interview Instrument .....	50
Appendix 5: Interview Instrument Results.....	53

**Measuring Social Vulnerability & Adaptive Capacity to  
Climate Change in Coastal Communities of the Dominican  
Republic** by Hilary Lohmann

Abstract.....	63
Table of Figures.....	64
Measuring Risk to Climate Change .....	65
Vulnerability .....	65
Resilience.....	66
The Marshall et al. (2010) Method.....	67
Coastal communities of developing nations: Balancing natural resource dependence and occupational multiplicity.....	69
Communities as integrated systems .....	72
Climate Change Impacts in the Dominican Republic.....	73
Vulnerability Assessment to Climate Change in the Dominican Republic.....	73
Sensitivity in the Dominican Republic.....	75
Comprehensive, Multi-scale Vulnerability Assessment.	76
Research Methodology.....	77
La Caleta/Boca Chica .....	78
Samana .....	78
Montecristi.....	79
Data Collection .....	80
Data Analysis .....	82
Results.....	84

Factors that Describe Vulnerability and Adaptive Capacity.....	85
Comparing Direct and Non-direct Marine Resource Users .....	87
Comparing Individuals with and without Occupational Multiplicity.....	88
Changes in Climate and Weather .....	89
Perceived changes in climate/weather.....	91
Discussion .....	92
Factors of Vulnerability and Adaptive Capacity .....	92
Comparing Vulnerability across User Groups .....	93
Exploring how Occupation Relates to Vulnerability.....	94
Gaps in Awareness and Prioritization: the Marine and Coastal Environment in the Face of Climate Change.....	95
Management Implications .....	96
Conclusion .....	98
References .....	100
Biographies.....	103
Mat Rosa.....	103
Hilary Lowmann .....	104
GFDD.....	105
Funglode.....	106
Fellows Program .....	107





## Foreword

The Global Foundation for Democracy and Development (GFDD) in the United States of America and the Fundación Global Democracia and Desarrollo (Funglode), headquartered in Santo Domingo, Dominican Republic, are dedicated to promoting research and awareness in areas crucial to the democratic, social and economic sustainable development of the Dominican Republic and the world. The two think tanks organize meetings, educational programs and research as well as generate studies and publications that contribute to the development of new perspectives, enriching public policy debate and proposals, promoting the search for innovative solutions and transformative initiatives on a national and international level.

GFDD and Funglode are honored to present the publication series Research and Ideas, which offers the results of research projects, academic articles and intellectual speeches that address critical issues of the contemporary world from local, regional and global points of view.

On this occasion the series showcases the work titled *Climate Change Adaptation in the Dominican Republic: Impact on Coastal Resources and Communities*, which presents an analysis of the adaptive capacity of individuals involved in various sectors of employment in three Dominican coastal communities, as well as the status of governance factors driving climate change adaptation planning for coastal resources in Santo Domingo, through the research of GFDD fellows Hilary Lohmann and Mat Rosa.

These selected works present scrupulous analysis, introduce innovative ideas, and transmit inspiration. We hope they will contribute to a better understanding of the world, empowering readers to act in more informed, efficient, and harmonious ways.

**Natasha Despotovic**  
Executive Director  
GFDD



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## Preface

The climate of the Dominican Republic, like many other Small Island Developing States (SIDS), is greatly influenced by large ocean-atmosphere interactions such as trade winds and El Niño. Tropical cyclones, hurricanes, and sea level rise also constitute important components of this climate. As a country that is highly sensitive to such changes in the climate and to sea-level rise, the Dominican Republic is therefore experiencing the more severe effects of climate change sooner than most nations.

In light of these vulnerabilities, and in an effort to enhance public understanding of the impacts of climate change on the country's coastline and promote climate adaptation policies, GFDD and Funglode have regrouped the research work of two of its 2014 research Fellows into this publication for the first time. The Fellows, Ms. Hillary Lohmann and Mr. Mat Rosa, were post graduate students in Marine Affairs at the University of Rhode Island focusing their theses on climate adaptation. Both research projects bring new perspective and innovative approaches to achieve adaptation solutions to the economic, social, and environmental challenges posed by climate change to coastal communities in the Dominican Republic and other SIDS.

Mr. Rosa carried out his research in the Dominican Republic over a two month period in January and February of 2014, during which he examined the status of governance factors driving climate change adaptation planning for coastal resources in Santo Domingo. He chose the capital city as it is ranked among the world's top five coastal cities most vulnerable to climate change, by cost of expected damage as percentage of GDP. For the duration of their studies, researchers work in close coordination with GFDD officials and national academic advisors to guide their search for information and data.

As part of his field research, Mr. Rosa received the guidance of Mr. Daniel Abreu of the Presidential National Council on Climate Change. He interviewed key stakeholders such as Mr. Bienvenido Santan at the Ministry of Environment and Professor Hugo Segura at the Department of Meteorological Education at the National Meteorological Office (ONAMET), and collaborated extensively with several representatives of civil society organizations across the country including Mr. Alejandro Herrera-Moreno of Programa EcoMarMr. Oswaldo Vasquez of ATEMAR, Mr. Monserrat Acosta Morel and Ms. Catherin Cattafesta of The Nature Conservancy, and Ms. Eva Perez of the Dominican Institute for Integral Development. Other collaborators with whom Ms. Rosa worked include Ms. Yolanda M. Leon, PhD, of Universidad INTEC y Grupo Jaragua, Mr. Ruben Torres of Reef Check Dominican Republic, Mr. Hector Ramirez of CIBIMA UASD, Ms. Patricia Lamela of the Center for the Conservation and Eco-Development of Samaná Bay and its Surroundings (CEBSE), Mr. Fausto Gómez of Pronatura, Mr. Jake Kheel at the Punta Cana Ecological Foundation, Ms. Carla Baraybar at DP World, Mr. Andy Jones of US Peace Corps, Ms. Patricia Lancho at FUNDEMAR, Mr. Victor Vinas at HDC International, Mr Enrique Pugibet Bobea of the Center of Marine Biology Research (CIBIMA-UASD), and Mr. Odalis Perez at USAID.

His work aimed to identify the status of enabling conditions commonly associated with capacity for implementing a plan of action to sustainably manage coastal resources vulnerable to climate change. His results indicated that the federal government remains the main source of governance that currently leads in shaping responses to climate change. Mr. Rosa's work helped to reveal that with enhanced coordination between government and civil society, the country does have the necessary capacity to implement adaptation policies to help coastal communities best prepare for the future social and ecological challenges of climate change.

Ms. Lohmann's work, conducted over a two month span between June and July of 2014, considers the ability of individuals to adapt to shifting climate conditions, as a priority concern for tropical communities that rely heavily on natural resources for socio-economic wellbeing, such as those on the coast of the Dominican Republic.

To carry out her research Ms. Lohmann worked under the guidance of Mr. Ruben Torres of Reef Check Dominican Republic. She also collaborated with several other environmental experts including Mr. Omar Shamir Reynoso of the Ministry of Environment and Natural Resources, Mr. Daniel Abreu of the National Council on Climate Change, Ms. Patricia Lamelas, of CEBSE and Mr. Frederick Payton of AgroFrontera. Her 2014 study investigated the adaptive capacity of individuals involved in various sectors of employment in three Dominican coastal communities: La Caleta, Samana, and Montecristi. The results she obtained indicated that many of the factors characterizing adaptive capacity are similar for all coastal individuals. However, direct resource users exhibited greater attachment to occupation and sole providers of household income showed lower financial security. The findings of this research have important implications for community and development planners working in coastal areas of the Dominican Republic. They highlight the value of understanding a person's role in a household to better predict an individual's ability and willingness to make changes related to occupation. As manifestations of climate change continue to impact coastal communities of the Dominican Republic, this report can therefore be a useful resource for developing strategies for preparedness.

Fellows such as Mat Rosa and Hilary Lohmann contribute to GFDD's growing body of research on issues of international interest such as climate change that directly affect the Dominican Republic, the region and the world. The Fellows Program provides opportu-

nities to Masters and Doctoral candidates to undertake high-level research in the Dominican Republic on issues related to democracy and sustainable development. During their studies, researchers work in close coordination with GFDD and Funglode teams as well as with national academic advisors.

We hope that this publication on climate adaptation will help stimulate debate as to what responses are required, at both the national and regional level, to prepare coastal communities of the Dominican Republic to the impacts of climate change. In promoting effective climate adaptation policies we wish to motivate a strong Dominican position at the next international conference on climate change in Paris, December 2015. We believe that achieving a bold international climate treaty that puts climate adaptation on the same level as curbing greenhouse gas emissions is essential for the sustainable development of the Dominican Republic and other SIDS that are affected by climate change.

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## Acknowledgements

### **Mat Rosa**

I am very grateful to the many people who have helped to make this publication possible and assisted in this research. Firstly, the entire staff at GFDD and Funglode who helped in every stage of the work, from the initial concept of the project up until today and certainly going forward with future research. Especially, Loriel Sanchez, Autumn Brookmire, Reyna Rodriquez, and Mandy Sciacchitano all helped tremendously with logistics, research assistance and overall support.

Many thanks to my professors at The University of Rhode Island for their continual help with designing and writing the research. Thank you to my advisor Dr. Austin Becker who offered insightful feedback. I am endlessly grateful to my inspiring mentor, Stephen Olsen, a true thought leader in the field of coastal governance. I had the honor and privilege to work closely with Stephen Olsen on this research, as I made an attempt to utilize his conceptual framework of the Orders of Outcomes to overlay an Integrated Coastal Management lens to climate change adaptation planning.

Finally, I am grateful to all my new Dominican colleagues and friends who offered their time and expertise to this research, including Alejandro Herrera-Moreno, Dr. Yolanda M. Leon, Ruben Torres, Hector Ramirez, Monserrat Acosta Morel, Patricia Lamela, Oswaldo Vasquez, Fausto Gómez, Catherin Cattafesta, Bienvenido Santan, Jake Kheel, Carla Baraybar, Andy Jones, Patricia Lancho, Victor Vinas, Enrique Pugibet Bobea, Odalis Perez, and Professor Hugo Segura.

## **Hilary Lohmann**

This report would not have been possible without the support of several parties. Thank you to my University of Rhode Island graduate adviser, Dr. Tracey Dalton, for the time and energy she committed to help me complete this project from initial development to final revision. Thanks to the rest of my graduate committee, Dr. Brian Crawford and Dr. Carlos Garcia-Quijano, for their evaluation and feedback. Thank you to Dr. Ruben Torres for sharing his resources throughout the course of my research and writing, and for his hospitality, friendship, and support while I worked in the Dominican Republic.

Thank you to my site contacts for Samana and Montecristi, namely Patricia Lamelas of the Center for the Conservation and Eco-Development of Samana Bay and its Surroundings and Frederick Payton of AgroFrontera. Thank you also to Omar Shamir Reynoso at the Ministry of Environment and Natural Resources and Daniel Abreu at the National Council on Climate Change who were great contacts, helping me to experience and understand the general Dominican context/landscape of my work.

Finally, thank you to GFDD and Funglode for funding my field research in the Dominican Republic and thank you to the entire staff at the foundations for all their continued support throughout this project.



**Coastal Resource Climate Change Adaptation  
in the Dominican Republic**  
by Mat Rosa



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## Abstract

As the capital city of the Dominican Republic, Santo Domingo is ranked among the top five coastal cities most vulnerable to climate change by cost of expected damage as a percentage of GDP. This research assesses the sources of governance driving climate change adaptation planning for coastal resources in the Dominican Republic. A governance baseline is a snapshot that examines a governance system, undertaken to analyze the current status of criteria influencing ecosystem-based climate change adaptation. Field research was conducted in country with an interview instrument based on the Orders of Outcomes framework to identify enabling conditions for implementing a plan of action to sustainably manage coastal resources vulnerable to climate change. Analysis of literature review and interview results find that the coastal resources most vulnerable to climate change are fisheries, eroding coastlines, seaports, and coral reefs. The Enabling Conditions in place to address these vulnerabilities are a codified commitment of national agencies to play a leadership role in adaptation planning, and the capacity for increasing local co-management of coastal resources. Coastal climate change adaptation planning must grant more autonomy to the national agency on climate change, and enact co-management arrangements with local organizations to sustainably manage social and ecological conditions of the coastal ecosystem.

## Key Words

Climate Change Adaptation, Governance, Ecosystem-Based Management, Developing States

## Acronyms

CC	Climate Change
CNCCDML	National Council on Climate Change and Clean Development Mechanism
DR	Dominican Republic
EBM	Ecosystem-Based Management
IPCC	Intergovernmental Panel on Climate Change
LOICZ	Land-Ocean Interactions in the Coastal Zone

NGO	Non-Governmental Organization
OOO	Orders of Outcomes
RC	Reef Check
SD	Santo Domingo

### **Table of Figures**

Figure 1- Orders of Outcomes.....	10
Figure 2- Map of Dominican Republic.....	15
Table 1- Interview Instrument Respondents by sector of governance .....	18
Table 2- Interview Instrument Questions Part 1 on vulnerability.....	18
Table 3- Interview Instrument Questions Part 2 on enabling conditions .....	20
Figure 3- Resources Most Vulnerable .....	22
Figure 4- Photo of littered beach .....	23
Figure 5- Seaport breakwater .....	24
Figure 6- Interview Responses to Sources of governance.....	26
Figure 7- Tourism % GDP.....	31
Figure 8- Interview Responses: Enabling conditions - Capacity .....	33
Figure 9- Interview Responses: Enabling conditions - Goals.....	35

## I. Introduction

Human society has never before faced forces of change as complex and potentially catastrophic as climate change. The Anthropocene corresponds to the current epoch of humans and our post-industrialization societies, as they have become a global geophysical force. Climate change and many other human-driven changes to the environment are raising concerns about the future of Earth's environment and its ability to provide the services required to maintain viable human civilizations (Steffen, Will, Crutzen, Paul, et al. 2011).

The motivation behind this research is the need for governments and funding agencies to understand where to focus and track progress on climate change adaptation. This research gathers evidence of adaptation planning for coastal resources from a case study of the Dominican Republic (DR). Global climate change impacts communities, ecosystems, and people's lives in the coastal zone, which is home to over 40% of the global population (USAID 2013). Climate change will be a major challenge for the DR; a World Bank study ranked the capital city of Santo Domingo in the top five coastal cities most vulnerable to climate change, by cost of expected damage as percentage of GDP. (World Bank 2013). The city is exposed to significant negative effects of extreme coastal weather events and rising sea level, at great economic and social cost (Hanson 2011).

This research utilizes the conceptual framework of the Orders of Outcomes (Olsen 2003) to examine the presence of enabling conditions for addressing the challenges of climate change in a climate-sensitive hotspot: Santo Domingo<sup>1</sup>. Data was gathered from the analysis of a

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1 Per recommendation in the 2013 USAID study on climate change vulnerability in the DR (USAID 2013) the capital city of Santo Domingo (SD) province is the area of focus for this research. The area of focus is the geographically defined area that ecosystem-based adaptation planning addresses and is therefore the focal point for a governance baseline. An approach to work at the appropriate level of scale recognizes natural functions of the coastal ecosystem, governance forces, and relevant stakeholders. Santo Domingo is legally 2 Provinces, comprising the National District that has historically been Santo Domingo, and the current City of Santo Domingo which is comprised of 3 municipalities: Santo Domingo North, East and West. This has important implications in terms of government management and governance dynamics in general.

literature review and a semi-structured interview instrument. The purpose of this research is to analyze the forces that influence actions to adapt to climate change in the DR. The main sources of governance are government, the private market, and civil society (Juda 2001). A “governance baseline profile” (Olsen, et al., 2009) provides analysis of a country’s experiences with changing ecosystem conditions and the processes of decision-making. The goal for this paper is to provide a level of analysis to make explicit recommendations for policymakers planning climate change adaptation for coastal resources. Identifying opportunities and barriers of the country’s current governance profile informs a plan of action and assists policymakers and stakeholders to set goals within the local governance context.

The questions this research seeks to answer are;

- 1) What coastal resources are most at risk to negative impacts of climate change?
- 2) Which source of governance currently leads in shaping responses to climate change?
- 3) What enabling conditions are in place as barriers and opportunities for planning a strategy to address these vulnerabilities?

This paper begins by introducing key concepts of climate change, coastal resources, governance, and the conceptual framework of the Orders of Outcomes. These key concepts are important to this research because of the significance of coastal resources, particularly for developing countries, the emerging challenges of climate change, the societal forces that determine a response of adaptation to these challenges, and a framework for monitoring the progress of adaptation. The process of assembling a governance baseline is then introduced, and the methodology for how these concepts informed the literature review and interview instrument used to answer the research questions. The case study of the Dominican Republic provides contextual background. Next, we present our interview findings that identify sources of governance and current conditions that act as barriers or opportunities to adaptation planning. In the Appendix, a detailed analysis is provided as an example of how a new use of a coastal resource that was previously dominated by destructive fishing is now conducting effective governance through a co-management

arrangement that provides SD with economic development and climate change resiliency. Finally, recommendations for adaptation planning are presented, based on findings where opportunities lie in current governance conditions to promote opportunities at hand, and barriers to be addressed.

## Introducing Concepts

### Climate Change

The United Nations Conference on Trade and Development (UNCTAD) declared that climate change continues to rank high on the international policy agenda in both developed and developing countries (UNCTAD 2013). Climate change vulnerability is a concept in research and policy that is inconsistently defined (Adger, 2006; Hinkel, 2008), and thus requires further understanding (USAID 2012, Hinkel 2011, Pahl-Wostl 2009). This research uses the Intergovernmental Panel on Climate Change (IPCC) definition of vulnerability as a function of three indicators: *exposure* to climate stressors; the *sensitivity* of a system to that stress; and the *adaptive capacity* to recover from the impacts of that exposure (USAID 2013, IPCC 2012, Sano 2009). *Exposure* to climatic stresses is based on the geographic location and frequency of meteorological events such as rainfall, temperature, and wind. *Sensitivity* is the degree to which the area is affected by climate events, such as resulting in flooding, storm surge, and coastal erosion (USAID 2013). *Adaptive capacity* is the ability of the people and communities of a society to respond and recover from the impacts of exposure and sensitivity (Adger, 2006).

Climate change presents a challenge that requires changes in ecological and social conditions (USAID 2012). Traditionally, coastal resource management has been organized around particular uses such as fisheries, tourism or seaports, resulting in separate governance regimes for each use. Over time it has become apparent that such a sectoral approach results in conflicts among users and is inadequate for sustaining the goods and services that flow from healthy ecosystems (US Commission on Ocean Policy 2004). Solutions to coastal ecosystem-based challenges must shift from managing individual sectors, to an integrated perspective of interconnected ecological and socio-political systems (Cicin-Sain 1998). This is often termed “an ecosystem-based approach.”

## **Coastal Resources**

Ecosystem-based management (EBM) is a process that recognizes resources should be comprehensively managed to reflect the relationships among all components of the system- including people (Burroughs 2011). The underlying aim is ecologically sound resource conservation that responds to the reality of ecosystem processes (Marasco 2007). Ecosystem-based approaches recognize the role of the human dimension in shaping ecosystem processes as dynamic, complex systems. These systems include a diverse set of institutions and behaviors, local interactions between actors, and selective processes, that shape future social structures and dynamics. EBM is concerned primarily with instigating the changes in human behavior that are required to restore and sustain the desired qualities of ecosystems in adapting to climate change.

Ecosystem components such as reefs provide natural barriers from climatic events like storm surge. Degraded conditions of such resources diminish the critical services provided and increase climate change vulnerability. Industries that utilize the marine environment, such as fisheries and tourism, which often have competing and potentially conflicting uses of resources, must be incorporated to provide a comprehensive analysis of relevant criteria to be considered in adaptation planning. The objective of EBM is to change human use of coastal ecosystem resources to be compatible with system's natural functioning.

## **Governance**

Governance is the formal and informal arrangements that drive behaviors of resource use. Juda (2001) identifies three primary sources of governance: government, civil society, and the private market. These sources of influence define goals, rules, and procedures for societies (Olsen, et al. 2009). Governance strategies and characteristics are the structures and processes by which people in societies make decisions and share power (Lebel, et al. 2005). Governance addresses the values, policies, laws and institutions that that are the basis for decision-making in adaptation planning, and sets the stage within which management occurs (Olsen 2003). Governance is not reactive management that simply responds to the unexpected. It is rather a conscious process of examining the course of events by pre-selected changes in indicators of both the social and environmental components of the ecosystem.



## Orders of Outcomes

A method for conducting a governance baseline by the LOICZ Guide utilizes the Orders of Outcomes (ooo) framework (Olsen 1997 & 2003; UNEP/GPA 2006; National Research Council 2008). This framework examines governance activities along a trajectory that advances towards more sustainable forms of coastal resource use for identifying strengths and weaknesses of the existing governance system. For example, the ooo might reveal that the weaknesses lie in lack of clarity, or disagreement over the fundamental goals of a coastal resource project, or important gaps in the stakeholders of that project. In other cases local support may be strong and well informed but sustained governmental commitment has been lacking. Using this baseline information, policymakers can develop a strategy to respond to changes in ecosystems, as well as the related social effects. The publication, “Adapting to Coastal Climate Change: A Guidebook for Development Planners.” (USAID 2009) devotes a section on the ooo framework for ordering coastal adaptation outcomes to sort out goals and think strategically over the long term.

The ooo framework suggests four phases of outcomes that lead to the sustainable implementation of a plan of action such as climate change adaptation. Each “Order” represents a phase along the path from an agreed-upon goal and the achievement of the goal. Figure 1 shows the sequence of the four phases in ooo, described as follows:

- 1) The 1st order, “Enabling Conditions,” occurs when necessary pieces have been put in place so that goals can be met. These include such conditions as plans being adopted and approved, funding obtained, and the interested parties identified and assembled.
- 2) Next, the 2nd order can occur. “Changes in Behavior” is represented by the actual investments being made and/or when actors in the system have made changes that are aligned with the specified goals.
- 3) The 3rd Order, known as “The Harvest,” has occurred once more sustainable forms of resource use are the new societal norm.
- 4) Finally, the ultimate fourth Order goal of “Sustainable Coastal Development” represents a mark of achievement that goals have been met and conditions have been improved (UNEP/GPA 2006).

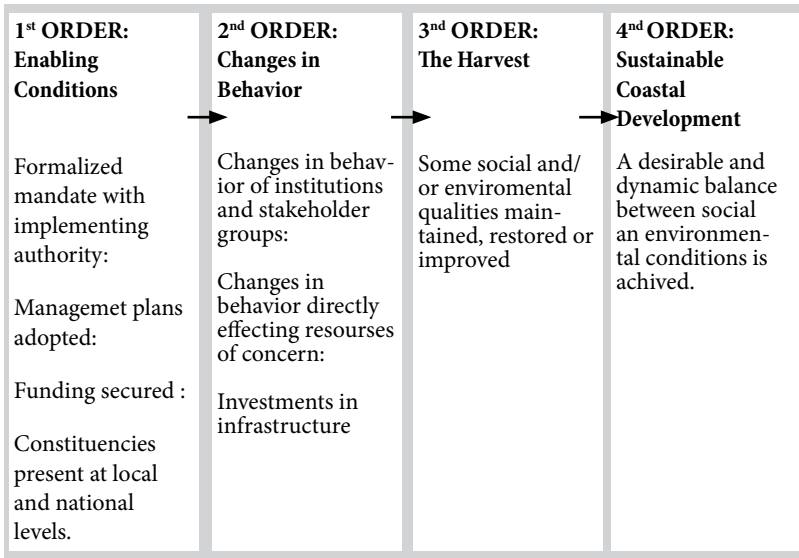


Figure 1. Orders of Outcomes (Olsen 2003)

The example of coastal management projects throughout the Philippines over the past several decades serve as a proving ground for a structured, long-term approach to more sustainable uses of coastal resources. Projects supported by the World Bank and USAID, such as the Central Visayas Regional Project (1984-1992) and Lingayen Gulf Coastal Area Management Program (1986-1992) achieved success at watershed management, fisheries development, mangrove and coral reef restoration, marine sanctuary establishment, and mariculture (White, et al. 2002). Lessons from these early efforts identified governance structures, culture, economic development, and environmental condition must all be taken into consideration during project design, implementation and evaluation. The same proven strategies of the Orders of Outcomes framework for changing human uses of resources in the past can be incorporated into modern day challenges of climate change.

These above concepts, climate change, coastal resources, governance, and the Orders of Outcome framework will be brought together for an analysis of conditions needed for adaptation planning in the DR. Responses to changing social and ecological conditions require structural change, signifying adaptive governance for climate

change planning. A country's progress towards climate change adaptation is indicated by where it falls along the Order of Outcomes. Initial literature review found the DR does not currently have a policy process for climate change adaptation planning for coastal resources (USAID 2009), no evidence of 2nd, 3rd outcomes were found, so this research focuses on 1st Order preconditions to make the necessary progress towards the transition to achieving 2nd Order changes in behavior through the implementation of formally approved policies and a plan of action. For the DR to be examined by a governance baseline, questions focus on the degree to which the 1st Order enabling conditions are currently in place.

## **II. Assembling a Governance Baseline Profile**

A governance baseline provides a snapshot of a governance system for ecosystem-based management (EBM) initiatives. There are three components to assembling a governance baseline: First, assess current coastal resource vulnerabilities. Second, document the presence/absence of Enabling Conditions to plan an adaptation strategy for coastal resources by identifying how the governance system has responded to ecosystem change in the past. Third, outline a strategic approach of obstacles to overcome and strengths to build upon of the existing governance system. A baseline profile creates a unit of analysis for a learning-based practice of governance that provides a structure for future adaptation planning (Olsen, et al. 2009) designed to identify barriers and opportunities to inform the design, implementation and evaluation of coastal resource management.

A governance baseline provides a reference point against which future adaptation planning in the social and ecological conditions impacted by climate change can be measured and assessed. Assembling a governance baseline for climate change adaptation in the Dominican Republic provides evidence needed to respond to climate change impacts needed to allow coastal communities to assess, anticipate and respond to the interaction of global change and the local pressures in determining coastal change (Kremer et al. 2005).

The Land-Ocean Interactions in the Coastal Zone (LOICZ) Guide (Olsen, et al. 2009) offers a step-by-step process for assembling a baseline of the sources of governance that affect the condition and

use of coastal resources. The standardized format for governance baselines allows comparison and learning across adaptation planning at other coastal ecosystems throughout the country and region. The LOICZ methods were applied in 2007 and 2008 to coastal sites in eleven countries in Latin America that include the urban coastline of Santo Domingo. For this paper, key informant interviews were conducted in the climate sensitive hotspot<sup>2</sup> of Santo Domingo. The LOICZ Guide is based on the premise that a thorough understanding of the governance dimensions of human impacts on ecosystems will increase the effectiveness of coastal resource management planning, such as governance for climate change adaptation.

### First Order Enabling Conditions

The LOICZ Guide lays out clear objectives necessary to reach the First Orders' targets of Enabling Conditions. These conditions are needed to implement planning that reduces climate change vulnerability. The presence of each of these enabling conditions lays the groundwork to progress through the next sequences of outcomes. Experiences from a history of ecosystem-based coastal management projects suggests that transition to implementation can be anticipated only when all four of these conditions are present (USAID 2009).

The 000 framework identifies the four First Order enabling conditions as 1. constituencies, 2. capacity, 3. commitment, and 4. goals. This theory identifies these EC in place before anything can happen.

An initiative such as adaptation planning can progress to the next phase of outcomes, only once these enabling conditions are in place. These conditions are defined as follows:

- **Constituencies** must be informed and supportive of a coastal management project, and understand and actively support its goals. Constituencies are the groups that will be most affected

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<sup>2</sup> The 2013 USAID study on climate change vulnerability in the DR (USAID 2013) identifies "hotspots" based on unique biophysical and ecological characteristics that share distinct climate change vulnerability. These hotspots provide an effective scale to develop context-specific resilience. Local level criteria reflect conditions of coastal ecosystem processes, sources of governance, and stakeholders comprise a hotspot.

by the implementation of adaptation planning. Constituencies and stakeholders are not one and the same. Stakeholders are individuals, groups, and institutions affected by management decisions or responsible for making and implementing management decisions. Constituencies, on the other hand, are the individuals, groups, or institutions that support the program and voluntarily abide by its rules. Ideally, most stakeholders become constituencies for the program.

- **Capacity** refers to the institutions responsible for fulfilling objectives of program. The institutional capacity necessary to implement adaptive, ecosystem-based approaches to governance is a limiting factor to success. The capabilities to carry out actions such as conflict resolution, the ability to manage interdisciplinary teams, the design and implementation of public education programs, the oversight of development projects, and the ability to evaluate performance are necessary.
- **Commitment** is the authority and resources to implement a course of action. This element of enabling conditions is often referred to as 'political will'. This may come initially in the form of a governmental mandate to administer a coastal resource management project. Once the policies and initial plan of action have been negotiated, government must formally provide the authority to institutions responsible for adaptation planning. Such commitment may take the form of a law or decree that establishes adaptation planning as a permanent feature of the governance structure. The creation of commissions, working groups, user organizations and non-governmental organizations (NGOs) dedicated to the advancement of a plan of action are other important expressions of commitment.
- **Goals** that clearly measure progress of societal and environmental conditions should be time-bounded and quantitative- answering questions such as 'how much', and 'by when'. Defining a goal of a program only as 'sustainable development' or 'ecosystem health' indicates the desired direction of change but little more. Goals should reflect the ecosystem and institutional processes to achieve 3rd Order outcomes of measurable improvements in ecological and social conditions, such as healthy reefs and reduced vulnerability to flooding.

## Case Study: Santo Domingo, Dominican Republic

This section will provide an introduction to the context of the DR as a case study for creating baseline governance profiles to better understand how sources of governance currently lead in shaping responses to climate change in Santo Domingo and the enabling conditions serve as barriers and which provide unrealized opportunities for climate change adaptation planning.

The DR is chosen as a case study due to its high vulnerability to climate change and importance of coastal resources for the country's development. The country has a tremendous amount at stake, and adaptation planning must be proactive. A governance baseline case study in the Dominican Republic considers critical factors needed to assess policy options for coastal adaptation planning, by identifying strengths to capitalize on and barriers to overcome. In short, the study identifies key opportunities and challenges to adaptation planning. It provides a baseline from which future assessments of climate change vulnerability may be conducted.

### Background Context

The Dominican Republic (DR) occupies the eastern two thirds of the island of Hispaniola, the second largest island in the Caribbean, which it shares with Haiti, as seen in the map in Figure 2. The DR's territory (48,380 square kilometers in total) is comprised of mountainous terrain interspersed with fertile valleys and a total coastline of 1,288 km, of which 21% (337 km) are sandy beaches and semitropical climate (Fuller, 1999). The DR has a complex political history that includes a recent rise to democracy from dictatorship<sup>3</sup>. Despite the DR's recent economic growth, much of the population of close to two million Dominicans still live in poverty (World Bank, 2013).

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<sup>3</sup> Rafael Trujillo was a dictator who ruled DR from 1930 until his assassination in May 1961. His tyrannical rule is considered one of the bloodiest eras ever in the Americas, responsible for the death of more than 50,000 people. During Trujillo's brutal reign, civil liberties were nonexistent, human rights violations were routine, and much of the country's wealth was placed in the hands of his family or close associates (Crassweller 1966).



Figure 2. Map of Dominican Republic (Source: Icupromo)

The DR is a Small Island Developing State (SIDS), with high incidence of damaging storms, compounded by limited resources (UN Conference on Small Island Developing States 2012). The UN Millennium Development Goals (MDGs) are international development goals established by the United Nations in 2000 to improve conditions in the areas of poverty and hunger, education, gender equality, child mortality, maternal health, diseases like HIV and malaria, and environmental sustainability. The DR and Caribbean region perform relatively well on meeting goals for hunger, education, HIV/AIDS, and health (MDG Report 2013). However, indicators needing progress include poverty and environmental sustainability, including water resources, and urban populations living in slums.

### Climate Change Vulnerability in the DR

Multiple projections of climate change impacts identify the DR as highly vulnerable, based on criteria of exposure, sensitivity, and adaptive capacity (IPCC 2012, Nature Climate 2012). A World Bank study ranked the capital city of Santo Domingo in the top five coastal cities most vulnerable to climate change, by cost of expected damage as percentage of GDP (World Bank 2013). The city is exposed to significant negative effects from extreme coastal weather events and rising sea level, at great economic and social cost (Hanson 2011). Challenges to climate adaptation in the DR include high economic

vulnerability, limited national resources, inadequate baseline data for scientific research, and high reliance on degraded coastal ecosystem conditions (Vignola 2009). Climate change will impact the health and welfare of coastal communities, the health and resilience of coastal ecosystems, and the billions of people that depend on these resources.

The DR has already experienced consequences of climate change on coastal resources, including coastal erosion and loss of property, flooding, saltwater intrusion, depletion of valuable marine species, accelerated spread of invasive species, coral bleaching, loss of coastal wetlands, and the expansion of marine dead zones (Grogg 2013). Many urban slum dwellers are highly vulnerable to climate change, living along the coastal areas and riverbanks that flood often. Likely future impacts of climate change in the DR in the coming years include sea level rise, increased frequency of storm events, acidification of seawater, desertification of arable land, and further declines in ecosystem function of coral reefs (Nichols 2013). The Gallup study (Gallup 2012) finds that 75% of the population is very concerned about climate change, however when compared with other issues like education, security, and health it ranks low in relative relevance. A governance baseline is an important next step to identify issues that must be addressed for the country to establish an adaptation planning strategy.

### **III. Methods**

#### **Literature Review**

This section provides an overview of the interview process and the documents chosen for the literature review. An initial literature review focused on research on capacity for climate change adaptation planning and coastal resource governance. Documents gathered from past coastal resource projects in the DR conducted by institutions such as the United States Agency for International Development (USAID), show evidence of results based on the Orders of Outcomes framework (USAID 2010). Specific planning documents examined included constitutional amendments, national development strategies, and international conventions where the DR has signatory status and actively engaged in drafting.



### **Interview Instrument**

The interview instrument consists of two parts. Part 1 is intended to answer the first question of which coastal resources are most vulnerable, asking open-ended questions based on framework by Moser (2010). Part 2 identifies the state of whether 1st Order Enabling Conditions are present, based on Orders of Outcomes framework modeled from questions used in the LOICZ Guide. Since the initial literature review suggested that DR governance for climate adaptation had not yet advanced to the 2nd Order, the interviews focused on assessing which, if any, First Order enabling conditions of commitment, capacity, constituencies, and goals were in place. Multiple-choice questions prompt respondents to reflect on the degree to which the criteria of each of the 1st Order Outcomes were present for coastal resource governance.

Of 64 stakeholders contacted, interviews were conducted with N=19 respondents throughout the SD province during the month of January 2014. The 19 interviewed had the necessary qualifications as informed stakeholders that were available during the relatively brief research period. All interviews and communication took place in Spanish and were transcribed and translated by the researcher. Respondents consisted of professionals across sources and levels of governance throughout the country, including local and federal coastal resource decision-makers, NGO managers, academics, and local community stakeholders. Table 1 shows the breakdown of respondents by source and specific sector of governance<sup>4</sup>.

Funding was secured through a research fellowship with the Global Foundation for Democracy and Development (GFDD), which supports research in the Dominican Republic on global issues of national concern. Preliminary contact was made to recruit interview respondents between October and December of 2013 (See Appendix). Interviewees included stakeholders suggested by GFDD,

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4 In the DR it is common use to interchange municipal with local community governance. DR is divided into thirty-one provinces, divided into municipalities which are the second-level political and administrative subdivisions of the country, but Santo Domingo is contained within its own Distrito Nacional, which consists of only of one municipality, Santo Domingo, the city council (ayuntamiento) and mayor in charge of its administration (Constitution of the Dominican Republic, Title I, Section II, Article 5).

authors of published research on climate change and coastal resource management in the DR, and respondents to an email request sent out to all cited contributors to the USAID reports on climate change in the DR (2009, 2012).

**Part 1** asks questions to answer the first research question of which coastal resources are most vulnerable. Based on the framework by Moser (2010), the respondents provide feedback related to resources most affected.

**Table 1. Interview instrument respondents by sector of governance**

<b>Government Level</b>	<b>N=7</b>	<b>Private Market</b>	<b>N=3</b>	<b>Civil Sector NGOs</b>	<b>N=9</b>	<b>Total N=19</b>
National	4	Tourism	1	National	4	
Municipal	2	Ports	1	Local	3	
Community	1	Fisheries	1	Academia	2	

**Table 2. Interview instrument Part 1 Questions on vulnerability**  
(translated from Spanish)

<b>Problem identification and awareness</b>
1. Which impact of climate change will be most important for the coastal zone of Santo Domingo?
A. Sea level rise B. Extreme weather events C. Destruction of coastal habitat D. Beach erosion E. Other
2. Which coastal resource will be most affected by climate change?
A. Fisheries B. Tourism C. Natural barriers D. Biodiversity E. Other

3. Which is the most serious societal affect?
A. Poverty B. Health C. Security D. Forced migration E. Other
Information Gathering
4. What types of baseline studies have been conducted to inform climate change planning? Has the planning process taken advantage of the research to fill important gaps?
A. No studies have been completed yet B. Environmental impact studies for private industries C. Complete assessment of coastal resources and interested socioeconomic groups identified D. Findings of studies have informed policy decision
Vulnerability Perception
5 A. From scale of 1 (most secure and resilient)-10 (most vulnerable and at risk). What is your perception of exposure, sensitivity, and adaptive capacity to forces and impacts?

### Part 2- Enabling Conditions

Respondents were asked 14 questions on several dimensions of each of the four Enabling Conditions that constitute the First Order of the OOO. Each question has four possible responses on the current status of the dimension of conditions in the local community. The LOICZ Guide recommends that the results should be expressed by ratings on the degree to which each 1st Order enabling condition is present, based on the researcher's evaluation of responses. Thus, each question has four possible responses on the current status of the status of conditions, in ordinal value from 0 score of no enabling conditions, to value of 3 that identify the outcomes of a successful planning phase for the successful long-term implementation of a plan of action. Tallying responses yields an ordinal score to rank the status of each condition overall. Responses to the interview results are coded in ordinal value, as follows:

- 0 – Lacking conditions to plan a strategy for sustainability of coastal resources
- 1 – Some evidence of conditions present, but only marginal
- 2 – Significant progress made, but important criteria lacking
- 3 – All conditions present to begin planning and implementing a strategy

Interview questions for each dimension of the four Enabling Conditions are in Table 2. The entire interview instrument with response options is located in the Appendix.

**Table 3. Interview Instrument Part 2 Questions on Enabling Conditions (translated from Spanish)**

<b>Constituencies</b>
1. Do the user groups who will be affected by adaptation planning actions understand and actively support its agenda?
2. How informed and supportive about the perceived causes and anticipated effects of CC are the stakeholders likely to be most affected?
3. What types of capacity building measures have been implemented?
4. What opportunities exist for stakeholder engagement to coordinate and share responsibility with decision-making?
<b>Capacity</b>
5. What capacities for planning do relevant institutions have?
6. Have responsible institutions demonstrated ability to practice adaptive management?
7. Have pilot scale projects been implemented?
<b>Commitment</b>
8. What authorities and financial resources have been committed to adaptation planning?
9. Which sectors are involved in planning process?
10. Is there a clear, long-term commitment from government to implement adaptation planning?
11. Which levels of governance are involved in planning process?
<b>Goals</b>
12. Are their specific goals based on time and measurable goals?

13. On what criteria are goals considered?

14. How realistic do you consider the strategy of public climate change education can create changes in behavior?

The leading questions posed in the LOICZ Guide for a governance baseline are designed to prompt discussion and analysis, and provide a consistent structure for a full baseline. Questions aim to elicit insights on criteria that affect specific barriers to be overcome and opportunities that could be leveraged towards making progress in planning for adaptation. An informal discussion with each respondent helped to further understand gaps and opportunities in governance for climate change planning. These conversations gave detailed information on the sources of governance influencing coastal resource management, and which specific resources were most important. The findings on the sources of governance and coastal resources, informed by a literature review and interview responses follows in the next section on Findings.

#### IV. Findings

This section provides the findings from the literature review and interviews and discusses which resources are most at risk, which source of governance leads adaptation planning, and what enabling conditions are in place for planning a strategy to address these vulnerabilities. Then, the results of the interview instrument providing the scoring on status of enabling conditions for First Order Outcomes are presented. Additional findings on previous coastal resource projects are provided for background context. A detailed analysis of an effective co-management arrangement of an NGO, Reef Check DR, is located in the Appendix as evidence of where Enabling Conditions are in place for adaptation planning.

#### **Vulnerable Coastal Resources in the DR: Fisheries; Coastline; Seaports; Reefs**

The literature and interviews answered the first research question of the most vulnerable coastal resources: fisheries, coastal erosion, seaports, and coral reefs. Figure 3 shows respondents most identified reefs and seaports as the most vulnerable resources.

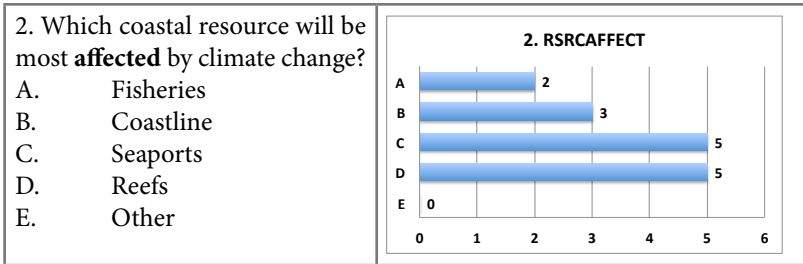


Figure 3. Resources Most Vulnerable

### Fisheries

Interviews and literature review identified fisheries in the DR as primarily artisanal fishers in small boats near shore, providing food for the local market. The industry has traditionally been open access, with minimal oversight to enforce any regulations and access to the fishery is unrestricted; i.e., the right to catch fish is free and open to all (OECD 2001). Open-access, common-pool resources, such as many fisheries often require some type of regulation of private access and use to avoid wasteful exploitation, however, most of the world's most important fisheries operate under what might best be termed regulated open access (Homans 1997).

Locally-conducted research by regional experts points to destructive practices such as overfishing that have driven down stocks and left fishers struggling to survive. The depletion of stocks and the destruction of fishery habitats in the DR are due to both anthropogenic and climate change stressors (Herrerra 2011, Carpenter 2008). Lack of management and the associated depleted stocks create poor socio-economic conditions for fishers. Interview respondents noted that fisheries are not a major economic factor and most stakeholders are “not solely engaged in fishing as their sole occupation.” However, the wellbeing of these stakeholders in the fishing industry increases their vulnerability to increased challenges to their livelihood from climate change.

### Coastline

Economic impact from coastal tourism is a major driver for national economy (Torres 2008). Coastline on the property of resorts is being developed in unsustainable manners below the high water mark,

increasingly vulnerable to erosion and storms. Respondents point to a lack of enforcement and education as the causes of destructive use of the coast, which is so valuable to the DR. Many stakeholders interviewed point to a lack of education that must be addressed to change the current destruction of the coasts. An interviewee described these educational initiatives to build awareness of improving conditions of the coastline as, “only short campaigns, never an institution that was solely responsible for protecting the coasts. The government can make a law to not destroy the beaches, but if there’s no consequence when you throw litter, without a penalty, you will not witness a change in people’s actions.” The photo in Figure 4 is a typical example of the amount of refuse such as broken glass that covers most of the coastline on the city of SD.

Regarding the destructive development practices of beachfront hotels, one respondent cited the, “Private market has a high degree of profitability largely due to its limited oversight.” This lack of enforcement provides an incentive for more maladaptive development practices, such as increasing investment in coastal infrastructure, eroding coastline and further degrading natural barriers. Interview respondents note that the limited oversight over the management of the coastline is due in large part to the agencies overseeing coastal resources and the tourism sector being grossly understaffed. One respondent discussed that “there is only one individual responsible for all oversight and implementation of laws, enforcement, for 40,000 hotel rooms, the busiest international airport in Caribbean, who doesn’t have fuel to work on inspections, in this, the most economically important part of the country.” Some of the actions undertaken by hotels on the coastline highlighted by interview respondents include building unregulated breakwaters that damage reefs, constructing



new developments too close to the sea, docking boats on beaches that destroy vegetation, and poor sanitation practices that pollute the coastal ecosystem.

Figure 4. Garbage strewn on SD coastline (Photo- Author)

## Seaports

Ports form a vital component of national and global economies, particularly in developing countries. The Port of Rio Haina is a public port operated and administered by the Autoridad Portuaria Dominicana (Dominican Port Authority)<sup>5</sup>. Haina is the main port in the DR that handles 70% of the country's maritime cargo, and serves freighters, bulk carriers, tankers, and tugboats (Autoridad Portuaria Dominicana 2012). The port is critical infrastructure for the country and Caribbean neighbors, with operations inland on both sides of the river and proximity to the capitol city of Santo Domingo. Figure 5 is a photo of the breakwater of one port in SD close to sea level, which would be flooded by storm surge or sea level rise.



Figure 5. Seaport breakwater (Photo: Author)

According to interviewees, ports in SD are already feeling the effects of climate change. Interview respondents discussed how, despite the need for the shipping sector to plan with long-time horizons, there is currently no planning processes undertaken in seaports to begin recognizing vulnerability and set goals for adaptation planning. An interview respondent working directly with one of the ports remarked, “increased storm frequency and severity

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<sup>5</sup> The Dominican Secretary of Environmental and Natural Resources identified Haina as a national point of significant concern in 2000. The port and industrial center has been called the “Dominican Chernobyl” as one of the ten most polluted places on the planet (The Blacksmith Institute 2006). An abandoned lead-acid battery smelting facility contaminates the local community from rainwater runoff that travels through the highly populated area and drains directly into the Bay of Haina downstream. According to the UN, over 90% of Haina’s residents have elevated blood lead levels (Ibid.).



bringing heavy rainfall and winds have negative effects on operations.” In stormy conditions, “cranes cannot be operated above certain wind speed and rain hampers visibility of work, significantly slowing down productivity.” Another interviewee noted, “in other countries ports are the strongest and most involved industry in the climate change dialog, but the port authority is weak and has limited data, only has resources to concentrate on security, *narco*, immigration, ...new construction is not incorporating risk of sea level and storms surge.” Other responses indicated that a privately operated port that regularly undertakes Environmental Impact Statements is trying to convince the government to undertake more rigorous research to provide ports with more information for climate change adaptation decision-making.

### **Reefs**

Coral reefs are critical for fisheries, tourism, and natural barriers protecting SD from climate change impacts of coastal erosion and storm surge. The loss of reefs and their associated ecosystem services can result in significant economic impact due to increased climate change vulnerability (McLeod 2009).

Broad consensus among interview respondents noted reefs as the most significant coastal resource needing improved governance to plan for climate change adaptation. The reefs of SD are currently highly degraded due to ocean acidity, and destructive fishing and tourist practices (Torres 2010). The decline and loss of coral reefs have significant social, cultural, economic, and ecological impacts on people and communities, particularly for SD residents highly dependent on the reef for food security and livelihoods from tourism.

Interviewees stated that government officials, “don’t understand that the reefs are very important, and think it is easier to engineer a project than conserve natural barriers, especially since there is a lot of money for contracts in engineering projects.” Another respondent noted there is a “Lack of vision, more is needed from the people who value the ecosystems, the general public needs to understand their level of resilience depends on the resilience of the ecosystem.”

## Sources of Governance: Government; Civil Society; Markets

The next question analyzed which source of governance currently leads in shaping responses to climate change in the Dominican Republic. As discussed above, the sources of coastal governance that drive behaviors of resource use are government, civil society, and the private market. These sources of governance define the rules that affect the conditions and use of coastal resources in SD and set the stage within which adaptation planning occurs. Figure 6 shows that the majority of respondents perceive the national government as the source of governance leading adaptation planning.

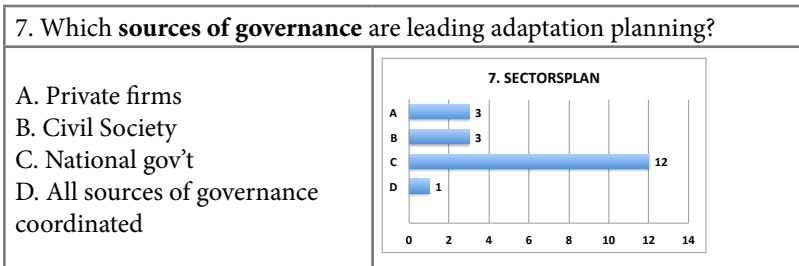


Figure 6. Interview Responses to sources of governance leading planning

## Government: National; Regional; Local

### National

The central government of the DR has made climate change adaptation planning a focus of the national development strategy (Estrategia Nacional Desarrollo 2030) and in the new Constitution approved in 2010. The focus has mostly been at the national level with international regimes, such as Intergovernmental Panel on Climate Change (IPCC) and United Nations. The country recently commissioned several adaptation planning programs conducted by NGOs, including the Dominican Institute for International Development and The Nature Conservancy. Data on stakeholder perception of vulnerability by a nationwide Gallup poll found considerable public concern for the impacts climate change, but marginal awareness of factors causing climate change (Gallup Dominicana 2012).

The DR has facilitated the Kyoto Protocol recommendation for developing countries to create national agencies that focus on climate change (CNCCMDL 2012). This newly institutionalized federal agency,

National Council for Climate Change and Clean Development Mechanism (CNCCMDL) is spearheading adaptation planning. There was stakeholder agreement amongst those interviewed that the CNCCMDL, or *Consejo*, is a well-respected and effective agency that is the country's greatest asset in the process of adaptation planning. Interviewees agreed that the CNCCMDL exists under a very complicated institutional arrangement. A major concern expressed by several interviewees was the lack of sufficient authority for the CNCCMDL to realize its potential as a rallying force driving adaptation planning. There were varying descriptions by respondents on the institutional arrangement of the *Consejo*. Several respondents noted that institution was nested within the Ministry of Environment. However, a key stakeholder closely involved stated that, "the CNCCMDL is nested under the President's Office who is the official President of the Council. The Ministry of Environment is in fact a member of the Council, however the Council has no authority to rule over the Ministry, since the Council was created by a Presidential Decree and the Ministry by a Law from Congress, which is more legally binding." One respondent described this arrangement as "based on a decree that can be removed like it never existed, by the president's signature." Several discussed how this decree is "in contradiction with a law dealing with international relations, since the representative of the Ministry of Environment must deal with international conventions on climate change matters." But, a respondent who explained the Environment Law 64-00 noted, "the law doesn't mention climate change in any article, it gives authority to the Ministry to rule on international environmental conventions, but it can be argued that climate change is no longer categorized an environmental issue per se, in many way it is more a development issue (the UNFCCC recently invited Ministries of Finance to assume climate change responsibilities). So legally there is a vacuum on this regard."

Respondents discussed that "The *Consejo* (CNCCMDL) should be a ministry, other countries like Jamaica realize the importance of a ministry dedicated to climate change. All ministries put their own specialty into climate change concerns, but since it's new, the old fashioned ministries are doing business as usual." Another remarked that, "they don't understand that climate change is not just an environmental problem, it is something that is very much on its own and affects all aspects of our society, our energy, transportation,

health, we need one specialized ministry with clear skills to approach this phenomenon threatening Dominicans.” Another respondent noted that, given the lack of coordination between national ministries, “The CNCCDML would be stronger and more successful if it were independent and could produce projects at all levels of the country, and collaborate with other ministries such as education to create bold new strategies. They (CNCCMDL) don’t get much funding since all the taxes go straight up to top, but they don’t need to be dependent on the president, they do such great work that they attract a lot of international funding and support for their work from outside the federal government.” Another example of funding issues was raised when a respondent noted, “the Ministry of Environment often does not have funding to attend international conferences, but the *Consejo* is more diligent at getting funding to attend. Ministers are huge and slow, but the *Consejo* is very nimble and can get fast results, which international donors want.” Another respondent noted that Consejo collaborates very effectively with the Ministry of Education, and is already working on educational projects regarding sustainable coastal development.

The CNCCMDL has already launched several pilot projects, including a campaign to train schoolteachers to deliver a climate change curriculum (UN CC: Learn 2012). Overall, the majority of respondents were very optimistic about this initiative. All respondents agreed that “education is the solution” to adapting to climate change. However, some respondents from academia stated the initiative is “not sufficient to inform students to confront challenges of adaptation”, since it is primarily a science-based curriculum on the causes of climate change, not giving students enough information to take action and make needed changes. There was also a comment on some “factual flaws in the curriculum being disseminated about the distinction between CO<sub>2</sub> emissions and the hole in the ozone layer.” But others working closely on the issue stated the education program designed in coordination with UNESCO devotes more than half of the program to local actions, including how to make risk maps and more local advocacy topics, noting, “There are already cases of students taking action, concretely in the coastal province of Puerto Plata. In fact it’s weakness in a recent evaluation is that it needs more scientific theoretical content.”

## **Regional**

Literature and interviews indicate the very limited role of municipal government authorities in managing coastal resources. Interview results support claims that municipal government bodies are lacking financial resources and authority. However, despite weak regional governance throughout the country, the four Santo Domingo Municipalities, especially the National District, do receive significant resources and “have proven to exert authority, and over the last two years the Municipality of the National District has recovered the degraded coastal area of Guibia in the heart of the city.” These bodies play a marginal role as source of governance for resource management, since they cannot affect policy from the national level, nor effectively enforce sustainable use at the local level. Interview respondents discussed marginal coordination between the national government and lower levels of governance. They also mentioned many of the challenges the government currently faces, such as services to remove garbage, heavy transit congestion, crime and violence, poor health of citizens, and lack of consistent electricity as problems taking precedent over climate change. They suggested that the massive investments required to facilitate climate change adaptation are not within the means of municipal government. While many adaptation plans have begun to take shape, multiple respondents stated these policies “have stayed at the ministry level and have yet to be implemented.” Respondents noted, “Tax revenue goes directly to the national government, leaving municipalities with nothing.” Many interviewees cited issues with regional garbage collection as an example of the inefficacy of regional and municipal governments. Noting, for example, “they can’t even handle garbage pickup, how could they take on climate change?”

## **Local**

Identifying criteria from the community level through stakeholder involvement results in legitimacy, community relevant processes, information from multiple sources, and the engagement of decision-makers (Smit et al. 2006). Integrating local conditions such as livelihoods into the analysis identifies potential future exposures and sensitivities, and measures through which the community will implement adaptation planning. Research shows that co-management of coastal resources, local communities share authority with the central government on natural resource management, offers synergies between the state and social groups where coastal resource use is

more sustainable (Pomeroy and Berkes 1997; McCay and Jentoft 1996; Berkes 2002). Research also points to the importance of local traditions allowing governance to legitimately modify behavior that improves social and ecological conditions.

In terms of the conditions of the local SD district, many respondents commented on the poverty and lack of education present in the community. Impoverished communities occupy informal settlements around the River Ozama in temporary shelters with dirt floors and no utilities. Residents inhabiting the area are routinely exposed to storm damage, and flooding, likely to increase with climate change. There have been efforts to relocate these populations, but most respondents stated, “the government kicks the local out, but then they always return, they have nowhere else to go.” A respondent noted that, “We always talk about what would be the impact on Ozama, but we have never done the modeling to understand just how bad the flooding would actually be.” A key stakeholder on the matter confirmed the current government is addressing this problem by making one of its flagship projects the relocation of vulnerable sections of the Ozama population.

### **Civil Society & NGO's**

Several non-governmental organizations (NGOs) are taking the lead with initiative in climate change adaptation planning. Most actions include building awareness and resiliency. Primary civil society stakeholders are international NGO The Nature Conservancy (TNC), local NGO the International Institute for Dominican Development (IDDI), and universities such as the National Institute for Technology (INTEC), and the *Fundación Sur Futuro* which is the only official observer at UNFCCC, which has developed or participated in many relevant national climate initiatives. Respondents stated the NGOs had more expertise than the government, “the non-profits and universities understand what's going on more than the government, but they don't fund them (the NGOs) to do the important work.”

These civil society actors employ strategic communication to share analysis and break results down to make them accessible to the general public. One clear example is an awareness campaign delivered by TNC, IDDI and the United States Agency for International Development (USAID). This campaign disseminated posters with a slogan that translates in English to, “The climate keeps changing...

We can't keep waiting.” These posters highlighted various impacts already affecting the country, including lack of potable drinking water and drastic temperature changes damaging agriculture. Respondents were widely supportive of the work of these NGOs, but noted, “They are very effective, but do not have adequate funding.” A detailed analysis of an example of successful local management coordinated by a community NGO in a section below reveals strong potential for preserving highly valuable coral resources through co-management, promoting alternative livelihoods for local economies, and granting enforcement authority to local actors.

### Private Market

All respondents cited the beachfront resort hotels in the coastal communities of Boca Chica and Juan Dolio<sup>6</sup> are the most significant stakeholders leading private market governance for coastal resources in SD. Figure 7 displays the disproportionate size of the tourism industry for the country's revenue.

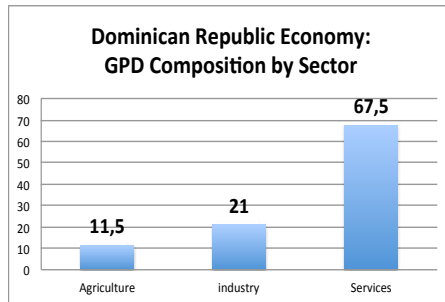


Figure 7. Tourism % GDP (CIA World Fact Book 2012)

Interviews with four resort stakeholders with management authority found marginal concern for climate change as an action item for their firms. Interviewees indicated that the growth trends in the sector demonstrated by future development plans do not take into account impacts from coastal erosion of beaches, and infrastructure losses from flooding and storm surge major challenges (Bueno 2007). The only climate-related concern found in the interviews was the increasing scarcity of potable water. No respondents had knowledge of any long-term adaptation strategies in place for modifying coastal

6 Juan Dolio is technically in another Province, San Pedro de Macoris.

development in anticipation of increased storms, coastal erosion or sea level rise. Many respondents noted that coastal development “continues below the high water mark”, and there is seemingly “no regulation.” A manager of a resort listed several poor practices including, “breakwaters are being built too close to shore having negative impacts on reefs, and they are docking boats on the beach that damages the vegetation.” Several respondents remarked there is little incentive for hotels to make adaptation investments, since “there is currently a steady tourism market, so no reason to stop building on the coast when it is so profitable.”

There was evidence of some proactive measures taken by hotels that had immediate economic benefit. For example, a respondent discussed how “private industry decisions are based on economics, so the tourism industry has begun replanting mangroves after cutting them down for the past 20-30 years. They realize now they need natural barriers to protect their investments. The mentality used to be ‘closer to the sea the better’ despite the law of only allowing development 60m from sea. But now they are voluntarily moving back, not because of the law, but because bankers demand hotels protect assets as lenders realize the climate is changing.

### **Enabling Conditions**

The following section examines the interview instrument results on the current state of First Order Outcomes to answer the research question of “what enabling conditions are barriers and opportunities for climate change adaptation planning in SD.” As suggested by the LOICZ Guide, results are expressed as ratings of the degree to which each 1st Order enabling condition is present. Each question has four possible responses on the current status of the status of conditions, in ordinal value from 0 score of no enabling conditions, to value of 3 that identify the outcomes of a planning phase for the successful long-term implementation of a plan of action. The total number listed before breaking down each question is the score for the total points received out of the total possible. Tallying responses yields an ordinal score to rank the status of each condition overall. The notes from respondents associated with the numerical ratings are useful to further understand gaps and opportunities in governance for climate change planning.



I. Commitment: **Total 5/12** All sources of governance display concern, various outputs are taking place, but not creating any real change. Results suggest that there is a great need to synthesize in coordinated effort.

- 1) Authority & Financing: **1/3** Low priority area in relation to more significant coastal resource problems, namely garbage collection and unregulated tourism infrastructure development are most noted issues.
- 2) Sectors Engaged: **2/3** No coordination between gov't, markets and NGOs, each working separately. No incentive for tourism sector to invest in adaptation projects while no impacts being experienced, yet. National NGO IDDI concerned with urban poor.
- 3) Long Term: **1/3** Many policies with long time horizons, but no funding allocated.
- 4) Levels Engaged: **1/3** No coordination, most action taking place at national level, not interrelated with regional or local initiatives. Local communities dependent on self-generating initiatives with limited resources and capacities.

II. Capacity: **Total 1/9** Capabilities are present, not a matter of ability, issue is in coordination and making necessary changes to institutionalized processes. Figure 8 shows the Enabling Condition of Capacity of local institutions having the technical skills and resources available to plan for adaptation as the greatest opportunity for addressing vulnerabilities.

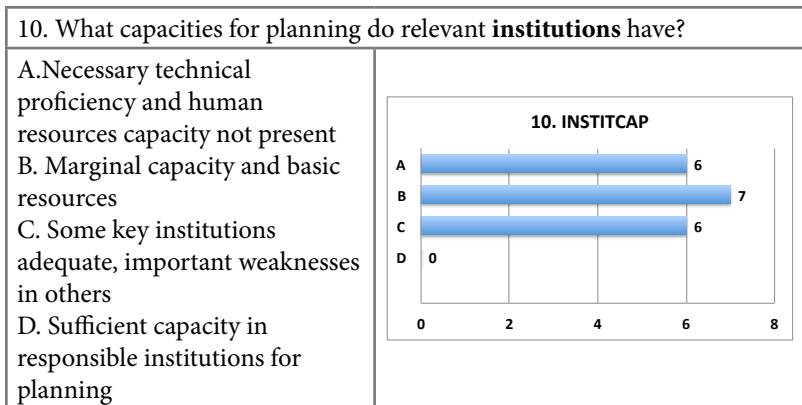


Figure 8. Interview response: Enabling condition- Capacity

- 1) Institutions: 1/3 CNCCMDL has capacity and support to be change-agent. Perhaps the greatest barrier to adaptation planning is the mandate that created the Council constrains its authority under the Ministry of Environment.
- 2) Adaptive Management: 0/3 Only marginal evidence of any significant institutions evolving in response to changing conditions of ecosystem. The greatest barrier is the ability, or will, of national government agencies to coordinate with local sources of governance, primarily ngos and local governments.
- 3) Pilot Projects: 0/3 Limited pilot projects, most notable is co-management of RC project in La Caleta. Project includes cooperation and mandated authority from national government for local stakeholders and ngo to manage resources, vital to livelihoods of fishermen, tourism resources of coral sands, and a vital natural barrier protecting from impacts of climate change, should serve as national model.

III. Constituencies: **Total 0/12** Stakeholder socioeconomic conditions must be principal priority. Critical gaps in stakeholder awareness to engage effectively with cc adaptation planning.

- 4) Understanding & Support: **0/3** Important gap in urban poor, highly vulnerable living in informal settlements exposed to increased flooding risk, absent from planning process.
- 5) Informed: 0/3 Minimal public awareness, interview results find lack of confidence in level of government decision-makers' knowledge on cc science.
- 6) Capacity Building: **0/3** Only capacity building measures undertaken by ngos and academia, principally iddi water awareness campaign. CNCCMDL plan to train teachers for widespread public education campaign underway.
- 7) Coordination: **0/3** One of most significant barriers, lack of capabilities to engage in meaningful coordination, both inter-institutional information sharing, and engaging with stakeholders in planning processes.
- 8) Well-being: **0/3** Consistent findings that populations likely to be most affected by cc are poorly educated and in poverty.

IV. Goals: **Total 0/9** Most significant of all enabling conditions lacking. Some planning is based on medium-length time frames (15-

20 years), but mostly lack explicit target-setting. Figure 9 shows the Enabling Condition proving to be the most significant obstacle to adaptation planning is establishing clear goals.

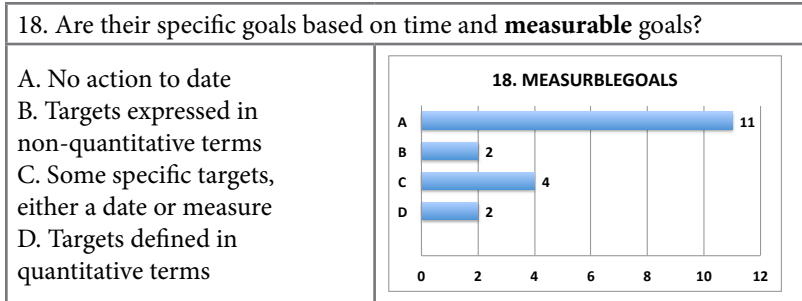


Figure 9. Enabling Condition Barrier- Goals

- 9) Measurable: 0/3 Time-based goals, but not with any measurable indicators to assess efficacy.
- 10) Criteria: 0/3 Mostly only considering ecological values, social context not widely considered in goal-setting.
- 11) Education Strategy: 0/3 No consensus on education strategy, but considerable optimism that informing general public will have positive outcomes.

These findings provide examples of opportunities to build on and obstacles to overcome. All sources of governance display commitment to adaptation planning, but are not yet creating any real change. Better coordination between government, markets and NGOs will enhance limited resources and capacities. Critical institutions have technical capacity and support, but only marginal response thus far to changing conditions of ecosystem. Perhaps the greatest barrier is ability, or will, of national government agencies to coordinate with local sources of governance, primarily NGOs and local governments. There are important gaps in stakeholder well-being and vulnerability, with many urban poor living exposed to increased flooding risk, absent from planning process. Finally, long-term planning with clear goals is the most significant of all enabling conditions lacking. Current goals are not set with any measurable indicators to assess efficacy, and mostly only consider ecological values, not socio-economic criteria.

## V. Limitations

Time constraints of the lead author proved to be a major challenge in this research. The three weeks allotted for fieldwork limited the number of stakeholders that could be interviewed. The data gathered from this round of research will be useful to return to the DR and continue conducting this work with greater focus, perhaps expanding into greater detail on one of the enabling conditions where there is evidence of being either the most significant challenge, or opportunity. Though all stakeholders interviewed were very involved and informed on matters of governance and coastal resources, responses to the interview instrument and accompanying discussions would provide even greater detail on specific opportunities and barriers to be considered in the profile in the governance baseline.

## VI. Discussion

Results indicate key vulnerabilities are principally due to human activity, such as the degradation of reefs that provide critical ecosystem services. Increasing educational awareness of the value of coastal resources that provide resiliency to climate change can reduce vulnerabilities, in the same way as enhancing enforcement can impede unsustainable exploitation of resources.

This study found that the enabling condition of “commitment from the government” to reduce climate change vulnerability, and the capacity of local community to co-manage resources was in place. Continuing to bridge coordination between the central government and community level will build networks for resources to flow to local actors that currently only have limited resources to enact the government’s adaptation plans. Investments in building capacity for local co-management arrangements will have lasting effects in reducing the vulnerability of key resources.

The main obstacle for progressing to 2<sup>nd</sup>, 3<sup>rd</sup>, and finally 4<sup>th</sup> Orders of Outcomes can only occur after clear goals are established. The Enabling Conditions to plan a program can only be evaluated once metrics have been established to gauge progress. Socio-economic indicators must be incorporated with ecological factors for an ecosystem-based adaptation strategy.

## VII. Recommendations

Examining the enabling conditions of First Order Outcomes shed light on dimensions of governance that truly affect the social and ecological conditions of coastal resource use. Explicit areas needing intervention were identified by asking actors involved in the process to reflect on the status of how functions of governance manifest in their daily lives. Applying the OOO framework revealed important gaps in the coordination and goals of governance arrangements. While recommendations are offered, it is still unclear whether these strategies would be successful unless tested in pilot projects.

This analysis recommends the following actions to being to overcome challenges and utilize existing opportunities towards adaptation planning.

1. Empower CNCCMDL, which has the capacity and support to practice adaptive, but requires more codified **commitment** of authority to play a leadership role and serve as a connecting institution. Further analysis of the legal authority of the Ministry of Environment regarding coastal management, which is relatively strong on paper, is needed to define a coordination scheme between these institutions.
2. Increase support for locally co-managed initiatives such as Reef Check that have the **capacity** to improve social and ecological conditions.
3. Improve livelihoods of vulnerable populations who will be disproportionately affected by CC impacts and must be included as supportive and informed **constituencies** in adaptation planning.
4. Continue building the education initiative as a **goal** that has broad support, but surpass merely science-based approaches to provide students with tools to confront impacts of climate change. One of the main weaknesses of the education system is a deficient approach to science. The program implemented so far does promote action but it has only trained 400 teachers. The Ministry of Education has already approved an expansion to 3000 more up to the year 2016.

5. Focus on adjusting processes to improve coordination between sources and levels of governance, from national resources serving community projects, to local actors getting more involved in national adaptation planning.

## VIII. Conclusion

This research assembled a governance baseline to assist climate change adaptation planning for coastal resources in the Dominican Republic. The integrating and holistic nature of the ecosystem approach requires that the goals of an adaptation program address both the societal and the environmental dimensions of desired outcomes at ecosystem scales. A well-informed understanding of the existing governance system and careful consideration of the markers for the 1st Order preconditions supports making decisions on when elements of the program are ready for implementation.

Through reviewing literature and analyzing feedback from interviews, the source of governance that currently leads in shaping responses to climate change is the federal government. This study found that the government remains encumbered by traditional problems of many developing and developed states, such as healthcare, education, and employment, but the DR has still made progress in beginning to address climate change. The CNCCMDL has the capacity of expertise and constituencies of wide support within the country and of the international community to direct climate change adaptation. However, institutional arrangements are needed for the agency to operate with the autonomy of a ministry to be effective.

This study found that the lack of the enabling condition of “clear, measurable goals” is a barrier for climate change adaptation planning. Specific targets of improvement in social and ecological criteria must be identified for real progress to take shape and decrease vulnerability of the coastal ecosystem and resource users.

Despite these challenges, the enabling condition of the “capacity of the government and civil society” represents an opportunity to achieve climate change adaptation. The case of how conflicts are resolved in La Caleta informs governance approaches for future

initiatives. RC has effectively changed the behaviors and preferences of foreign tourists and local operators to appreciate the valuable source benefits of an increasingly vulnerable resource. Granting authority to civil society actors such as RC should be a national model for community-based coastal resource management. Empowering local communities to govern coastal resources aligns economic priorities with conservation goals.

This study found that all of the pieces necessary for effective adaptation planning are present to some degree. However, lack of coordination among levels and sectors of governance towards a focused action plan stood out as a key barrier. Establishing this baseline identifies good practices to be replicated and areas needing improvement. Enacting real change in governance of coastal resources is a lengthy process. If coastal management follows a structured, proven sequence such as the Orders of Outcomes framework, informed by lessons learned such as through baseline profiles, the necessary changes can be achieved for coastal communities to successfully adapt to future social and ecological challenges of climate change.

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## Appendices

### Appendix 1: Historical analysis of DR coastal management

In addition to interviews, we conducted an analysis of past coastal governance initiatives for comparison of how critical factors have improved or worsened, and if any previous findings have been influential and incorporated in current decision-making. We identified documents by looking at past efforts to work with sources of governance to promote more sustainable use of coastal resources, and any work related to climate change vulnerability. We found two documents that met our criteria of discussing strengths and barriers to more sustainable forms of coastal resources in the SD region. The first was a coastal resource assessment for the DR conducted by the Global Environment Facility, the second a climate change vulnerability assessment conducted by USAID.

#### • Global Environment Facility Assessment 1999

In 1999, the URI Coastal Resources Center conducted an OOO project in the DR called *The Global Environment Facility (GEF) project: Promoting Biodiversity Protection in the Coastal Zone of the Dominican Republic* (Coastal Resources Center 1999). The evaluation team used the OOO framework for a “capacity assessment” that would provide information to increase the effectiveness of coastal management efforts addressing challenges including fisheries, pollution, and coastal erosion. The research findings identified strategies to create new information on coastal ecosystem conditions through an inclusive, participatory process that engaged stakeholders at the community and national level. Using the OOO framework resulted in recommendations for: improvements to management at specific pilot sites, identifying baseline conditions that needed further data, institutional policies successfully change desired behaviors, and capacity training needed for implementing management plans.

The capacity assessment identified “instrumental adjustments” that the evaluators believed would increase the effectiveness and efficiency of ecosystem based management efforts. Successes of the evaluation included creating new information on coastal ecosystem conditions, pioneering an inclusive, participatory process that drew

together stakeholders at the community and national level, pilot sites that demonstrated community-level participation, and a large number of capacity building initiatives that increased technical capabilities of NGO, government and community-level staff. The final recommendations were for the adoption of clear conceptual management frameworks at pilot sites, documenting baseline conditions, increased attention to analyzing institutional issues for designing decision-making processes that change desired behaviors, and enhancing training activities for resource management plans.

Relevant conclusions from the evaluation team of this earlier study recommend that future coastal management projects implemented by select NGOs and universities require appropriate governmental institutions as full partners. Interview respondents report there was still a disconnect between the government and civil society sources of governance in effectively coordinating on coastal resource projects. The research concluded that coastal management projects require appropriate non-governmental institutions as full partners.

- **USAID Vulnerability Assessment 2013**

The USAID vulnerability assessment describes current and historical manifestations of climate-related risk and the potential sensitivity of communities, livelihoods, and natural systems to those risks. This report strongly recommends adaptive capacity needs to be developed at a local level. Examples of promising practices serve to influence the development of national policies and programs effective at all levels. Three adaptive pathways were recommended by the report to guide the direction that local and institutional actors can follow to strengthen resilience, specifically Management and Conservation of Coastal Habitats and Watersheds. Strategies defined to guide the development are focused on strengthening the capacity of stakeholders, and strengthening institutional abilities to improve coordination and response adaptively to changing climatic conditions. Recommended approaches are to educate NGOs, the academic community, and citizens regarding laws and regulations for the permitting process and supporting monitoring and reporting mechanisms.

An analysis identified areas most susceptible to flooding and storm surge, given climate change projections. Economic and population criteria were applied to define susceptible areas with populations and

important economic areas sensitive to flooding risks. Using these criteria and information form, key informant interviews identified communities, livelihoods, and natural systems geographically located in the highest risk areas. Four areas, including Santo Domingo, were identified as climate-sensitive hotspots to be studied further.

## **Appendix 2: Detailed Analysis- La Caleta Underwater National Park**

This section provides a detailed examination of the La Caleta reef to better understand NGO co-management opportunities for improving coastal governance towards adaptation planning in SD. Given the importance of the reef and success of the management regime noted by many interview respondents, a case study was selected for closer analysis. The purpose is to highlight an example of adaptive governance that serves as a model for replication. The degrees of influence by the three sources of governance are discussed, as well as the presence of the four enabling conditions of First Order Outcomes.

### **Introduction**

La Caleta Underwater National Park is on the southern coast of SD. The protected area was created by Decree in 1986 as the first underwater park to protect the DR's coral reefs. Several studies prove the importance of La Caleta reefs for fisheries, natural barriers protecting SD from coastal erosion and storm surge, and production of coralline white sand beaches for tourism (Torres 2010, USAID 2012, WRI 2011). The reefs are currently degraded due to ocean acidity, destructive fishing, and irresponsible tourist practices such as recreational divers damaging the reef (Torres 2010). Historically, no singular authority has governed use of the reef in a sustainable manner.

A balance should be struck between the public and private sectors in the management of natural resources, such as reefs (Field 2008). Research shows that co-management of coastal resources offers synergies between the state and social groups that promote sustainable utilization, and local level governance provides the strongest potential to implement effective conservation strategies (Pomeroy, et al. 1997; McCay & Jentoft 1996; Berkes 2002).

## Sources of Governance

### **Government**

The focus of federal ministries in the DR has traditionally been on national legislation and signatory status of international conventions (USAID 2013). Interview respondents report that access to coastal resources such as fisheries and reefs is open access in DR, since the government has proved incapable of instituting direct controls to influence user behaviors of the user groups, mainly fishers and coastal tourism. There is broad consensus among interviewees that challenges to manage the reefs are lack of financial resources and coordination between national and municipal governments. There is neither incentive nor capacity for the government to monitor and enforce protection of the reefs.

### **Private Market**

Since natural resource depletion or degradation can often be attributed to lack of property rights (Hardin 1968), placing the resources in the hands of the private market is an alternative to be considered<sup>7</sup>. In SD, the most significant firms with an interest in maintaining reef conditions are the beachfront resort hotels. However, interview respondents familiar with the tourism industry stated that there is little incentive for hotels to make investments in restoration projects, since they are continuing to earn revenue from the current condition of the ecosystem.

### **Civil Society Management**

Due to the lack of government and private sector to maintain the reefs, a local NGO, Reef Check (RC), has taken the role of governing agency. The primary actions of RC are restoring degraded corals, and educating fishers about alternative livelihoods to halt depletion of fish stocks and damaging practices that destroy the reef.

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<sup>7</sup> Hardin's essay describes the "tragedy" that can occur when common pool resources are exploited, and explains how property rights could solve a problem such as overfishing. The creation of property rights of a resource creates the incentives of those utilizing the resource to practice good stewardship. As owners of a share in the resource, users have a stake in ensuring conditions are maintained sustainably.

### **Enabling Conditions**

RC is enabled by the **commitment** of a government mandate to manage the reef. Law 64-00 lays out the policy instrument through which an NGO such as RC can become the legitimate management authority of a natural resource (Ministerio de Medio Ambiente 2012). Under this arrangement, the government hands authority to private parties or NGOs to enforce conservation activities such as limiting access to the reef and establishing rules to end destructive practices.

RC has demonstrated the **capacity** to fulfill the objectives of reef governance through employing a market-based approach to their conservation efforts as an ecotourism project. The agency conducted research with The World Resources Institute to gather feedback from tourists regarding their perception of the value of La Caleta Marine Park. Methods to determine viable options for a fee-based entry system for tourists were used to identify consumer demand to utilize the reefs. A fee-based policy was implemented, limiting entry to only visitors who wish to utilize the reef for non-destructive activities, like recreational diving. RC attracts “citizen scientists” that gather data on the condition of the reef while diving. This strategy permits divers to experience the reef in exchange for conducting research that benefits restoration efforts.

RC has garnered **constituencies** that are informed and supportive of their conservation activities through raising public awareness and encouraging responsible utilization of the reefs. Building this awareness is necessary to gain necessary stakeholder support for implementing climate change adaptation planning. RC practiced adaptive governance to resolve competing uses of the reef between fishermen and the tourism industry. The World Resources study identified incentives for fishermen to become involved in the tourism sector instead of continuing to rely on fishing (Wielgus 2010). This work identified what price fishers were willing to accept to no longer engage in fishing and undertake an alternative livelihood working in the ecotourism industry surrounding the reef. RC incentivizes fishers to no longer exploit the reef through using tourism to increase the market value of the reef. This collaboration created a strong disincentive to damage the reef through destructive fishing practices. By training tourists and local fishers to conduct scientific research on the reefs, they are promoting awareness of the critical functions of

the resource, while also gaining vital data in an economically efficient manner. The RC approach also creates wealth distribution for fishers who were otherwise struggling to survive from the depleted stocks, now being trained to provide services for visitors, such as guiding and transportation. The governing agency is convincing users of the economic benefits of responsible tourism and the ecosystem services reefs provide in building climate change resiliency.

Finally, RC has established quantitative **Goals** that identify an efficient visitation rate of access into the marine zone of the reefs, and setting goals on restoring a measurable percentage of the reef. By identifying what price fishers were willing to accept to no longer engage in fishing and tourists' willingness to pay to visit their reef, a monetary value can be used to annually track the success of the project. Establishing the system of citizen scientists to monitor the reef conditions compiles quantitative baseline data for the project to set and track conservation efforts.

## **Conclusion**

This analysis confirms previous coastal management research that partnerships with non-governmental institutions such as RC are necessary for sustainable resource management. In many countries, governments are directly involved, such as managing access to national parks and protected areas. In some cases, private companies have formed to operate ecotourism activities in a market setting. In the DR, there is minimal political will or capability from the national government or private market to effectively manage coastal resources such as reefs. RC has transformed reefs from a degraded liability into a key element for stimulating economic development for the community that also provides natural barriers against the impacts of climate change.



### Appendix 3: Respondent Recruitment Letter



Date

Dear (Participant Name):

I am a graduate student in the Department of Marine Affairs at the University of Rhode Island conducting research under the supervision of Professor Austin Becker on climate change planning for coastal resources in the Dominican Republic (DR). The DR has extensive coastal resources, and is predicted to be highly vulnerable to impacts from climate change. As a professional of an industry likely to be affected by these events, your opinions may be important to this study. I would appreciate the opportunity to speak with you about your experience on this topic.

I would like to conduct this research either at your office or the offices of FUNGLODE, at your convenience. Your involvement in this survey is entirely voluntary and there are no known or anticipated risks to participation in this study. If you agree to participate, the interview should not take more than about 20 minutes. The questions are quite general, such as any pilot projects you are aware of that have begun to assess the environmental and socio-economic impacts of climate change for coastal resources such as coral reefs. However, you may decline answering any questions you feel you do not wish to answer. All information you provide will be considered confidential and will be grouped with responses from other participants. Further, you will not be identified by name in any paper, report, or publication resulting from this study. The data collected will be kept for a period of 3 years in my supervisor's office at the University of Rhode Island.

If, after receiving this letter, you have any questions about this study, or would like additional information to assist you in reaching a decision about participation, please feel free to contact me at [emailmatrosa@gmail.com](mailto:emailmatrosa@gmail.com), or Austin Becker, [abecker@uri.edu](mailto:abecker@uri.edu).

Thank you in advance for your interest in this project.

Yours sincerely,

Mat Rosa, Student Investigator

University of Rhode Island

Austin Becker, Principle Investigator

## Appendix 4: Interview Instrument

### I. Commitment

1. What authorities and <b>financial</b> resources have been committed to adaptation planning?
<ul style="list-style-type: none"> <li>A. No government support or financial resources committed</li> <li>B. Acknowledged by some leaders, some pledges and commitments but significant gaps</li> <li>C. Commitments negotiated, adequate short-term funding</li> <li>D. Formal law or decree, legitimacy, sufficient financial resources</li> </ul>
2. Which <b>sectors</b> are involved in planning process?
<ul style="list-style-type: none"> <li>A. No planning at all, yet</li> <li>B. Mostly national government and private businesses</li> <li>C. National gov't and some local civil society agencies</li> <li>D. All levels of society are working together</li> </ul>
3. Is there a clear, long-term commitment from <b>government</b> to implement adaptation planning?
<ul style="list-style-type: none"> <li>A. Formal approval process has not been initiated</li> <li>B. There is a governmental mandate for planning</li> <li>C. Policies and actions are being negotiated with approving authorities</li> <li>D. Plan of action approved for implementation</li> </ul>
4. Which <b>levels</b> of governance are involved in planning process?
<ul style="list-style-type: none"> <li>A. Power and responsibility concentrated at international level outside of country</li> <li>B. Responsibility and initiative at various national and local levels</li> <li>C. Decision-making and responsibility decentralized, but significant coordination issues</li> <li>D. Governance integrated top-down and bottom-up, structured as decentralized system</li> </ul>

### II. Capacity

5. What capacities for planning do relevant <b>institutions</b> have?
<ul style="list-style-type: none"> <li>E. Necessary technical proficiency and human resources capacity not present</li> <li>F. Marginal capacity and basic resources</li> <li>G. Some key institutions adequate, important weaknesses in others</li> <li>H. Sufficient capacity in responsible institutions for planning</li> </ul>

6. Have responsible institutions demonstrated ability to practice <b>adaptive</b> management?
<ul style="list-style-type: none"> <li>A. No evidence of adaptive management</li> <li>B. Practice expressed as minor adjustments</li> <li>C. Periodic self-assessments, modified behavior based on experience and learning</li> <li>D. All levels and sectors of governance demonstrate ability to learn and adapt by modifying important targets/policies</li> </ul>
7. Have <b>pilot</b> scale projects been implemented?
<ul style="list-style-type: none"> <li>A. No pilot programs initiated</li> <li>B. Pilot programs underway to assess viability</li> <li>C. Pilots completed and outcomes have shaped actions/policies</li> <li>D. Action plans successfully tested at pilot level</li> </ul>

### III. Constituencies

8. Do the user groups who will be affected by adaptation planning actions <b>understand</b> and actively <b>support</b> its agenda?
<ul style="list-style-type: none"> <li>A. Important user groups unaware of goals, strategies, targets</li> <li>B. User groups aware of goals and targets but degree of support varies</li> <li>C. Most understand with few important missing</li> <li>D. All relevant user groups understand and actively support</li> </ul>
9. How <b>informed</b> and <b>supportive</b> about the perceived causes and anticipated effects of CC are the stakeholders likely to be most affected?
<ul style="list-style-type: none"> <li>A. Minimal public awareness</li> <li>B. Awareness, but misinformed of causes and expected effects of climate change</li> <li>C. Support building due to public education and community leaders</li> <li>D. Surveys reveal stakeholders are well informed and widely supportive of adaptation planning strategies</li> </ul>
10. What types of <b>capacity</b> building measures have been implemented?
<ul style="list-style-type: none"> <li>A. None at all</li> <li>B. Workshops for ministry level officials</li> <li>C. Focus groups with community members</li> <li>D. Public education for general population</li> </ul>
11. What opportunities exist for stakeholder <b>engagement</b> to <b>coordinate</b> and share responsibility with decision-making?

- A. No interaction between stakeholders and decision-makers
- B. Separate initiatives at community-level
- C. Nominal engagement but no impact on decision-making process
- D. Broad stakeholder involvement and co-management throughout country

12. What is the **well-being** status of stakeholders most vulnerable to coastal impacts?

- A. Poverty and lack of education
- B. Economically vulnerable and poorly educated
- C. Moderate income and education
- D. Economically resilient and well-informed

#### IV. Goals

13. Are their specific goals based on time and **measurable** goals?

- E. No action to date
- F. Targets expressed in non-quantitative terms
- G. Some specific targets, either a date or measure
- H. Targets defined in quantitative terms

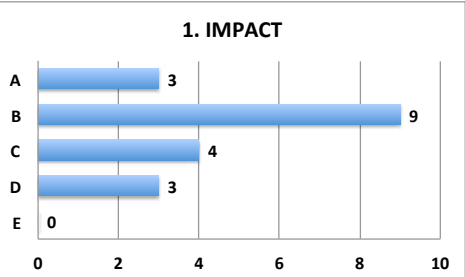
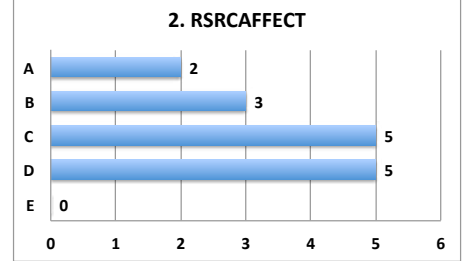
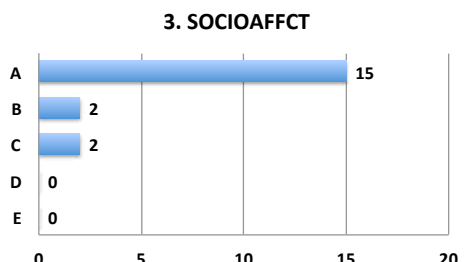
14. On what **criteria** are goals considered?

- A. No goals defined
- B. Goals being negotiated but not formalized
- C. Long term goals address either societal or environmental outcomes
- D. Goals define goals for both societal and environmental outcomes

15. How realistic do you consider the strategy of public climate change **education** can create changes in behavior?

- A. Not at all, a misguided strategy
- B. Education could work, but many other more viable options
- C. Education is a good approach, but lacking resources and capacity
- D. Education is the most effective measure and can be implemented

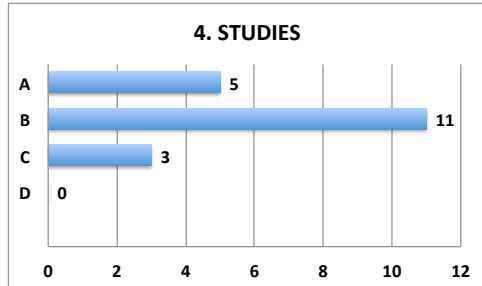
### Appendix 5: Interview Instrument Results

<p>A. Sea level rise  <b>B. Extreme weather events</b>                      C. Destruction of coastal habitat                      D. Beach erosion                      E. Other</p>	<p style="text-align: center;"><b>1. IMPACT</b></p>  <table border="1"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>3</td> </tr> <tr> <td>B</td> <td>9</td> </tr> <tr> <td>C</td> <td>4</td> </tr> <tr> <td>D</td> <td>3</td> </tr> <tr> <td>E</td> <td>0</td> </tr> </tbody> </table>	Category	Count	A	3	B	9	C	4	D	3	E	0
Category	Count												
A	3												
B	9												
C	4												
D	3												
E	0												
<p>2. Which coastal resource will be <b>Resource Most Affected</b> by climate change?</p>													
<p>A. Fisheries                      B. Tourism                      C. Natural barriers                      D. Biodiversity                      E. Other</p>	<p style="text-align: center;"><b>2. RSRCAFFECT</b></p>  <table border="1"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>2</td> </tr> <tr> <td>B</td> <td>3</td> </tr> <tr> <td>C</td> <td>5</td> </tr> <tr> <td>D</td> <td>5</td> </tr> <tr> <td>E</td> <td>0</td> </tr> </tbody> </table>	Category	Count	A	2	B	3	C	5	D	5	E	0
Category	Count												
A	2												
B	3												
C	5												
D	5												
E	0												
<p>3. Which is the most serious <b>Social Affect?</b></p>													
<p>A. Poverty                      B. Health                      C. Security                      D. Forced migration                      E. Other</p>	<p style="text-align: center;"><b>3. SOCIOAFFECT</b></p>  <table border="1"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>15</td> </tr> <tr> <td>B</td> <td>2</td> </tr> <tr> <td>C</td> <td>2</td> </tr> <tr> <td>D</td> <td>0</td> </tr> <tr> <td>E</td> <td>0</td> </tr> </tbody> </table>	Category	Count	A	15	B	2	C	2	D	0	E	0
Category	Count												
A	15												
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### Information Gathering

4. What types of baseline **Studies** have been conducted to inform climate change planning? Has the planning process taken advantage of the research to fill important gaps?

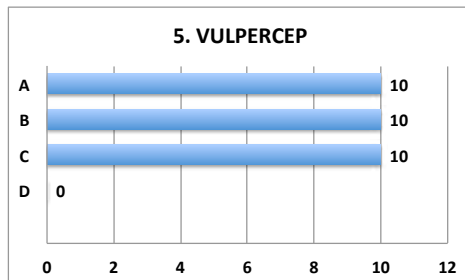
- A. No studies have been completed yet
- B. Environmental impact studies for private industries
- C. Complete assessment of coastal resources and interested socioeconomic groups identified
- D. Findings of studies have informed policy decision

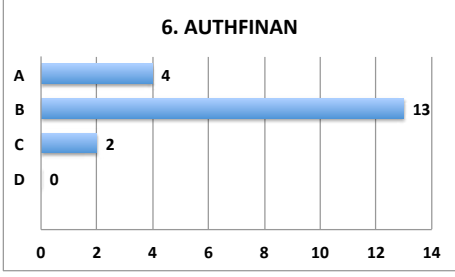
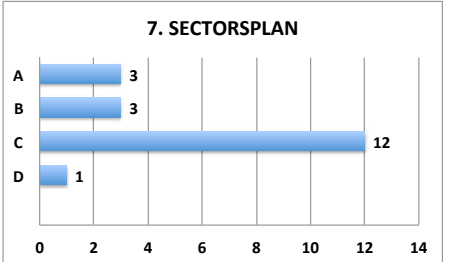
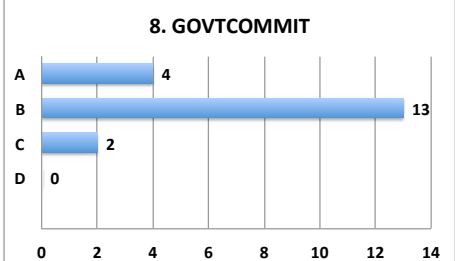


### Vulnerability Perception

5 A. From scale of 1 (most secure and resilient)-10 (most vulnerable and at risk). What is your **Perception of Vulnerability** to forces and impacts?

- A. Exposure
- B. Sensitivity
- C. Adaptive Capacity



<p>6. What <b>Authorities and Financial Resources</b> have been committed to adaptation planning?</p>											
<p>E. No government support or financial resources committed</p> <p>F. <b>Acknowledged by some leaders, some pledges and commitments but significant gaps</b></p> <p>G. Commitments negotiated, adequate short-term funding</p> <p>H. Formal law or decree, legitimacy, sufficient financial resources</p>	<p style="text-align: center;"><b>6. AUTHFINAN</b></p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>4</td> </tr> <tr> <td>B</td> <td>13</td> </tr> <tr> <td>C</td> <td>2</td> </tr> <tr> <td>D</td> <td>0</td> </tr> </tbody> </table>	Category	Count	A	4	B	13	C	2	D	0
Category	Count										
A	4										
B	13										
C	2										
D	0										
<p>7. Which <b>Sectors</b> are involved in planning process?</p>											
<p>E. No planning at all, yet</p> <p>F. Mostly national government and private businesses</p> <p>G. National gov't and some local civil society agencies</p> <p>H. All levels of society are working together</p>	<p style="text-align: center;"><b>7. SECTORSPLAN</b></p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>3</td> </tr> <tr> <td>B</td> <td>3</td> </tr> <tr> <td>C</td> <td>12</td> </tr> <tr> <td>D</td> <td>1</td> </tr> </tbody> </table>	Category	Count	A	3	B	3	C	12	D	1
Category	Count										
A	3										
B	3										
C	12										
D	1										
<p>8. Is there a clear, long-term <b>Government Commitment</b> to implement adaptation planning?</p>											
<p>E. Formal approval process has not been initiated</p> <p>F. <b>There is a governmental mandate for planning</b></p> <p>G. Policies and actions are being negotiated with approving authorities</p> <p>H. Plan of action approved for implementation</p>	<p style="text-align: center;"><b>8. GOVTCOMMIT</b></p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Category</th> <th>Count</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>4</td> </tr> <tr> <td>B</td> <td>13</td> </tr> <tr> <td>C</td> <td>2</td> </tr> <tr> <td>D</td> <td>0</td> </tr> </tbody> </table>	Category	Count	A	4	B	13	C	2	D	0
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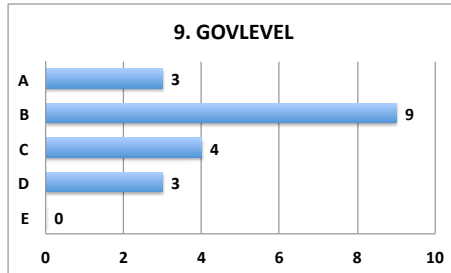
### 9. Which **levels** of governance are involved in planning process?

E. Power and responsibility concentrated at international level outside of country

F. Responsibility and initiative at various national and local levels

G. Decision-making and responsibility decentralized, but significant coordination issues

H. Governance integrated top-down and bottom-up, structured as decentralized system



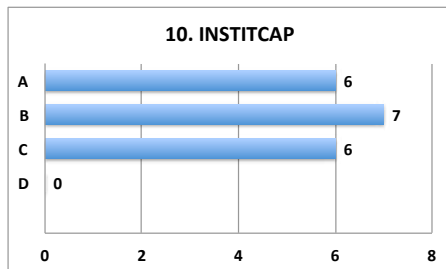
### 10. What Institutional **Capacity** for planning is present?

I. Necessary technical proficiency and human resources capacity not present

J. Marginal capacity and basic resources

K. Some key institutions adequate, important weaknesses in others

L. Sufficient capacity in responsible institutions for planning

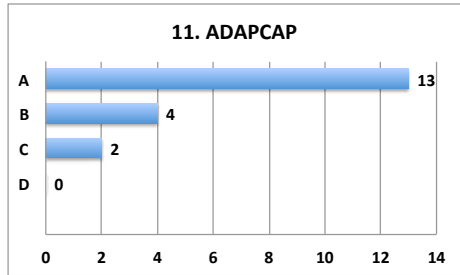




11. Have responsible institutions demonstrated **Capacity for Adaptive Management?**

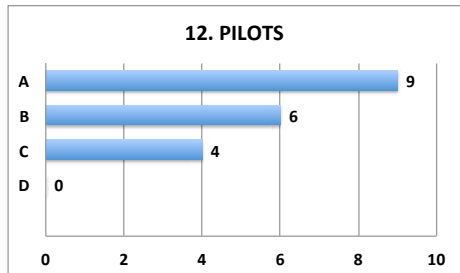
E. **No evidence of adaptive management**

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- G. Periodic self-assessments, modified behavior based on experience and learning
- H. All levels and sectors of governance demonstrate ability to learn and adapt by modifying important targets/policies



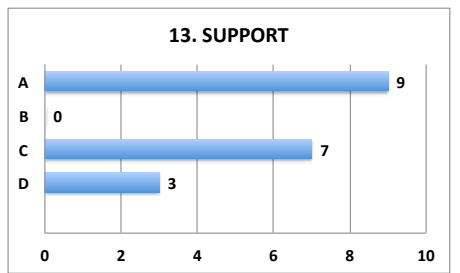
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- H. Action plans successfully tested at pilot level



13. Do the user groups who will be affected by adaptation planning actions **understand** and actively **support** its agenda?

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- G. Most understand with few important missing
- H. All relevant user groups understand and actively support



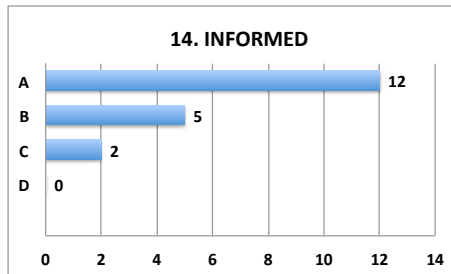
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E. **Minimal public awareness**

F. Awareness, but misinformed of causes and expected effects of climate change

G. Support building due to public education and community leaders

H. Surveys reveal stakeholders are well informed and widely supportive of adaptation planning strategies



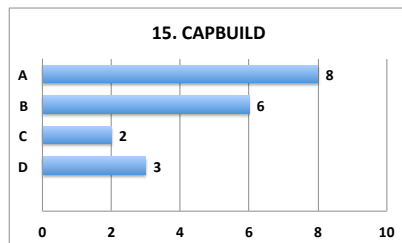
15. What types of **Capacity Building** measures have been implemented?

E. None at all

F. Workshops for ministry level officials

G. Focus groups with community members

H. Public education for general population



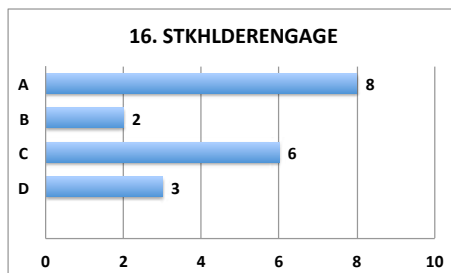
16. What opportunities exist for **Stakeholder Engagement** to coordinate and share responsibility with decision-making?

E. No interaction between stakeholders and decision-makers

F. Separate initiatives at community-level

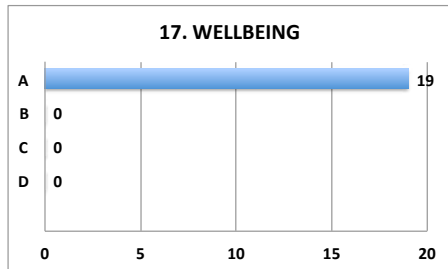
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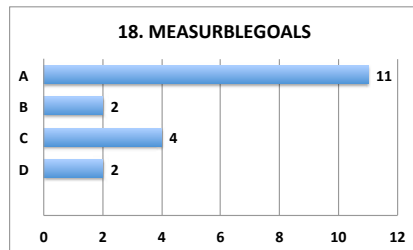
17. What is the **well-being** status of stakeholders most vulnerable to coastal impacts?

- E. Poverty and lack of education
- F. Economically vulnerable and poorly educated
- G. Moderate income and education
- H. Economically resilient and well-informed



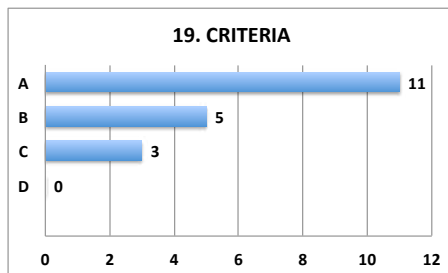
18. Are their specific goals based on time and **Measurable Goals**?

- I. No action to date
- J. Targets expressed in non-quantitative terms
- K. Some specific targets, either a date or measure
- L. Targets defined in quantitative terms



19. On what **criteria** are goals considered?

- E. No goals defined
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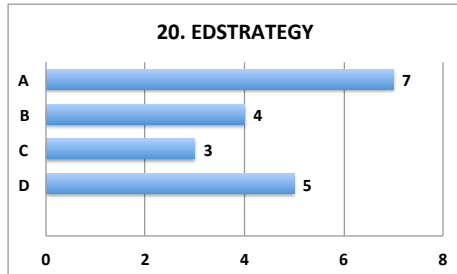
20. How realistic do you consider the **Education Strategy** of public climate change to create changes in behavior?

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G. Education is a good approach, but lacking resources and capacity

H. Education is the most effective measure and can be implemented



**Measuring Social Vulnerability & Adaptive Capacity  
to Climate Change in Coastal Communities  
of the Dominican Republic**  
by Hilary Lohmann



## Abstract

The ability of individuals and communities to adapt to shifting climate conditions is of priority concern at local, national, and regional scales. This report adds to the global discussion of social vulnerability and adaptive capacity to changing climate conditions; how to measure it and how to mitigate it. A study was conducted in the summer of 2014 to assess these characteristics in 175 individuals of various sectors of employment in three coastal communities of the Dominican Republic. The specific research questions addressed in this study are:

- What are the factors related to adaptive capacity in coastal communities of the Dominican Republic?
- Do these factors vary between direct marine resource users and non-direct marine resource users?
- Do these factors vary amongst individuals who do and do not share household responsibility for income?

Principal component analysis of responses to 26 statements resulted in seven factors related to occupational adaptive capacity: *ability to plan, learn, and reorganize; attachment to occupation; occupational adaptability/flexibility; attachment to place; employment security; financial security; and occupational mobility*. Factor scores were compared between direct resource users and non-direct resource users, and between individuals who are the sole providers of household income and those who share the responsibility of providing income to the home to determine whether there is a difference in vulnerability and adaptive capacity between these groups of individuals. Results indicate that many of the factors related to vulnerability and adaptive capacity are similar for all coastal individuals. However, direct resource users exhibited greater attachment to occupation and sole providers of household income showed lower financial security. This research has important implications for community and development planners working in coastal areas of the Dominican Republic. It highlights the value of understanding a person's role in a household to better predict an individual's ability and willingness to make changes related to occupation. As manifestations of climate change continue to impact coastal communities of the Dominican Republic, this report can be a useful resource for developing strategies for preparedness.

## Table of Figures

Figure 1. Map of the Dominican Republic, with the three study site communities highlighted.....	77
Table 1. Terms Used to Define Participant Groups .....	83
Table 2. Demographic Information Collected from Study Participants.....	84
Table 3 Seven factors emerged from a principal component analysis of 26 likert statements.....	85
Table 4. Results of t-test Comparing the Mean Component Scores of Non-direct Resource Users and Direct Resource Users.....	87
Table 5. Results of t-test Comparing the Mean Component Scores of Participants Who are Sole Providers and Participants Who are Shared Providers.....	88
Table 6. Responses from Participants Regarding Perceived Changes in Weather and Climate in Recent Past.....	90
Table 7. Total Number and Percentage of Participants Who Mentioned Specific Climate and Weather-Related Changes in the Recent Past .....	91



## Measuring Risk to Climate Change

In 2012, the World Resources Institute reported that people's capacity to adapt to shifting and emerging climate conditions may be the most important characteristic when addressing climate risks (Dixit et al., 2012). There is an abundance of research, reports, and analyses that measure human risk to impacts of climate change. There are several aspects of vulnerability to consider in risk assessment, namely exposure, sensitivity, adaptive capacity, and resilience. Multiple frameworks exist for investigating these related factors, and assessments can be conducted across a range of scales from the individual and household level, to community level, to national and regional level of analysis (e.g. Cinner et al., 2011; Brooks et al., 2005; Magis, 2010; Berkes & Ross, 2013).

### Vulnerability

Most studies of vulnerability consider the cumulative effects of exposure, sensitivity, and adaptive capacity. For this study, vulnerability is defined as the susceptibility of an individual within a system or community to disturbances caused by exposure to perturbations, sensitivity to perturbations, and the capacity to adapt to such perturbations (Nelson et al., 2007).

Exposure, as defined by the Intergovernmental Panel on Climate Change (IPCC) (2007), is "the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected." It has also been described as the "extent to which a region, resource or community experiences changes in climate" (Marshall et al., 2010). Characteristics of exposure include the magnitude, frequency, duration, and spatial extent of weather events or patterns (Marshall et al., 2010). Specific to the Dominican Republic, exposure to increased sea surface temperatures and more frequent storms of high intensity can threaten the integrity of coral reef ecosystems, which provide sustenance to local people and natural barriers to inclement storms (Caffrey et al., 2013). Increased storm intensity can also threaten the livelihoods of fishers and tour operators, who are often restricted in their ability to leave port and conduct work in foul weather.

Sensitivity describes the degree to which a system is affected by and responds to changes in climate (Marshall et al., 2010). Sensitivity can refer to ecological systems and their response to stressors like increasing temperature, variation in rainfall, and sea level rise (Marshall et al., 2010). In the Dominican Republic, the coral reefs and mangroves have a threshold of response to biophysical changes in air and water temperature, and/or physical and chemical conditions (Caffrey et al., 2013). When describing social systems, sensitivity encompasses the economic, political, institutional, and cultural factors of a community (Fenton et al., 2007). Many of the Dominican Republic's coastal communities are highly dependent on the health and stability of coastal habitats to sustain major livelihoods of fishing and tourism, as well as to mitigate the effects of potential and frequently more probable natural disasters, such as flooding and storm surge (Caffrey et al., 2013).

Adaptive capacity is the third factor that thoroughly affects vulnerability. According to much of the climate change literature, adaptive capacity describes the ability to respond to changes in a system through learning, managing risk and impacts, accruing new knowledge and developing effective management plans (Marshall et al., 2010; Caffrey et al., 2013). The capacity of individuals to cope and adapt to climate variability is determined by their circumstances, characteristics, and the ability to take advantage of other opportunities (Marshall et al., 2010).

## **Resilience**

Resilience is inversely related to vulnerability. While resilience was first used in natural sciences to describe ecosystems, it has been transformed by social scientists to describe societies (Adger, 2000; Folke, 2006). The relationship between ecological and social resilience, or the amount of change that can occur in a (natural or social) system while function and structure are retained, has been the foundation for studies of communities that are dependent on natural resources for livelihoods (Adger, 2000). Many argue that ecological and social resilience are connected by a community's economic dependence on ecosystems, and that a society's resilience is subject to the extent of their resource dependence (Adger, 2000; Folke, 2006). For the purposes of this study, resilience is defined as the flexibility with which an individual can cope with and adapt to changes in resource availability and access (Marshall & Marshall, 2007).

**The Marshall et al. (2010) Method**

The Marshall et al. (2010) method for assessing social vulnerability is an adaptation of an approach first introduced in 2007 (Marshall & Marshall, 2007). Adapted versions of this method have been operationalized in several contexts. Marshall et al.'s (2010) framework has been modified to study the level of dependency of both coastal and terrestrial communities in Australia, Africa, and Southeast Asia (e.g., Cinner et al., 2009; Marshall & Marshall, 2007; Marshall et al., 2009).

Indicators used to measure adaptive capacity in the Marshall and Marshall framework fall into four categories:

- Perception of risk associated with potential change
- Perception of ability to plan, learn, and reorganize
- Perception of ability to cope with change
- Level of interest in change

These indicator categories include specific measures related to attachment to occupation, attachment to place, employability, family characteristics, formal and informal networks, and financial status (Marshall et al., 2010). For instance, individuals' financial situation, ability to secure alternative employment, and ability to remain competitive within their current occupation are used to measure one's perception of risk, which relates to one's management of risk (Marshall & Marshall, 2007). The ability to cope with change is measured by determining proximity to emotional thresholds like anger, stress, and anxiety, or financial thresholds related to debt, property ownership and other assets (Marshall et al., 2010). Furthermore, individuals with a higher interest in changing and adapting to changes often have measurably higher financial, social, and emotional flexibility (Marshall et al., 2010).

Results from previous implementations of the methodology identified relationships between these characteristics and the level of resource dependency as well as adaptive capacity. For instance, in Australia, cattle grazers were highly attached to both their occupation and their place, and had low employability as measured by their interest in, and skills transferrable to, other types of work (Marshall, 2011). They also tended to make business decisions without consulting others for advice, and did not have extensive social or professional

networks with individuals outside of their occupation. Additionally, the level of interest in changing occupations was found to be lower for individuals with constraints (e.g. dependent family members, low personal capital, high debt) (Marshall, 2011).

A similar study of adaptive capacity using the Marshall et al. (2010) method in Madagascar used measures of dependency on natural resource(s), livelihood diversity, and formal and informal institutional networks as flexibility indicators (Cinner et al., 2009). Results showed that a majority of the sample population participated in fisheries and considered it their most important occupation. It was concluded that the extent to which alternative livelihood opportunities are available is an indicator of flexibility within a community. This quantitative evaluation of flexibility relates to a population's ability to cope or adapt to changes that occur in the natural and social system. Understanding these factors that influence behaviors of change (or failure to change) can lead to more informed decisions about the form and necessity of adaptation strategies (Marshall et al., 2010).

Communities composed of individuals with diverse livelihoods are more likely to be able to adapt to changes brought about by climate variability (Nelson et al., 2007). Furthermore, societies with stable and successful economies often have individual constituents that are better able to consider a wider range of adaptation options to counter climate-driven instability (Marshall et al., 2010). A comparative study of adaptive capacity in five Western Indian Ocean countries using the original Marshall & Marshall (2007) framework concluded that communities with low levels of adaptive capacity are likely to suffer from disruptions to coral reef ecosystem goods and services caused by climate variability (McClanahan et al., 2008).

This methodology was designed on the principle that there are significant social, economic, and environmental components of resource dependency (Marshall & Marshall, 2007). When all these aspects are combined, the nature and magnitude of potential impacts from a change in the relationship with the natural resource(s) are more clear (Marshall et al., 2010).

## **Coastal Communities of Developing Nations: Balancing Natural Resource Dependence and Occupational Multiplicity**

Natural resource-dependent communities are particularly vulnerable because climate-induced changes to the environment will directly affect their livelihoods (Marshall et al., 2010). The capacity of such communities to adapt to unavoidable climate impacts, or adaptive capacity, requires immediate attention because global changes in climate patterns and events are altering the accessibility, quality, and availability of natural resources, leading to extensive impacts on the social and economic systems they support (Marshall, 2011).

Resource dependency has been defined as a strong dependence on a narrow range of resources, which can lead to economic and social stress within a community (Adger, 2000). Societies that consist of individuals who display resource dependency often exhibit community structure in which livelihoods and stability are a direct function of resource production (Machlis et al., 1990). Many coastal communities of the Dominican Republic exhibit this type of social construction, as livelihoods dependent on coral reef resources like fishing and tourism provide for a considerable proportion of the population (Caffrey et al., 2013).

According to Marshall (2011), resource dependency describes the nature and magnitude of resource users' sensitivity to changes in the condition of or access to resources as a result of climate variability, environmental degradation, or changes in regulatory policy. Higher resource dependence is correlated with higher vulnerability (Marshall et al., 2010). Measuring resource dependency leads to a greater understanding of the degree of vulnerability of a population to impacts of climate change, which can enhance the development of strategies for reducing people's climate vulnerability and support mechanisms for coping and adaptation (Marshall, 2011).

Increasingly, the context of resource-reliant populations is coastal communities (Bailey & Pomeroy, 1996; Adger, 2000; Folke, 2006; Costanza et al., 1995; Marshall et al., 2010). Coastal fishing communities, for example, are dependent on the health and stability of entire marine and coastal ecosystems more than any single resource (Bailey & Pomeroy, 1996). The livelihoods these communities depend

on can be diverse and include extractive activities, such as fishing, and others like transport and/or tourism. Ultimately, though, these diverse coastal activities depend on healthy and functional ecosystems to be productive, thereby setting up coastal people to depend on the integrity of these ecosystems as well (Adger, 2000).

Coastal communities of developing nations in particular often exhibit high resource dependency on marine and coastal ecosystem goods and services (Sesebo et al., 2006). Enterprises that rely directly on natural resources (e.g. fisheries and coastal tourism) are highly vulnerable to impacts of climate change because of their dependence on climate-sensitive natural resources for their livelihoods (Zamani et al., 2006). Impacts of climate variability include increased storm intensity; ecosystem degradation; cultural change due to increased use of technology; and climate-driven changes in regulations and management (Marshall et al., 2010). Moreover, these climatic stressors act as a catalyst to non-climate drivers of economic, environmental, institutional, cultural and political pressures (Marshall, 2010; Nelson et al., 2007). The combination of stresses makes socio-ecological changes inevitable, and understanding the ability of resource-reliant communities to cope and adapt all the more critical (Adger, 2000; Marshall et al., 2010; Cinner et al., 2009).

This complex and interdependent relationship of coastal communities to their environments complicates their social resilience. The complexity of tropical coastal resource systems in particular can increase resilience and community stability by providing multiple available resources, decreasing the dependence on any one particular resource (Bailey & Pomeroy, 1996). This can also provide opportunities for participation in more than one livelihood or occupation.

An individual or household that participates in more than one livelihood activity is considered to exhibit occupational multiplicity (Daw et al., 2012; Cinner et al., 2008). A related finding is the presence of occupational diversity, defined as the “maintenance and continuous adaptation of a highly diverse portfolio of activities in order to secure survival that is a distinguishing feature of rural livelihood strategies in contemporary poor countries” (Ellis, 2000, p. 290). Individuals and households that take part in multiple, diverse livelihoods, often including some degree of fishing, is seen in many coastal communities

of the tropics (Pollnac et al., 2001; Daw et al., 2012; Cinner et al., 2008). Awareness of the number and role of occupations is important when considering how individuals within these communities will respond to change.

Furthermore, occupational multiplicity has been shown to affect one's willingness to leave a risky occupation, such as fishing (Daw et al., 2012; Cinner et al., 2008). An individual with more than one occupation, or an individual living in a household where others have occupations as well, is better prepared to spread the risks associated with decreased productivity, income, or total loss of one particular livelihood. That is, an individual who is the sole responsible party for providing income to a household assumes more responsibility, and thus more risk, if s/he leaves his/her occupation and takes a chance with another. A study in Madagascar that assessed the adaptive capacity of individuals whose primary livelihood was in fisheries found that the extent to which alternative livelihood opportunities are available is an indicator of flexibility, or resilience, within a community (Cinner et al., 2009).

However, it is important to remember that the degree of community dependence on a healthy ecosystem, often high in coastal communities of tropical, developing nations, can greatly threaten resilience if a notable ecological disaster or disturbance occurs. Therefore, weakened resilience can lead to negative impacts on multiple livelihoods in coastal communities (Adger, 2000).

Adger (2000) describes the influence that resource dependency can have on social resilience, food security, and the ability of a community to cope with shocks. He argues that resilience, which can be threatened by disturbances brought by climate variability, depends on a diverse ecosystem and diverse market to buffer a society from disruptions.

To sustain communities challenged with unknown levels of unavoidable change, it is important to identify their vulnerability and resilience, and take actions to enhance the ability to adapt (Marshall, et al., 2010, Cinner et al., 2009; Gunderson et al, 2002; Walker et al., 2002). Societies that are better able to respond or cope with change quickly and easily are considered to have high adaptive capacity (Smit

& Wandel, 2006). Assessing social vulnerability to impacts of climate variability leads to a better understanding of the ability to cope and adapt. This, in turn, can help local, regional, and national leaders to develop policies that are feasible and practical for the community of interest (Smit & Wandel, 2006).

### **Communities as Integrated Systems**

Recent research on impacts of climate variability on resource dependent groups has focused primarily on individuals whose livelihood is based on the abundance and health of certain natural resources (e.g., Cinner et al., 2009; Marshall et al., 2010). There has been insufficient focus on the impacts to communities as integrated systems of individuals who have diverse livelihoods that vary in the degree to which they rely on natural resources. This study expands the population of interest for assessing adaptive capacity to include both direct and indirect resource dependents of coastal communities in the Dominican Republic. For the purposes of this study, individuals who interact directly with natural resources for a living (e.g. fishermen, tour and transportation operators) are considered to be direct resource dependents, while individuals who rely on direct users and others for a living (e.g. restaurateurs, shop keepers, mechanics) are considered non-direct resource users. Both user groups are dependent on a healthy, functional, social-ecological coastal system for a resilient lifestyle and community.

Climate change, environmental degradation, and/or regulatory modifications can change a population's access to a resource. Resource dependency affects the nature and magnitude of a population's sensitivity to such changes, and adaptive capacity describes a population's ability to cope (Marshall, 2011). This research examined the capacity of both direct and non-direct marine resource users in coastal communities of the Dominican Republic to adapt to climate variability as an antecedent for understanding their vulnerability to climate change (Marshall, 2010).

While the study uses the individual and the household as the main units of analysis, it is widely acknowledged that individuals represent an important source of resilience across other scales (Marshall, 2010; Adger, 2000). That is, individuals and households of individuals collectively make up larger social groups (communities, societies,



etc.) and therefore information about individuals can be aggregated to understand policy and development issues at community, regional, or national scales.

### **Climate Change Impacts in the Dominican Republic**

Climate change is threatening reef ecosystems in a number of ways. Much of the recorded degradation to reefs is due to impacts of ocean warming and acidification (Wielgus et al., 2012). Warmer, increasingly acidic water compromises carbonate accretion, which inhibits coral growth (Hoegh-Guldberg et al., 2007). It is predicted that this will result in less diverse reef communities and weaken the carbonate structure of reefs (Hoegh-Guldberg et al., 2007). Impacts of climate change also exacerbate localized stressors like declining water quality and overexploitation of key species like grouper and parrotfish, driving reefs closer toward functional collapse (Hoegh-Guldberg et al., 2007). This presents serious consequences for reef-dependent fisheries, tourism, and coastal protection.

Climate change affects the Dominican climate beyond reef degradation as well. Temperatures in the Dominican Republic have increased steadily in recent decades by an average of 0.5-1 degree Celcius (Caffrey et al., 2013). Rainfall events are growing less and less predictable, with fewer extreme events in northern regions and more extreme events in the south of the country (Caffrey et al., 2013). Climate projections for 2050 indicate that these trends in rising temperature and inconsistent rainfall will continue, in addition to sea level rise and increased intensity of tropical storms. Coastal and marine ecosystems like mangroves and coral reefs face greater risk to the impacts of sea level rise and extreme storm events, as these stressors are compounded by existing issues like critical habitat destruction through unchecked development, overfishing, increased risk of flooding and warming temperatures (Caffrey et al., 2013).

### **Vulnerability Assessment to Climate Change in the Dominican Republic**

The Dominican Republic was recently listed as one the most at-risk developing nations for impacts from climate change (Hallegatte et al., 2013). In 2013, USAID published the Dominican Republic Climate Change Vulnerability Assessment Report, which presents the results

of an investigation of the exposure, sensitivity, and adaptive capacity of four climate-sensitive hotspots on the island nation as well as certain recommendations for bolstering preparedness. The areas of study for USAID's 2013 and the study presented in this report were selected independent of one another, but their overlap provides evidence of the high vulnerability that must be addressed in these particular regions. The hotspot zones identified in the USAID report overlap (Samana, Montecristi) or lie adjacent to (Santo Domingo) the areas of study for this research (La Caleta/Boca Chica, Samana, Montecristi).

Each community is on a different part of the Dominican coastline, and "has a unique set of bio-physical, socio-economic, and ecological characteristics in various stages of development, which collectively will contribute a diversity of information and experiences to enrich our understanding of climate change vulnerability and how to develop resilience in a variety of contexts" (Caffrey et al, 2013, pg. 10). The areas selected for study in both these works are considered increasingly vulnerable to current and anticipated climate impacts based on high exposure and sensitivity coupled with low adaptive capacity (Caffrey et al, 2013). In particular, the coastal sites of interest are vulnerable because of their reliance on marine habitats, which are themselves vulnerable to climate and non-climate induced stressors (e.g. increased temperatures, sea level rise, decreased regular rainfall, increased frequency and intensity of storms and flooding) (Caffrey et al, 2013; Wielgus et al., 2013).

Many coastal Dominican populations are dependent on critical and vulnerable ecosystems, particularly coral reefs and mangroves, that regulate water quantity (e.g. reduce flooding) and quality (e.g. filter pollutants) and indirectly, or directly, support local livelihoods like fisheries, tourism, and agriculture (Caffrey et al, 2013; Wielgus et al., 2013). As a result, degraded marine habitats are likely to negatively impact the well-being of coastal residents at the individual and community level, especially by threatening the livelihoods that depend on the health and abundance of natural resources like fishing and tourism (Caffrey et al, 2013). Individuals reliant on such livelihoods will suffer direct impacts, while the community members who rely on their neighbors to maintain a productive and active member of the local social network and economy will also be at

increased risk to a vulnerable social-ecological environment. Higher exposure and sensitivity to risk decrease adaptive capacity, and this inability to absorb shock or change can ripple through an area from the individual and sector (e.g. fishing) to the rest of the community.

### **Sensitivity in the Dominican Republic**

In the Dominican Republic, the coalescence of climate stressors (e.g. sea level rise, increasing temperatures, more and intense storms) and non-climate stressors (e.g. low levels of education, livelihood dependence on natural resources) will negatively impact coastal human security and livelihoods (Wielgus et al., 2013; Caffrey et al, 2013). Other notable vulnerabilities to the island nation include beach erosion, coral reefs that are 'at risk' or highly threatened, ocean acidification, and increased freshwater flooding (Wielgus et al., 2013; Caffrey et al, 2013). These stressors have impacts directly related to the tourism industry of the Dominican Republic, but also threaten local businesses in terms of infrastructure, health and security of employees, and abundance and access to natural resources like fisheries.

The coral reefs of the Dominican Republic, like the fishermen who rely on reef fish and tour operators who depend on continued demand, may also be vulnerable with low adaptive capacity to respond to changes. For instance, biological and ecological studies of the reef ecosystems have found that incidences of disease and coral bleaching are increasing (Goreau, 1992; Wielgus et al., 2013). Corals are also displaying low recruitment, which means slow and/or less corals replacing old, dead corals over time (Porter and Meier, 1992; Caffrey et al., 2013).

Perhaps the biggest threat to Dominican coral reefs is the mass mortality of reef fish, which has been documented for decades (Lessios et al., 1984; Wielgus et al., 2013). Biological studies of reef fish abundance and diversity and social studies that include interviews with local fishers both show that the majority of large, preferred species like grouper and snapper are less frequently captured (Caffrey et al, 2013). Instead, fishers are catching parrotfish, pez loro. These herbivorous species are indicators of overfishing (the herbivores are selected generally only when the predatory fish are gone) and are of great importance to a healthy coral reef, as they graze the algae that can overrun corals and kill a reef (Lessios et al., 1984). Recent

international efforts to protect parrotfish are helping, as studies show that sites where parrotfish are protected have healthier, resilient reefs (ICRI, 2012).

### **Comprehensive, Multi-scale Vulnerability Assessment**

The USAID (2013) report finds that the Dominican Republic is seeing the emergence of climate change action and policy at the national level, but these plans have yet to reach sub-national levels. This lack of local preparedness, coupled with the high risk and low capacity to manage shock or change, calls for further investigation of vulnerability and adaptive capacity at the local level. The present study conducted a local assessment of vulnerability and adaptive capacity in the same hotspots as the USAID (2013) regional investigation. Therefore, the present study can be used in conjunction with the recent USAID study to further inform, design and implement the capacity building and local adaptive responses that are recommended by USAID to enhance awareness of threats and associated regulations, as well as the ability for individuals and communities to prepare and cope with change (Caffrey et al., 2013).

Both the present study of local adaptive capacity and the USAID (2013) assessment of national capacity are based on the same definition of vulnerability as the Marshall et al. (2010) framework. The agreed concept is that vulnerability is a function of exposure to a stress, sensitivity to the stress, and the adaptive capacity to recover from the impacts of the stress. This framework can be studied at various levels of analysis and can be used to describe natural and/or social systems. In the case of the USAID (2013) project, the unit of analysis was regional institutions and the method of data collection was based on secondary data (literature review, key informants). In the case of the present study, the unit of analysis was the individual and household within a community and the data collected represents primary sources. Together, these reports provide a more comprehensive picture of the vulnerability of certain coastal communities across the Dominican Republic.

While the USAID (2013) report provides a wealth of knowledge on the critical state of exposure and sensitivity in the Dominican Republic considering a future riddled with implications of climate change, their assessment of adaptive capacity occurs at the institutional

and sector-based level of analyses. The USAID (2013) findings on Dominican adaptive capacity are therefore useful at a national and regional level, but lack a local component to triangulate findings. The report calls for individual and household level research to provide a greater understanding of local adaptive capacity, which this current study provides.

## Research Methodology

This study applied several of the indicators from the Marshall et



al. (2010) vulnerability assessment framework to coastal communities of the Dominican Republic during June and July of 2014. Sites for implementation were La Caleta/Boca Chica, Samana, and Montecristi (Figure 1).

Figure 1. Map of the Dominican Republic, with the three study site communities highlighted. (Source: Destination 360)

The 2010 National Census reported a population of approximately 10 million people, with a median age of 26.5 years (ONE, 2010). National unemployment is about 13 percent, but the unemployment rate for young people is a staggering 30 percent, which arguably increases social vulnerability in itself (Caffrey et al., 2013). Furthermore, close to 70 percent of the national population live in urban areas, which may further increase the vulnerability of rural populations, such as those studied along the coasts (Caffrey et al., 2013).

While the World Bank classifies the Dominican Republic as an upper middle-income country based on a per-capita income of roughly USD \$5,250, the nation suffers severe inequality in income distribution as more than 40 percent of people live at or below the poverty line (Caffrey et al., 2013). A majority of the residents in the study sites fall within this latter population, with some representation of the poorest 10 percent of the population that receives just two percent of family income (Caffrey et al., 2013). The inhabitants of

the three study sites can be characterized by low socio-economic status and little education, factors that are also known to increase vulnerability (Caffrey et al., 2013).

Multiple climate projections and models point toward an increase in temperature of approximately 1 degree Celsius by 2030 (Caffrey et al., 2013). This forecast would accompany an increased likelihood of associated climate change consequences like intense rainfall events and associated flood risk, as well as less specific rainy and dry seasons, and continued sea level rise.

### **La Caleta/Boca Chica**

The municipality of Boca Chica, within which lies the municipal district of La Caleta, is a 140.9 sq km region on the central southern coast, east of the nation's capital city Santo Domingo. The population in 2010 was 142,019 residents, with an eight percent unemployment rate (ONE, 2010). La Caleta/Boca Chica citizens have a 78 percent literacy rate.

Occupational reliance on coastal resources here is high. Coastal tourism is popular in the area, and many residents rely on this industry, including recreational watersports and fishing, for employment. La Caleta is home to the *Parque Nacional Submarino La Caleta*, a co-managed protected area with an aquatic center. El Carey was started as an alternative livelihood project by Reef Check Dominican Republic in 2007 to help reduce local fishing activity by replacing it with recreational tourism.

### **Samana**

Samana lies at the peninsular mouth of Samana Bay, on the northeastern coast of the country. The municipality is 410.8 sq km in size, has a population of 58,156 residents, and an unemployment rate of 11 percent (ONE, 2010). One of the area's most popular protected areas is *Parque Nacional Los Haitises*, located in the southern part of the bay. This park draws high numbers of tourists, as do the whales that winter in Samana Bay. The bay has a soft-bottom substrate that makes it critical habitat and spawning grounds for locally important fisheries like shrimp. The bay also has patches of coral reefs, though they are in a highly degraded state.

A majority of residents rely on fisheries and agriculture for livelihoods, with up to three-quarters of the population involved in informal agriculture of plants and livestock and approximately 9,000 formal and informal fishers (Caffrey et al., 2013). Also important for livelihoods are the businesses that are associated with tourism, including the service industry and real estate. All of these livelihoods are vulnerable to changes linked to climate variability, such as degraded fish spawning areas and beaches, and infrastructure threatened by flooding and sea level rise.

### **Montecristi**

Montecristi is on the most northwestern coast of the nation, bordered by the Atlantic Ocean to the north and the neighboring nation of Haiti to the west. The municipality is 517.4 sq km in size and has approximately 24,644 inhabitants, with an unemployment rate of 6.8 percent (ONE, 2010). Only about half of the residents have finished secondary school, though literacy rates are higher at almost 80 percent. Despite natural aridness, this region is responsible for major agricultural production, namely rice. One of the nation's largest rivers, Yaque del Norte, supports agriculture in the region and empties into Montecristi Bay. This river increases risk to flooding during heavy rain events. However, Montecristi also faces long periods without regular rainfall, and has presently been suffering a debilitating drought that has left many farmers without work for three consecutive years.

The largest reef formation in the Dominican Republic is off of Montecristi, and the area is host to several protected areas including the *Parque Nacional Submarino Montecristi*, and the *Cayos Siete Hermanos reef* and island chain. However, high fishing pressure and low enforcement of regulations to protect spawning grounds and related vulnerable habitats have left a degraded ecosystem and depleted fish stocks (Garza and Ginsburg, 2007). While tourism development is projected to increase in the area, the infrastructure and related businesses are currently limited. Common livelihoods here are fishing and salt harvesting, along with the nascent tourism sector. These livelihoods are at risk of climate change stressors as well as non-climatic stressors like unchecked sedimentation and pollution from the land, and alterations to the natural drainage system due to land-based development.

### **Data Collection**

Interviews were held with national actors (e.g. natural resource managers, climate and environmental policymakers, NGO directors) to determine the three sites of study based on perceived applicability and prioritization for local-level research. At least one local key informant for each study site was consulted before implementation. This consultation was used to gather information regarding best times and places to encounter individuals representative of many occupations within the municipality.

Following the advice of these key informants, the survey was implemented using purposive sampling at multiple local sites and at various times of day over the course of two weeks per site. Purposive sampling relies on the researcher's judgment and interest to build a sample that satisfies the specific needs of the project (Robson, 2011). In this way, locations that were sure to provide encounters with direct resource users and/or non-direct resource users were chosen to maximize the number of surveys collected in a community in a short amount of time. Sampling sites included the local waterfront, beaches, and landing sites for fishers as well as local businesses located in the downtown business area of a municipality.

Structured face-to-face surveys were conducted with community members living in La Caleta and Boca Chica, Samana, and Montecristi. Structured surveys provide a relatively straightforward approach to studying attitudes, values, beliefs, and motives; they are adaptable to collect generalizable information from a variety of human populations; and they allow for large amounts of collected data to be standardized (Robson, 2011). Community members participating in the surveys included non-direct resource dependents as well as direct resource dependents, the latter being the only population of interest in previous uses of the Marshall et al. (2010) framework. The population of interest in this study is the entire community and not just the direct resource users. Therefore, the sample population included those with livelihoods in fishing, tourism, and transportation, as well as small business owners and operators, and others living in the community.

The survey contained three sections. The first section collected demographic information from the participant. This included age, gender, primary occupation, level of formal education, family/



household structure (e.g. number of individuals living in the household, number of occupations of the participant, number of occupations in the participants' household), and number of years in the community.

The second section included 26 Likert scale statements adapted from the Marshall et al. (2010) method. These statements quantify the level of social, economic, and environmental dependency of the participant. This section asked participants to rate their level of agreement with statements regarding the perception of risk; capacity to plan, learn, reorganize, and cope; and level of interest in adapting to change (Marshall and Marshall, 2007).

The third section included thirteen additional statements related to an individual's environmental awareness and preferences. This final section also included three statements about the degree to which the participant had observed changes in climate (e.g. rainfall, temperature, storms, seasons) in the past ten years or less and whether such changes had affected their work. Participants were encouraged to provide more detailed, qualitative responses to these final three questions as well.

The survey was translated into Spanish and previewed by several Dominican research experts in order to maximize the effectiveness of the language used. The survey was first piloted in Puerto Plata, a coastal community with several conditions in common with the communities of interest including the prevalence of tourism and fishing for local residents. Responses to the pilot survey benefitted the study by ensuring that the vocabulary and concepts introduced in the survey were understandable and elicited the intended thoughts and considerations from the participants. After the pilot implementation, further revisions to the specific language used in the survey were made before implementation in the study sites.

The Likert scale used for the survey sought to elicit an attitude, opinion, or viewpoint from the participant along a four-point agreement scale (1= strongly disagree, 2= disagree, 3= agree, 4=strongly agree) (Marshall, 2011). The four-point scale has been used in previous studies using the Marshall framework in order to discourage ambiguous responses of neutrality (Marshall, 2011).

### **Data Analysis**

Principal component analysis with varimax rotation and Kaiser normalization was conducted using SPSS software. This analysis determined which of the 26 Likert statements from section two of the survey consistently elicited reliable responses from all participants by grouping the statements into meaningful categories related to social vulnerability and adaptive capacity. Standardized factor scores were computed for each group of statements. These factor scores were compared among different groups of coastal individuals based on resource use in occupation (direct vs. non-direct), number of livelihoods undertaken by the participant (single vs. multiple livelihoods), and number of occupations present in the participants' household (sole vs. shared provider) (Table 1).

Factor scores were compared between direct resource users and non-direct resource users using a t-test. This analysis determined if there was a difference in vulnerability and adaptive capacity between these groups of coastal residents. T-tests were also conducted to assess the vulnerability and adaptive capacity in consideration of occupational multiplicity. Factor scores of individuals with a single livelihood were compared to those of individuals with multiple livelihoods, and factor scores for individuals who were sole providers of household income were compared to those of shared providers. Significance for all statistical tests was determined at the 5% level.

Responses to questions from section three of the survey about changes in climate and weather in the past ten years were also analyzed. Qualitative responses from participants regarding the type of change(s) they have noted were coded and counted. Coding creates clusters, or categories, of similar responses by different participants to be counted and analyzed (Miles et al., 2014). Six categories emerged from the responses: rainfall, temperature, seasonality, wind, storms, and sea level rise. The number of times each type of climate change was mentioned by respondents was counted. Some respondents mentioned more than one type of change, and some respondents mentioned no change at all.

Table 1. Terms Used to Define Participant Groups.

Term	Description	Example
<b>Resource User: Direct</b>	individual who interacts directly with natural resources for a living	fishers, fish sellers, tour and transportation operators
<b>Resource User: Non-direct</b>	individual who relies on direct users and others in a community for a living	restaurateurs, shop keepers, hospitality staff
<b>Livelihood: Single</b>	individual who only participates in one income-generating livelihood	participant with only one occupation (fisher; shop clerk)
<b>Livelihood: Multiple</b>	direct resource user who participates in more than one income-generating livelihood	participant who fishes and drives a motorbike taxi for livelihoods
<b>Provider: Sole</b>	individual in a household with no other income-providing individuals	participant whose income supports an entire household
<b>Provider: Shared</b>	individual in a household with other income-providing individuals	participant whose income is supplemented by others to support a household

## Results

A total of 175 surveys were conducted. This included 90 direct resource user participants and 85 non-direct resource user participants, 97 participants with one livelihood and 78 with multiple livelihoods, and 85 participants who were sole providers of household income and 90 participants who shared household income responsibilities (Table 2). Generally, characteristics between participant groups were similar. For all participants, the average age ranged from 37-41 years old, the mean number of years of formal education ranged from 9-11 years, and the individual's mean household size was between three and four persons. All participants had between one and three employed persons in their household on average, and approximately two dependent, or unemployed, persons per household.

**Table 2. Demographic Information Collected from Study Participants.**

Variable	Non-direct resource users		Direct resource users		Single livelihood		Multiple livelihoods		Sole provider		Shared provider	
	(N=85)		(N=90)		(N=97)		(N=78)		(N=85)		(N=90)	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
<b>Age</b>	38.6	13.6	39.9	13.7	38.3	14	40.5	13.2	40.8	13.7	37.8	13.6
<b>No. years of formal education</b>	11.2	4	9.1	3.9	10.8	4.1	9.1	3.9	9	4	11	3.9
<b>No. years living in community</b>	26.4	15.4	32	18	26.6	16.1	32.4	17.5	30.6	16.6	27.9	17.2
<b>No. people in household</b>	3.9	2.2	3.8	2.1	3.8	2.2	3.8	2	3.2	1.9	4.4	2.2
<b>No. employed people in household</b>	1.9	1.1	1.6	0.8	1.8	1.1	1.7	0.8	1	0	2.4	0.9
<b>No. dependents in household</b>	1.9	2	2.2	1.9	2.1	2	2.1	1.9	2.2	1.9	1.9	2

<b>Community:</b> La Caleta / Boca Chica	27*	27*	33*	21*	23*	31*
<b>Communi- ty: Samana</b>	31*	30*	29*	26*	25*	36*
<b>Community:</b> Montecristi	27*	33*	35*	31*	37*	23*
	* number of participants per community					

**Factors that describe vulnerability and adaptive capacity**

The seven factors that emerged from the factor analysis were identified as follows: *ability to plan, learn, and reorganize; attachment to occupation; occupational adaptability/flexibility; attachment to place; employment security; financial security; and occupational mobility* (Table 3).

Table 3. Seven factors emerged from a principal component analysis of 26 likert statements. The factors are listed here, with the composite statements that had a loading with an absolute value of 0.50 or higher.

Factor	Statements	Loading
<b>Ability to plan, learn, reorganize</b>	I am confident that my skills will mean that I am successful in my job.	0.554
	I can cope with small changes in my job.	0.653
	Every time there is a change, I plan a way to make it work for me.	0.699
	I am more likely to adapt to change compared to others I know.	0.596
<b>Attachment to occupation</b>	I cannot imagine myself in any other occupation.	0.689
	I love my job.	0.529
	My occupation is more than a job-it is a lifestyle.	0.505
	It is a waste of my skills to get a job elsewhere.	0.721

<b>Occupational adaptability/ flexibility</b>	I would like to start a business one day doing something other than what I do now.	0.613
	I always get professional advice before making any business decision.	0.691
<b>Attachment to place</b>	I feel like I belong to this community.	0.824
	The friendships I have with people in this community mean a lot to me.	0.733
	I plan to be a resident of this community for many years.	0.531
<b>Employment security</b>	I have many options available to me other than my current primary occupation.	0.647
	I have many options available to me if I decide to leave my job.	0.739
<b>Financial security</b>	If there are any more changes I will not survive in this job much longer.	0.777
	I have some good ideas about how to ensure the sustainability of my job.	0.594
<b>Occupational mobility</b>	I would be nervous trying something other than what I do now for work.	-0.833

\* The factors are listed here, with the composite statements that had a loading with an absolute value of 0.350 or higher.

### Comparing Direct and Non-direct Marine Resource Users

After identifying the factors that relate to social vulnerability and adaptive capacity, the means of each of the seven component scores were compared between all direct resource users and non-direct resource users (Table 4).

Factor scores for direct and non-direct resource users differed significantly for one factor: *Attachment to Occupation*. Direct resource users scored higher ( $M=0.230$ ,  $SD=1.02$ ) than non-direct resource users ( $M=-.0243$ ,  $SD=0.927$ ),  $t(173)=-3.22$ ,  $p=0.002$ .

**Table 4. Results of t-test Comparing the Mean Component Scores of Non-direct Resource Users and Direct Resource Users\***

Factor	Non-direct Resource Users (N=85)		Direct Resource Users (N=90)		t	df	P-value
	M	SD	M	SD			
Ability to plan, learn, reorganize	0.096	0.887	-0.091	1.093	1.25	169	0.214
Attachment to occupation	<b>-0.243</b>	<b>0.927</b>	<b>0.23</b>	<b>1.017</b>	<b>-3.22</b>	<b>173</b>	<b>0.002</b>
Occupational adaptability/ flexibility	-0.143	0.988	0.135	0.998	-1.85	173	0.066
Attachment to place	0.069	0.987	-0.065	1.014	0.89	173	0.378
Employment security	-0.049	0.999	0.047	1.004	-0.63	173	0.527
Financial security	0.092	0.898	-0.087	1.085	1.19	170	0.235
Occupational mobility	-0.04	0.972	0.038	1.029	-0.52	173	0.604

\* for the seven factors of vulnerability and adaptive capacity. Equal variances are not assumed for the means. (bold indicates significant difference)

### Comparing Individuals with and Without Occupational Multiplicity

There were no significant differences in vulnerability and adaptive capacity between participants with a single livelihood and those with multiple livelihoods.

Mean factor scores were compared for participants who are sole providers in their households and participants who are shared providers in their households (Table 5). Individuals who were sole providers in their households scored significantly lower ( $M=-0.158$ ,  $SD=0.932$ ) on *Financial Security* compared to individuals who were shared providers in their households ( $M=0.149$ ,  $SD=1.043$ ),  $t(172)=-0.205$ ,  $p=0.041$ . This suggests that individuals who are the only one in their household with an occupation are less able to plan and save for the future. This may make them more vulnerable and negatively affect their willingness to make changes, for instance changes associated with occupation.

Table 5. Results of t-test Comparing the Mean Component Scores of Participants Who are Sole Providers and Participants Who are Shared Providers\*

Factor	Sole provider of household income (N=85)		Shared provider of household income (N=90)		t	df	P-value
	M	SD	M	SD			
Ability to plan, learn, reorganize	-0.037	1.081	0.035	0.921	-0.472	165	0.638
Attachment to occupation	0.018	1.02	-0.017	0.987	0.234	172	0.815
Occupational adaptability/flexibility	-0.15	1.106	0.141	0.871	-1.925	160	0.056
Attachment to place	0.057	0.961	-0.054	1.038	0.738	173	0.462
Employment security	0.001	1.089	-0.001	0.914	0.013	164	0.990



<b>Financial security</b>	<b>-0.158</b>	<b>0.932</b>	<b>0.149</b>	<b>1.043</b>	<b>-0.205</b>	<b>172</b>	<b>0.041</b>
<b>Occupational mobility</b>	-0.066	1.021	0.063	0.981	-0.853	171	0.395

\*for the seven factors of vulnerability and adaptive capacity. Equal variances not assumed for the means (bold indicates significant difference)

### Changes in Climate and Weather

Finally, coastal residents' perceived changes in climate were quantified by counting yes or no responses from participants regarding changes in climate and weather events in the past ten years or less (Table 6). By asking about specific changes in both events (e.g., rainfall, storms) and patterns (e.g., rainy season), these results further investigate the different effects of climate change for direct and non-direct resource users. Results show that a majority of participants from both direct and non-direct resource user groups (159 of 175, or 91%) have noticed changes in weather conditions. More direct resource users felt that these changes affected their work compared to non-direct resource users (64% and 24% respectively), and 81% of participants from both user groups (142 of 175) are concerned about climate changes in the future.

**Table 6. Responses from Participants Regarding Perceived Changes in Weather and Climate in Recent Past**

Statement	Non-direct resource users (N=85)				Direct resource users (N=90)				All Participants (N=175)			
	No	Percent	Yes	Percent	No	Percent	Yes	Percent	No	Percent	Yes	Percent
I have noticed changes in weather conditions over the past ten or less years.	9	11%	76	89%	7	8%	83	92%	16	9%	159	91%
Changes in typical weather conditions have affected my work.	65	76%	20	24%	32	36%	58	64%	97	55%	78	45%
I am concerned about changes in weather conditions in the future.	21	25%	64	75%	12	13%	78	87%	33	19%	142	81%

Qualitative responses from participants regarding the type of change(s) they have noticed were coded and counted for seasonality, temperature, rain, wind, storms, and sea level rise (Table 7). Overall, 73 participants (42%) said that they have observed changes in seasons in the recent past; specifically, the rainy season is less predictable and reliable than it used to be. Over half of participants (57%) perceived changes in temperature and many participants (56%) noted changes in rainfall. Twenty-six participants (15%) mentioned changes in the wind, and twenty participants (11%) noted changes in storms.

**Table 7. Total Number and Percentage of Participants Who Mentioned Specific Climate and Weather-Related Changes in the Recent Past**

Type of climate change	Non-direct resource users (N=85)		Direct resource users (N=90)		All Participants (N=175)	
	Total	Percentage	Total	Percentage	Total	Percentage
Changes in seasons	34	40%	39	43%	73	42%
Changes in temperature	54	64%	45	50%	99	57%
Changes in rainfall	44	52%	54	60%	98	56%
Changes in wind	8	9%	18	20%	26	15%
Changes in storms	8	9%	12	13%	20	11%
Sea level rise	3	4%	3	3%	6	3%

### **Perceived Changes in Climate/weather**

Most study participants acknowledged that there have been changes in climate within the past ten years. Observed changes include rainfall, temperature, seasons, wind, storms, and sea level rise. With regard to rainfall, many participants commented that there is less rainfall than there used to be. Several individuals stated that the rainfall events of the rainy season are no longer predictable or reliable. There is less rain during this season than in the past, but now there are rainy events more frequently during other times of the year.

Temperatures are said to have risen, in general and also specifically in the summer. Many participants shared negative comments about the hot and dry summers they experience now compared to the past, when they used to have rains that brought relief from the heat.

About a third of participants commented that the seasons, which are typically distinguished by moderate changes in temperature and more serious changes in rainfall, are no longer predictable. It was

often commented that it rains when it shouldn't (if and when it rains at all) and it is hotter than it should be, particularly in the summer. Many of the direct resource users and a handful of non-direct resource users also commented that it is windier than it used to be, and that storms are more intense. Changes in wind and storms were of greater concern to direct resource users, many of whom were concerned about the increased intensity of both because the frequency of heavy winds and foul weather in general prohibits them from leaving port. Six participants noted sea level rise.

## Discussion

### Factors of Vulnerability and Adaptive Capacity

This study found seven different factors that characterize vulnerability and adaptive capacity in coastal residents of the Dominican Republic: *ability to plan, learn, and reorganize; attachment to occupation; occupational adaptability/flexibility; attachment to place; employment security; financial security; and occupational mobility*. The factors attachment to occupation and attachment to place are similar to those that have been found in comparable studies using Marshall et al.'s (2010) survey questions (Marshall, 2011). The *ability to plan, learn, and reorganize and financial security* factors are also found in other studies, but with a slightly different configuration of only two or three statements each (Marshall & Marshall, 2007; Marshall et al., 2010).

Marshall et al.'s (2010) study found a single factor referred to as Employability, which in this study is captured in several different factors, namely *Occupational adaptability/flexibility, Occupational mobility, and Employment security*. It is possible that employability was captured in several different factors because the occupations considered in this study are broader than those in other studies that focused on a single employment sector, such as grazers or fishers (Marshall, 2011; Marshall & Marshall, 2007).

It is argued that a change of occupation out of necessity is not the same as change due to choice (Ellis, 2000). The division of employability found in this study is useful to separately measure an individual's interest (*occupational adaptability/flexibility*), willingness (*occupational mobility*), and preparedness (*employment security*) to adapt to changes. For instance, a person may have a desire to make a

change in their occupation but feel constrained to act on it because of their financial or social situation. Alternatively, a person may find him/herself in a situation where a change of occupation is obligatory, regardless of personal interest in doing so. This could be caused, for example, by a loss in employment, a change in access rights (e.g., loss of hunting or fishing license), or changes in costs and fees they are unable, not just unwilling, to meet.

### **Comparing Vulnerability Across User Groups**

The finding that direct marine resource users were more likely to be attached to their occupation is a common result in studies that focus on resource-dependent groups around the world (e.g., Cinner et al., 2008; Shaffril et al., 2012; Pollnac et al., 2001). This indicator of vulnerability can be characterized by disinterest in changing occupation, and can present a serious challenge to the suitability and success of attempts to introduce alternative livelihoods that reduce pressure on natural resources (Cinner et al., 2008; Shaffril et al., 2012; Pollnac et al., 2001). Greater attachment to occupation is associated with lower interest in changing location and livelihood, which reduces an individual's ability to provide for themselves and others when climate variability and/or limitations to resource availability reduce the productivity of, and income from, one's work (Shaffril et al., 2012).

Changes in climate conditions (e.g. wind and storms) were noted more often by direct resource users than non-direct resource users. This is not surprising, as such changes are more likely to directly affect their ability to work. The Dominican Navy prohibits vessels from leaving port when the weather is foul and winds are strong. Therefore, more frequent, stronger storms and winds reduce the productivity of direct resource users by limiting their ability to conduct work on the sea. For a group of individuals who are also disinterested in changing occupation, reduced productivity may make them more vulnerable.

It is also important to note that only one of seven factors characterizing vulnerability and adaptive capacity showed a significant difference between direct and non-direct resource users. This implies that in coastal communities such as the Dominican Republic, direct resource users and non-direct resource users share many of the same characteristics of vulnerability and adaptive capacity. It is therefore important to consider the vulnerability and adaptive capacity of all

stakeholders regardless of type of occupation because climate change will have impacts that affect the occupations of many people within a community.

### **Exploring How Occupation Relates to Vulnerability**

There are many dimensions of occupation that have been studied in relation to preparedness for climate change, including occupational multiplicity. Participants in this study who were shared providers to household income displayed higher *financial security* (confidence in one's savings and job security, and awareness of possible economic impacts stemming from potential changes) than those who were sole providers of household income. Individuals who are sole providers might feel less willing to take risks, for example changing occupation, because of a lack of alternative or supplementary sources of income in the home. Shared providers, on the other hand, may feel more willing and able to consider risky decisions because they do not feel as individually responsible for household financial security and well-being.

This finding is consistent with other studies of occupational diversification. Fishers in the Pacific and Indian Oceans were more likely to be willing to stop fishing when they lived in households that had more than one employed person (Daw et al., 2012; Cinner et al., 2008). This highlights the fact that any individual's occupation is often just one part of a broader network of income and resource sharing within households. Therefore, the factors that influence whether an individual will be willing and able to make changes may be better understood if viewed through a wider lens that considers an individual's connections to others in their household, family or broader social network.

Distinguishing between changes made by choice and those made out of necessity may also provide greater insight into the motivations and reasoning for an individual's decision to make a change. For example, an individual who used to fish but is now trying to make a living as a mechanic might have done so by choice because fishing became less beneficial (e.g., less fish are caught but costs to go out are the same or higher). However, s/he also might have done so out of necessity, without having a choice, because fishing ceased to be an option (e.g., loss of fishing license due to stringent regulation changes; income from fishing no longer meets requirements for rent

and children's school fees). These different circumstances may lead to a similar outcome but conclusions about the reason for the change (e.g., willingness and interest in doing it) may not be clear.

### **Gaps in Awareness and Prioritization: the Marine and Coastal Environment in the Face of Climate Change**

This study unveiled a serious lack of public knowledge and awareness in the Dominican Republic regarding climate change impacts, and in particular those impacts that are specific to the sea. Many of the concerns voiced by participants about changes in climate were related to public health and terrestrial resource management, and marine-related issues were less frequently mentioned, if at all. For example, most participants who noted less rain and hotter temperatures felt these changes were detrimental to agricultural productivity. Environmental concerns about the ocean were rare, with only six participants mentioning sea level rise, and only two individuals, who were involved in scuba diving businesses, mentioning declining coral reef health.

This notable lack of awareness and concern for the ocean among Dominican citizens was confirmed through conversations with more than one Dominican resource manager and environmental policy expert. Many professionals involved in environmental conservation and climate change in the Dominican Republic seem to agree that there is greater professional capacity, research, and education related to the terrestrial environment compared to the marine environment.

The results of a 2011 nationwide report that assessed public knowledge and perceptions of climate change also indicate the need for greater awareness. While many participants in that study mentioned the same changes as those in this study (e.g. rising temperatures, changes in the seasons), only about fifty percent knew that climate change was causing these variations (DR CC, 2011). In fact, climate change was ranked on average eight out of ten on the participants' list of national concerns. On the same list, national preparedness for natural disasters was ranked ten out of ten (DR CC, 2011). This may also indicate a lack of awareness of the impacts of climate change, as extreme weather events like strong storms and hurricanes are predicted to increase in likelihood and frequency with climate change (IPCC, 2007).

Of highest concern, though, is the fact that marine and coastal resources sector is ranked third (and last) on the priority list of the Dominican Republic's National Adaptation Plan (PANA) (DR CC, 2011). This seems surprising for an island nation whose economy depends on its coral reefs and coastal beaches for tourism and fisheries, yet whose reefs are losing productivity and beaches are eroding (Wielgus et al., 2010).

### **Management Implications**

This study provides valuable insight for local officials, practitioners, and researchers interested in vulnerability and adaptive capacity to climate change in coastal communities of the Dominican Republic and beyond. Direct and non-direct resource users shared many of the same vulnerabilities. Community planners and local officials working to prepare coastal areas for impacts of climate change should consider these similarities and expand outreach projects and development plans beyond the immediately vulnerable sectors (e.g., fishing, tourism) to better prepare the community as an integrated network of individuals facing similar issues.

In this study, both direct resource users and sole providers of household income are particularly vulnerable groups of individuals. These people have the lowest interest in change and have less financial security to buffer them from the risks of a change in occupation. In consideration of the increased vulnerability in terms of attachment to occupation of direct resource users compared to non-direct users, attempts to introduce or expand alternative options (e.g., livelihoods, education and/or training) may be better received by individuals who have not yet entered, or are not yet fully integrated into, a resource-dependent occupation.

This recommendation is supported by the findings of a job satisfaction study in Southeast Asia, which found that fishers who were not interested in changing their livelihoods were equally disinterested in their children becoming fishers (Pollnac et al., 2001). Rather than trying to change the occupation—often considered a way of life—of people who are not interested in doing so, it may be more advisable to aim the (often limited) resources of alternative opportunities at those who have yet to come into a livelihood.



Furthermore, practitioners should consider working beyond the unit of individuals, to ensure that entire households are financially secure. While Marshall et al.'s (2010) framework for assessing social vulnerability and adaptive capacity has primarily focused on the characteristics of an individual, the findings from this study indicate that characteristics of an individual's household, such as the number of jobs in a household, can influence adaptive capacity. Planners and managers could work toward increasing overall employment levels in households within a community rather than focusing employment efforts on individuals who are working in vulnerable sectors. For example, a community that promotes and/or offers incentives for households to seek employment for more than one person can increase financial security at the household level. Also, offering small loans to individuals, especially direct resource users, who commit to a new and/or alternative livelihood can help compensate for the income that the individual and their household may lose during a time of occupational transition.

A study measuring the success of microfinance programs in vulnerable, rural communities in India supports this recommendation. Eighteen months after providing loans to certain households, these families were more likely to have started a business and to consume less while investing more to ensure the success of their business (Banerjee & Duflo 2011, p. 171). This suggests that providing a small financial safety net to jumpstart new, alternative occupational initiatives and buffer from the risk of financial collapse or debt may make a big difference to households who are interested in, but unable to, make changes related to occupation. Other studies have also found that social development (e.g., training and education) must be integrated with economic development (e.g., job creation, microfinance, market access) in order to sustain coastal communities with vulnerable livelihoods (Pomeroy et al., 2006). The importance of financial security to the willingness and ability of an individual to make changes should be incorporated into development projects in vulnerable coastal communities, especially for individuals who are sole providers of income for a household.

The high level of reliance on coastal and marine resources, coupled with an overall low level of prioritization and awareness, calls for more resources and initiatives devoted to marine-focused

research, education, and awareness for the public from local to national scales. A more thorough and widespread understanding of all possible impacts of climate change to the environment, and specifically the threats to livelihoods that depend on healthy marine resources like fishing and tourism, may lead to greater public concern for the potential climate-induced consequences and increase support for adaptation and mitigation efforts in the Dominican Republic.

### Conclusion

This study provides new information about the vulnerability and adaptive capacity of individuals in coastal communities of the Dominican Republic. Results indicate that direct resource users and non-direct resource users share many of the same characteristics of vulnerability and adaptive capacity, such as *ability to plan, learn, and reorganize; occupational adaptability/flexibility; attachment to place; employment security; financial security; and occupational mobility.*

Direct resource users were found to have a greater *attachment to occupation* compared to non-direct resource users, a finding that has been reported in related studies around the world. This may have important implications for practitioners interested in developing alternative livelihood opportunities, especially within a direct resource-using sector of employment. It suggests that individuals who have yet to enter a livelihood may better receive alternative occupation opportunities.

Sole providers of household income in this study displayed *lower financial security* compared to individuals who shared income responsibilities with others in the home. Local officials and practitioners in development and aid projects would benefit from considering these results when deciding how to direct loans and related microfinance funds. For example, individuals may be more able to cope with changes that affect their occupation if they have a financial buffer to protect them and the rest of their household from the risks of lost income when making a transition in employment. Results also point to the need for a deeper understanding of an individual's role in a household to better understand their ability and willingness to make changes.

The low level of public awareness regarding climate change, coupled with the low level of prioritization for the marine and coastal sector in the National Adaptation Plan, suggest that there is a need for growth and development in research, education, and outreach specific to climate change in the marine and coastal environment. The well-being of the nation's fisheries and tourism sectors, as well as the numerous communities that are intricately tied to the coastal environment, will benefit from such an investment.

Finally, this study adds a new case to the global conversation on the adaptive capacity of vulnerable coastal communities of the tropics. Together with the USAID (2013) report that assesses institutional and national preparedness, this study provides a valuable assessment of Dominican social vulnerability and adaptive capacity to climate change.

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Mat Rosa

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Mat Rosa is a social scientist and entrepreneur from Rhode Island, USA, with over a decade of experience in international development and natural resource governance throughout the U.S., Latin America, Caribbean, and Southeast Asia. He participated in The Fellows Program from January to April of 2014. He holds a Bachelor of Arts (BA) in Politics from St. Anselm College, an MA in Political Science from the University of Rhode Island (URI), and is a candidate for a Masters (MA) of Marine Affairs at URI. Furthermore, he is an adjunct faculty at URI and is in charge of the university's study abroad course in the Dominican Republic.



Hilary Lohmann

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Hilary Lohmann's love for adventure, travel, and the environment led her to the field of international development. Hilary has an MA in Marine Affairs from the University of Rhode Island and a BA in Animal Behavior and Spanish from Bucknell University. She has spent years working abroad, with dynamic experiences ranging from coastal resources conservation in Belize to teaching in Vietnam and anti-poaching efforts in Zambia. These experiences cultivated a passion for humanitarian conservation. In the face of climate change and dwindling resource availability, Hilary's work facilitates a more symbiotic and resilient relationship between the natural environment and the people who depend on it.



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## GFDD

[www.globalfoundationdd.org](http://www.globalfoundationdd.org)

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GFDD is a non-profit, non-partisan, organization dedicated to the advancement of global collaboration and exchange relevant to Dominican professionals, general audiences and institutions in the homeland and abroad by implementing projects that conduct research, enhance public understanding, design public policies, devise strategies, and offer capacity building in areas crucial to social, economic, democratic and cultural sustainable development.

GFDD promotes a better understanding and appreciation of the Dominican culture, values and heritage, as well as its richness and diversity, in the Dominican Republic, United States and worldwide.

GFDD creates, facilitates, and implements wider scope international human development projects, building on its own experience, expertise and strong national and international networks.



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GFDD

## Funglode

[www.funglode.org](http://www.funglode.org)

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Fundación Global Democracia y Desarrollo (Funglode) is a private, nonprofit, and pluralistic organization devoted to conducting high-level research, and committed to academic excellence and the promotion of culture and art.

The organization formulates public policies aimed at strengthening democracy, and fostering respect for human rights, sustainable development, creativity and the modernization of the Dominican Republic. Through the design of policy proposals and strategic action plans aimed at creating interdisciplinary solutions to national problems, Funglode seeks to become a knowledge center with a large range of world-class academic programs and exchanges with internationally renowned universities and research centers.



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FUNGLODE

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## Fellows Program

[www.drfellowsprogram.org](http://www.drfellowsprogram.org)

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The Fellows Program, an extension of the internship and academic exchange program InterRDom, was developed in 2009 to respond to the desire of gfdd and Funglode to develop a community of scholars that contributes to the Foundations' growing body of research on matters of international concern that directly impact the Dominican Republic. The Program complements the overall mission of GFDD and Funglode to promote academic exchange, generate scholarship, and influence the creation of public policy related to economic and social development both at the national and international levels.

Through the Fellows Program, GFDD and Funglode seek to generate scholarship on issues at the forefront of the United Nations' agenda in order to give voice to national and regional concerns and offer viable solutions to domestic and international challenges.

The Fellows Program provides opportunities for MS., MA., and PhD candidates interested in conducting high-level research in the Dominican Republic on issues related to sustainable development. The final output of the investigation is a comprehensive report, which includes empirical data. Fellows do their research in coordination with gfdd and Funglode staff, National Academic Advisors, and their university professors. Fellows who produce exemplary work have the opportunity to present their findings before the United Nations community on behalf of GFDD and Funglode



