



# Comparing vulnerability and adaptive capacity to climate change in individuals of coastal Dominican Republic



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## ABSTRACT

People's capacity to adapt to shifting and emerging climate conditions is one of the most important characteristics to consider when addressing climate risks. This study explores the vulnerability and adaptive capacity of individuals in various sectors of employment in three coastal communities of the Dominican Republic to changing climate conditions. Participants included individuals who directly use marine resources for their occupation and those who do not. Specific research questions in this study are: What are the factors related to vulnerability and adaptive capacity in coastal communities of the Dominican Republic? Do these factors vary between direct resource users and non-direct 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 likert statements resulted in seven factors related to occupational adaptive capacity. Results suggest that many of these factors are similar across individuals in coastal Dominican Republic. However, direct resource users displayed greater *attachment to occupation* than non-direct users, indicating perhaps a lower willingness to change. Sole providers of household income exhibited lower *financial security* than those with shared responsibility, which suggests restricted ability to make changes in livelihood. This research can inform climate change preparedness in coastal communities of the Dominican Republic and beyond regarding the characteristics and circumstances that facilitate or inhibit an individual's occupational adaptation in a changing environment.

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## 1. Introduction

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). Global changes in climate patterns and events are altering the accessibility, quality, and availability of natural resources. This leads to extensive, and growing, impacts on the social and economic systems they support (Marshall, 2011).

Many studies about resource-reliant populations focus on coastal communities of the tropics (Adger, 2000; Bailey and Pomeroy, 1996; Costanza et al., 1995; Folke, 2006). The livelihoods of individuals in these communities are diverse and vary in the degree to which they depend on natural resources. Enterprises that rely directly on ecosystem goods and services are highly vulnerable to impacts of climate change (Zamani et al., 2006). However, the social fabric of these communities is often so blended that even those who do not rely directly on coastal resources for

employment (e.g. local business owners and operators) do still rely on individuals with resource-dependent businesses (e.g. fisheries and tourism) for a stable socio-economic structure. Thus, a community's social system is based on healthy and functional ecosystems (Adger, 2000).

This study adds to the growing field of climate change preparedness for individuals in coastal, tropical communities. It adapts a livelihood-specific assessment to compare vulnerability and adaptive capacity across employment sectors and household situations. An examination of the vulnerability and adaptive capacity of individuals living in coastal communities in the Dominican Republic offers adaptation recommendations based on differences in one's willingness and ability to make livelihood changes. Results suggest that an individual's characteristics and perceived circumstances may warrant independent consideration and strategic interventions for climate change adaptation as it relates to occupation.

### 1.1. Vulnerability and adaptive capacity related to climate change

Vulnerability is the susceptibility of an individual within a

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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 refers to the degree to which a community or resource incurs changes in climate (Marshall et al., 2010). In many parts of the Caribbean and the tropics in general, exposure to increased sea surface temperatures and more frequent storms of high intensity can threaten the integrity of coastal systems (Kushner et al., 2012). Sensitivity describes the degree to which a system or community is affected by and responds to changes in climate (Marshall et al., 2010). For instance, the extent to which individuals whose livelihoods occur and/or depend on the sea (e.g. fishers and tour operators) are affected by climate and weather events prohibiting work, like high winds and storms.

Adaptive capacity is argued to be the factor most effectively addressed by policy (Dixit et al., 2012; Marshall et al., 2010). 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 (Caffrey et al., 2013; Marshall et al., 2010). The capacity of individuals to cope and adapt to changes in climate is determined by their circumstances, characteristics, and the ability to take advantage of other opportunities (Marshall et al., 2010).

### 1.2. Measuring adaptive capacity to assess vulnerability

There are multiple methods for evaluating vulnerability. Theoretical contributions are derived from a combination of social, ecological, and psychological perspectives (Adger, 2000; Berkes and Ross, 2013; Folke, 2006). Indicators have been established to measure vulnerability via adaptive capacity at many levels, from national (e.g. Brooks et al., 2005) to community (e.g. Berkes and Ross, 2013; Magis, 2010) to household (e.g. Cinner et al., 2011) and individual (e.g. Marshall and Marshall, 2007).

This study adapts the Marshall et al. (2010) method for assessing social vulnerability and adaptive capacity. The method has been adapted for related studies of individual community member's vulnerability to climate change in tropical, coastal communities (e.g., Cinner et al., 2009b, 2011; Shaffril et al., 2013).

Indicators used to measure adaptive capacity in this framework include: an individual's perception of risk associated with potential change; perceived ability to plan, learn, and reorganize to cope with change; and level of interest in change (Marshall and Marshall, 2007; Marshall et al., 2010). Specific measures describe attachment to occupation, attachment to place, employability, family characteristics, formal and informal networks, and financial status (Marshall et al., 2010). For instance, an individual's financial situation, ability to secure alternative employment, and ability to remain competitive within a current occupation are used to measure one's perception of risk, which relates to one's management of risk (Marshall and Marshall, 2007).

### 1.3. Occupational multiplicity and diversity

Individuals in tropical coastal communities often take advantage of multiple available resources. This decreases dependence on any one particular resource or livelihood, and is an important consideration in an assessment of how individuals within these communities respond to change (Bailey and Pomeroy, 1996). An individual or household that participates in more than one livelihood activity exhibits occupational multiplicity (Cinner et al., 2009a; Daw et al., 2012). A related behavior is occupational diversity, which is 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 undertake multiple, diverse livelihoods including some degree of fishing is common in coastal communities of the tropics (Cinner et al., 2009a; Daw et al., 2012; Pollnac et al., 2001).

Occupational multiplicity has been shown to affect one's willingness to leave a risky occupation, such as fishing (Cinner et al., 2009a; Daw et al., 2012). An individual with more than one occupation, or an employed individual living in a household with other employed individuals, is able to spread the risks associated with decreased productivity or total loss of a livelihood. That is, an individual who is solely responsible for providing income to a household assumes more responsibility, and thus more risk, if s/he leaves his/her occupation. For example, in coastal communities of East Africa, fishers in households with other income-generating occupants were more likely to be willing to consider leaving their occupation than those without such financial support (Cinner et al., 2009a).

### 1.4. Vulnerability and adaptive capacity in coastal Dominican Republic

This study considers vulnerability by measuring the adaptive capacity of individuals in coastal communities of a Caribbean nation that is experiencing socio-ecological changes of both climate and non-climate origins. The Dominican Republic is an ideal location to investigate the vulnerability and adaptive capacity of individuals in coastal communities. Dominican communities are highly dependent on the health of coastal habitats to sustain major livelihoods of fishing and tourism. These habitats, like coral reefs and mangroves, also mitigate the effects of natural disasters, such as flooding and storm surge (Caffrey et al., 2013). With such high exposure and sensitivity, the Dominican Republic is listed as one of the most at-risk developing nations for impacts from climate change (Hallegatte et al., 2013).

This study explores the vulnerability and adaptive capacity of coastal individuals across sectors of employment to occupation-related impacts of climate change. Specific research questions examined in this study include: What are the factors related to adaptive capacity in coastal communities of the Dominican Republic? Do these factors vary between direct resource users and non-direct resource users? Do these factors vary amongst individuals who do and do not exhibit household occupational multiplicity?

## 2. Methodology

### 2.1. Study area: Dominican Republic

In June and July 2014, research was conducted in the coastal communities of La Caleta/Boca Chica, Samana, and Montecristi in the Dominican Republic (Fig. 1). The Dominican Republic rests on the eastern two-thirds of the island of Hispaniola, with Haiti neighboring to the west. The 2010 National Census reported a population of approximately ten million people, close to 70 percent of which live in urban areas. National unemployment is about 13 percent, and unemployment for young people is a staggering 30 percent (Caffrey et al., 2013). Urbanization and low levels of opportunity can marginalize rural populations, such those studied along the coasts, increasing sensitivity and thus vulnerability (Caffrey et al., 2013).

While the World Bank classifies the Dominican Republic as an upper middle-income country, the nation suffers severe inequality in income distribution as more than 40 percent of its people live at or below the poverty line (Caffrey et al., 2013). A majority of the

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