Assessing the Vulnerability to Climate Change of Small Scale Fisheries: The Grenada Example

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ABSTRACT

Small scale fisheries, critical to the livelihoods, coastal economies and food security of coastal communities, are particularly vulnerable to the impacts of climate change. As such, developing sustainable resource management for this sector depends on our ability to predict the risk of climate change on small scale fisheries and harness the capacity of coastal communities to cope or adapt with these changes. This chapter describes progress to date in building a spatial vulnerability assessment of Grenada fisheries. A framework to guide these types of assessments, the indicators developed to date, and the challenges and opportunities encountered in building the Grenada fisheries vulnerability assessment are discussed.

Key words: small scale fisheries, climate change, coastal hazards, vulnerability assessment, risk assessment, Eastern Caribbean

THE ISSUE

The changes predicted for our oceans and the projected climate specific impacts to fisheries will have serious implications for the 520 million people who depend on fish for their livelihoods and the nearly three billion people for whom fish is an important source of animal protein [1]. Not surprisingly, coastal communities are disproportionately dependent on fish and fish related industries to provide food and jobs. In the Caribbean the fisheries sector employs nearly 200,000 persons, earns between US$5,000 million and US$6,000 million in foreign exchange, and accounts for approximately 10% of the region's protein intake [2]. As in other parts of the world, small-scale fisheries make important but undervalued contributions to the economies and the animal protein needs of the region.

Given these figures, the economic and social dimensions of the threats posed by climate change to fishing communities in the region are evident. Our ability to predict the risk of extreme climatic effects and to harness the capacity of coastal communities to cope or adapt becomes essential as we try and develop sustainable strategies for resource management and community development. This is particularly important for the millions of small-scale fisherfolk who are among the most vulnerable to climate change [3].

Assessing and mapping the vulnerability of fishery dependent people and regions to the impacts of climate change will allow decision makers to focus climate change responses where they are most needed. Historically, most global and regional climate vulnerability assessments have focused on agricultural production. Although there has been a recent surge in fisheries global assessments, examples of national, sub-national and site level assessments remain limited. Yet predictions at these scales are urgently needed, especially for some small-scale fisheries, as these are the scales most relevant and most compelling for local fisherman. Also, most policy responses relating to planned climate change adaptation and fisheries management are, or will be, implemented at national levels and will rely on a solid understanding of national, sub-national and site level vulnerability.

Vulnerability analyses have been used to identify priority activities for future development and hazard mitigation, and several examples exist of mapping specific aspects of vulnerability [4], some specifically related to fisheries [3,5]. A number of these efforts use indicators in combination with risk assessment vulnerability frameworks. Examples of the application of this approach exist mainly at the global scale, e.g. [6], with some promising examples at the regional and site-specific scales [3,5], but very few sub-national level examples.

This chapter will outline our progress to date in building a national, sub-national and site level spatial fisheries assessment for Grenada. The work took place within the context of a larger project initiated in 2011 (At the Water's Edge: coastal resilience in Grenada, Saint Vincent and the Grenadines) aimed at

helping to build the resilience of coastal communities to flooding from sea level rise and storm surge. Our intention here is not to report on patterns observed in the vulnerability of Grenada fisheries, but rather to share challenges and opportunities encountered in building a fisheries vulnerability assessment. Our hope is that this experience can provide guidance for managers who are interested in assessing climate and disaster risk to small-scale fisheries.

THE GRENADA CONTEXT

Grenada is comprised of the main island of Grenada, two smaller islands (Petite Martinique and Carriacou), and a number of smaller uninhabited and semi-inhabited cays. It marks the southern end of the Caribbean's Windward Islands and is among the youngest islands in the Insular Caribbean (Figure 1). Despite the fact that this island nation is among the countries emitting the least amount of climate changing greenhouse gasses, its high coastal population densities, limited land space, geographic location, scarce freshwater supplies, and high dependence on natural resource based livelihoods (specifically tourism, fisheries, and agriculture), make it among the most vulnerable to climate change impacts. The government of Grenada is actively working to develop responses to climate change. Although capacity has been evolving rapidly, the individuals, agencies, and local organizations charged with developing adaptation strategies have limited access to information and tools needed to help articulate current impacts, visualize likely future events, understand the socio-economic implications of those events, and take action to protect people and the environment.

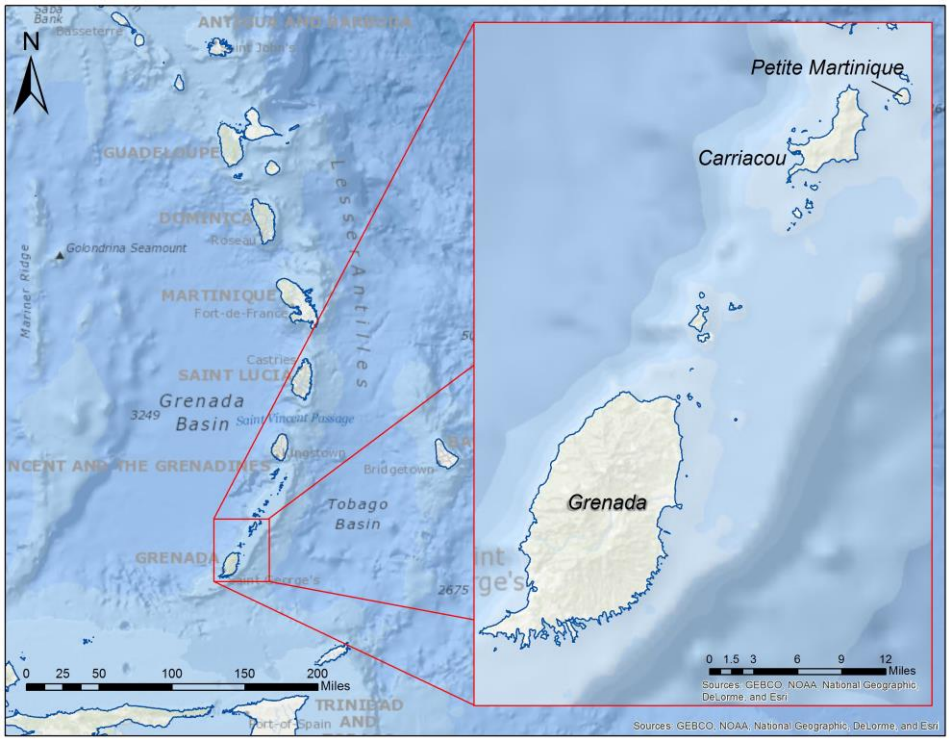

FIGURE 1 LOCATION OF GRENADA AND THE GRENADINE ISLANDS IN THE SOUTHEASTERN CARIBBEAN

To help decision-makers identify vulnerable areas and develop adaption strategies we conducted a spatial analysis over the course of 1 year that identifies communities most vulnerable to inundation from sea level rise and storm surge. As part of this effort, we formulated fisheries indicators across a suite of both ecological as well as socio-economic characteristics, populated those for which we could rapidly collect information and embedded them in an overall coastal vulnerability assessment.

DESCRIBING THE VULNERABILITY OF FISHERIES

The vulnerability of fisheries to climate change has been examined using a variety of frameworks. A common thread has been to measure vulnerability as a function of exposure, sensitivity and adaptive capacity. We used a framework promoted by the IPCC [7] to describe the vulnerability of coastal communities of Grenada to sea level rise and storm surge. This framework helped us organize, synthesize and communicate information about the climate and disaster risks to fisheries.

Exposure
Exposure is the degree to which a community experiences climate change as defined by the amount of the community that was inundated by a given scenario. For fishing communities, exposure captures the amount of the resource or infrastructure, which they depend upon, that will be impacted by a climate change scenario. In this particular study we examined storm surge and sea level rise scenarios.

Sensitivity
Sensitivity captures the characteristics of a community that influence its likelihood to experience harm under a given scenario. These characteristics determine the impact from climate exposure. The sensitivity of social systems depends on economic, political, cultural and institutional factors that allow for buffering of change [5]. For fishing communities, sensitivity is related to the degree to which a particular community is dependent on fish for food and livelihoods, with the idea being that if a community is highly dependent on fish for overall protein intake or whose livelihoods are highly dependent on fisheries, that community will be more sensitive to climate change.

Adaptive Capacity
Adaptive capacity describes the ability of a system to anticipate, respond to, cope with, and recover from climate impacts. This category captures variables that determine how flexible individuals may be, for example, in adapting to new employment opportunities or shifts in living patterns brought about by climate variability or change. For fishing communities this is often related to the diversity of livelihood, fishing grounds and gear types fishers have access to and the level of social networks in place.

DESCRIBING THE FISHERIES VULNERABILITY OF A PLACE – THE INFORMATION NEEDS
In order to make decisions on what information to use to populate our framework with the appropriate social and ecological indicators, we examined the availability of fisheries information and existing gaps across the five following categories: 1) resource characteristics, 2) governance, 3) livelihood, 4) infrastructure (social and physical), and 5) economics. For each of these areas we asked ourselves “what are the key pieces of information necessary to describe a place (be it a section of the nation’s coastline or a section of a site’s bay)”? The following indicator types emerged for each category:

1. Resource characteristics: abundance of the resource (e.g. catch per unit effort data, biomass data), and distribution of the resource (e.g. distribution of particular species)
2. Governance: level of management in place and institutional capacity
3. Livelihood: number of fishers and/or number of registered vessels
4. Infrastructure: number of critical fisheries facilities (e.g. marketing centers, landing sites, storage lockers), fisher networks (e.g. fisher cooperatives)
5. Economics: investment and revenue from fisheries (e.g. dollars invested in gear, vessels, and fisher facilities; revenue generated from catch, fisheries infrastructure)

Next we examined the availability of information to populate these indicators at the national, sub-national and site level. Most successful site level fishery vulnerability assessments rely on extensive field surveys (e.g. [5]). In order to build an information base for Grenada without conducting extensive field surveys, we accessed a variety of information types. We drew from the following sources to generate indicators: information collected from government programs (fisheries, physical planning and government census departments), and stakeholder-based methodologies (fisher focus group surveys, and participatory mapping). While these were not sufficient to describe all of the categories outlined above, a useful first set of indicators was generated. Information from government programs has been especially useful for national and sub-national level assessment, while stakeholder-based methodologies are proving to be the most useful for site level assessments.

INDICATORS – SOME EXAMPLES

Below we illustrate some examples of fisheries related vulnerability indicators that we computed to date. As outlined above, to calculate these we used a combination of government data and information collected via participatory mapping and fisher focus group surveys for specific sites. For the suite of indicators to describe the vulnerability of coastal populations of Grenada, a full description as well as details on methodology is outlined [8].

Exposure

We modeled several different inundation scenarios and calculated exposure of fishing related structures to inundation from two-meter sea level rise and a Hurricane Ivan type storm (Figure 2). Ideally, to measure the exposure to storm surge and sea level rise, one would also capture an ecological indicator (e.g. given a particular flooding/storm surge scenario, the amount of destruction of X habitat with the assumption being that this would in turn generate a decrease or displacement in fish) but these types of data are not generally available in the region.

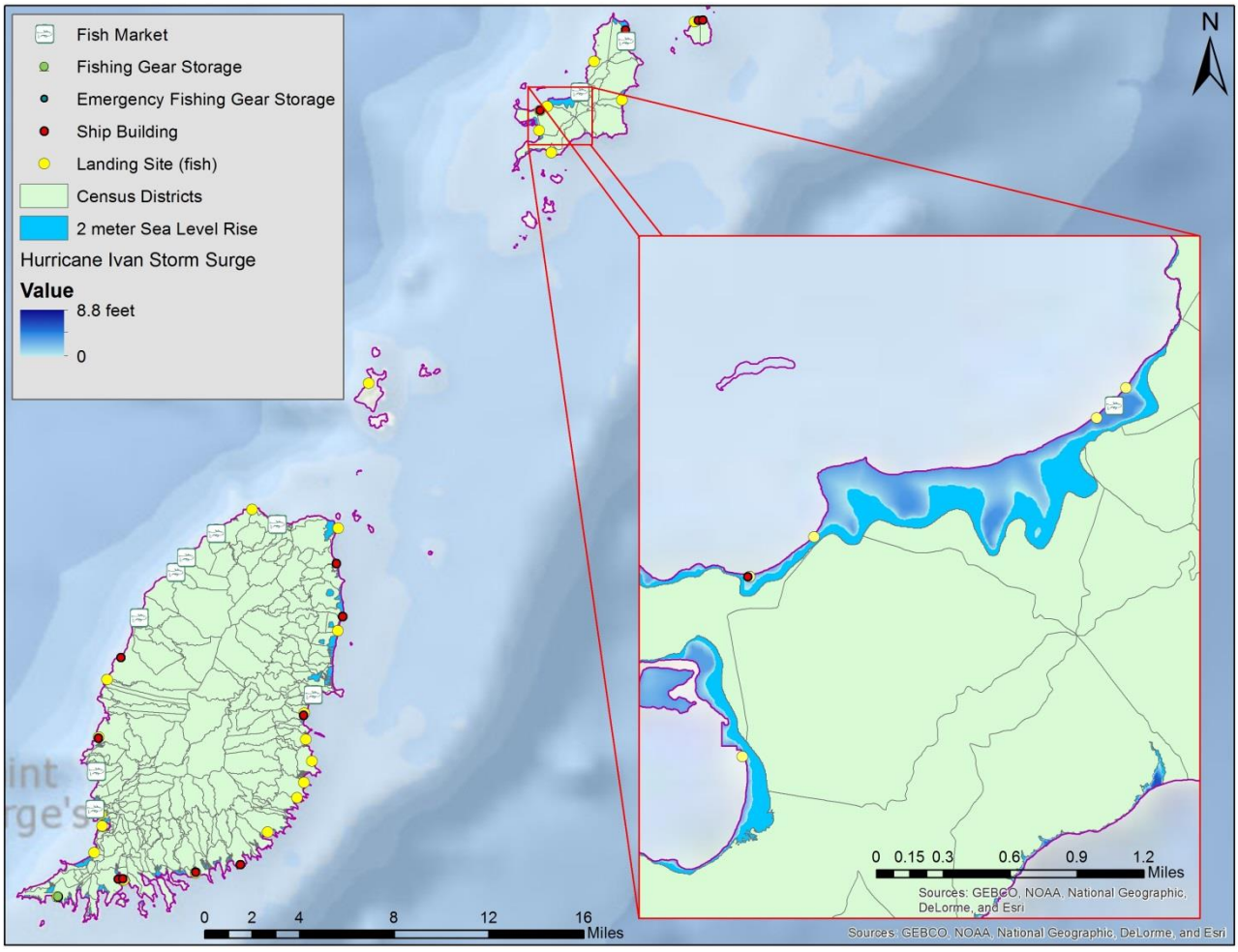

FIGURE 2 LOCATION OF FISHERIES FACILITIES AND EXTENT OF FLOODING FROM A MODELED TWO-METER SEA LEVEL RISE AND STORM SURGE FROM A HURRICANE IVAN TYPE STORM. INSET DETAILS MODELED EXTENT OF FLOODING FOR WESTERN CARRIACOU.

Sensitivity

To measure how fisheries are contributing to sensitivity of coastal communities we examined different aspects of community dependence on fisheries. Some examples include:

a) The share of the population whose primary income comes from fisheries (the more reliant on fisheries a community is the more sensitive; Figure 3).

b) Site specific distance to fish markets that fishers rely on (the greater distance a fisher has to travel to reach a landing site or fish market the more sensitive as there is more opportunity for that passage way to be flooded in the event of a storm; Figure 4).

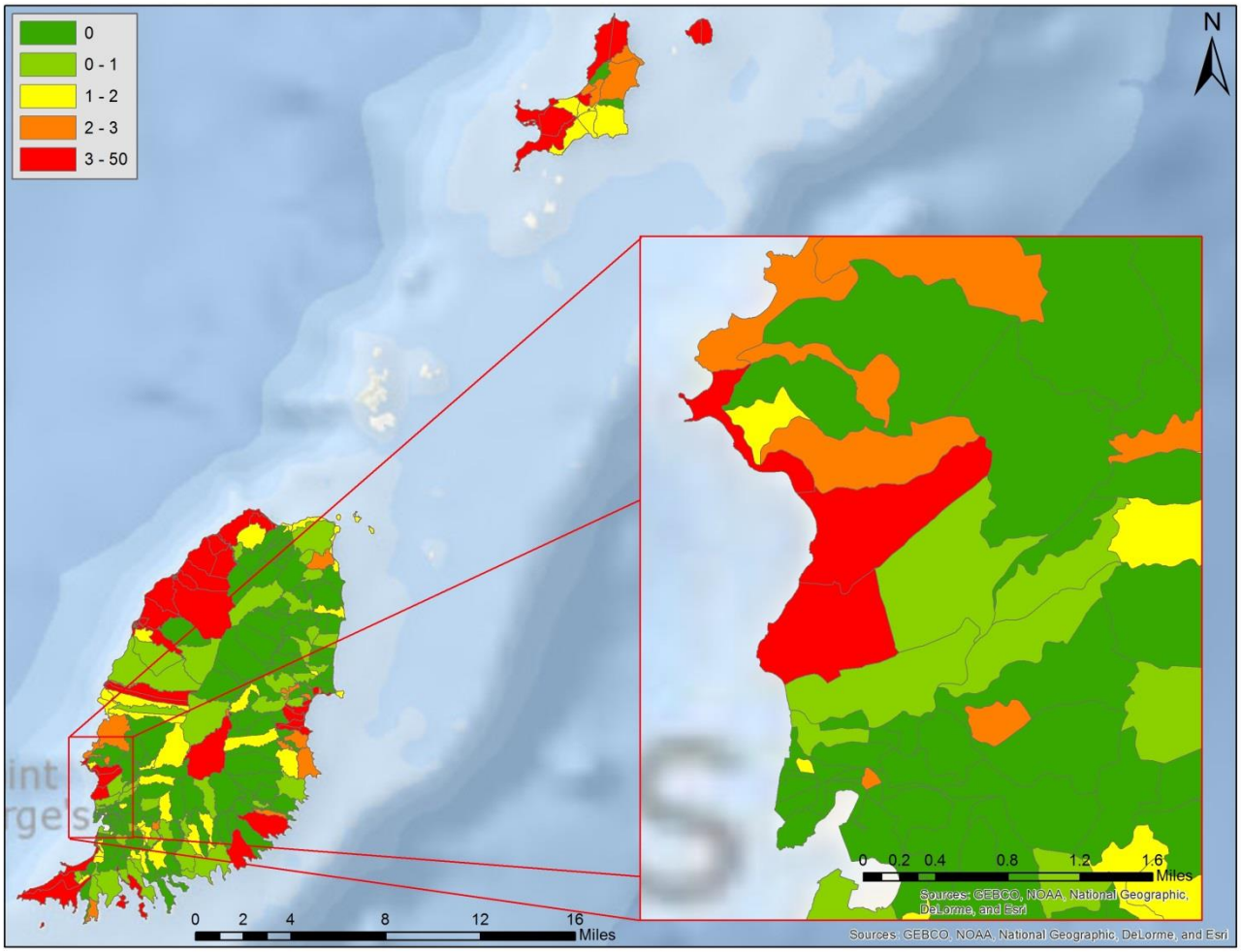

FIGURE 3 PERCENT OF FISHERIES RELATED WORKERS BY CENSUS DISTRICT IN GRENADA, CARRIACOU, AND PETITE MARTINIQUE. DATA DERIVED FROM THE CENSUS DEPARTMENT.

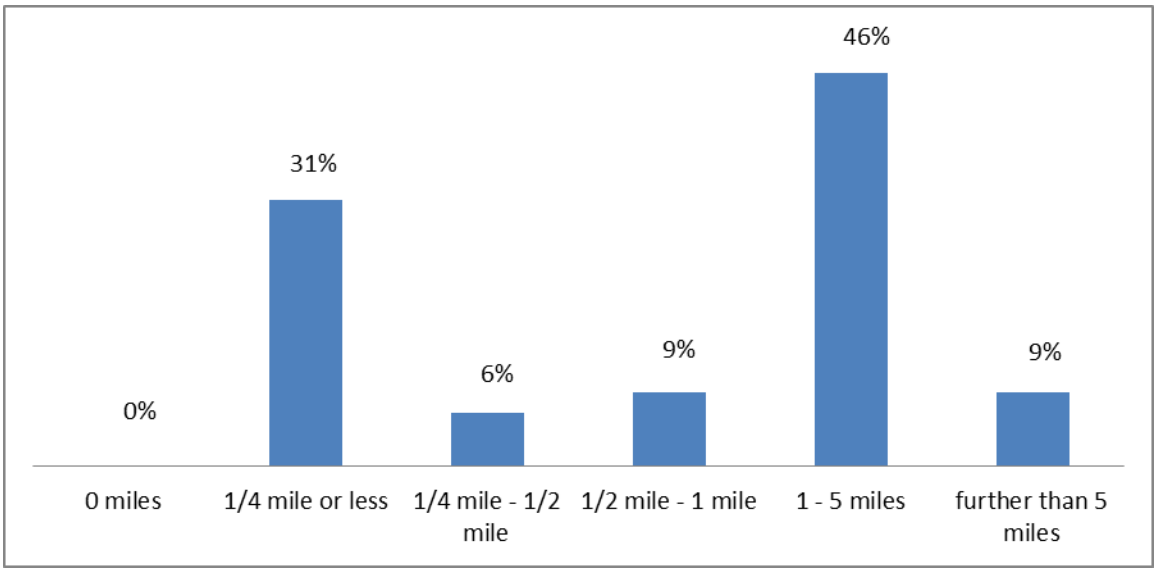

FIGURE 4 DISTANCE PEOPLE TRAVEL TO GET TO THE CLOSEST FISH MARKET IN GRENVILLE, GRENADA (N=37). DATA DERIVED FROM HOUSEHOLD SURVEYS CONDUCTED IN GRENVILLE.

Adaptive Capacity

One of the indicators we computed to measure the adaptive capacity of a fisheries community is the diversity of livelihoods available by census district (Figure 5). The assumption being: when there are more livelihood options available to, and practically feasible for, fishers there is a higher chance that they will be able to adapt to a different industry if something were to happen to their primary livelihood option. An example of a site level indicator is: percent belonging to a fisher cooperative association (Figure 6). Social networks, such as fisher co-operatives, provide important means for developing and maintaining social cohesion. The more social cohesion the more adaptive a community is.

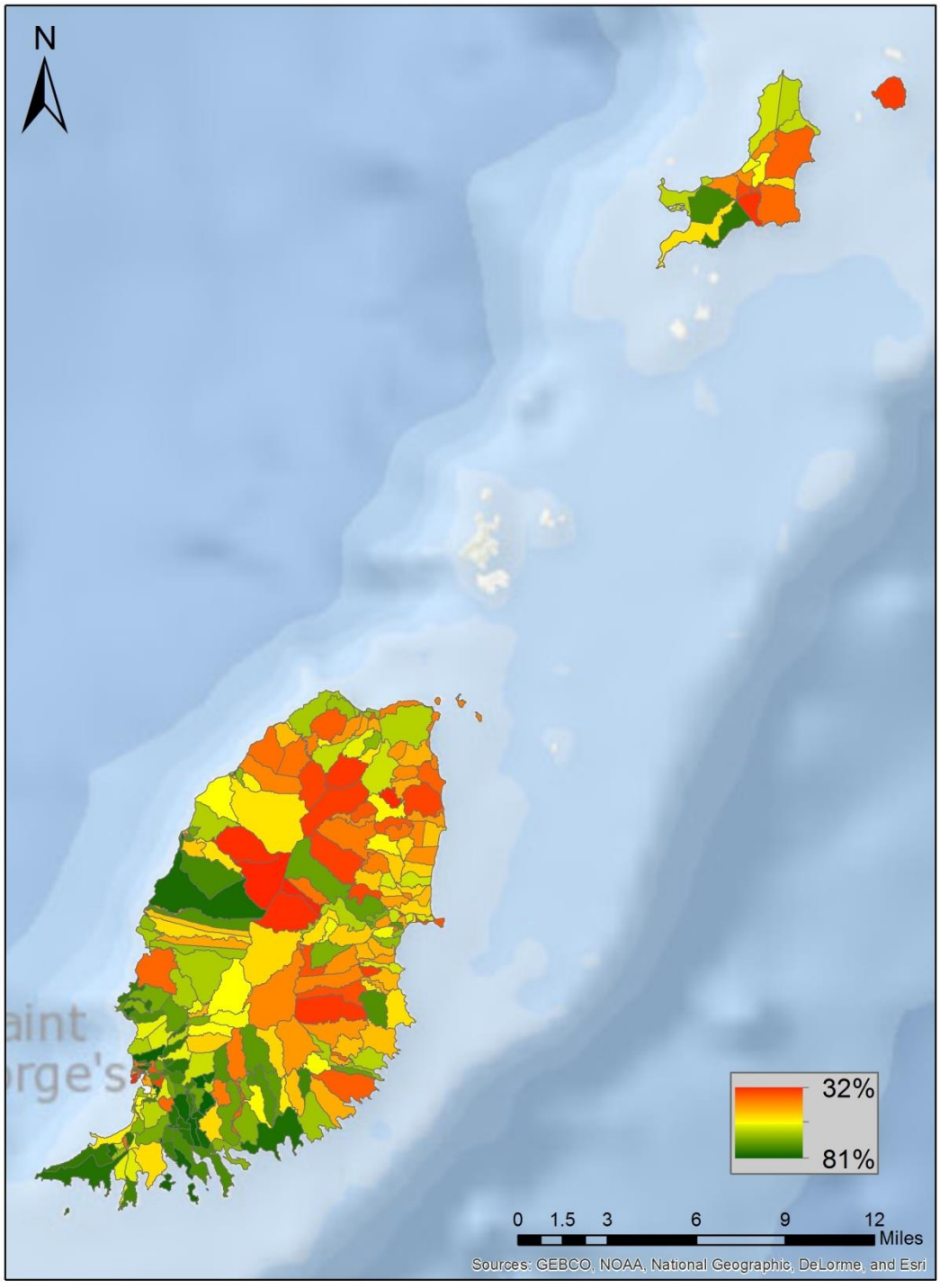

FIGURE 5 DIVERSITY OF LIVELIHOODS OPTIONS BY CENSUS DISTRICT IN GRENADA, CARRIACOU, AND PETITE MARTINIQUE. THE HIGHER THE PERCENTAGE THE MORE LIVELIHOOD OPTIONS AVAILABLE. DATA DERIVED FROM THE CENSUS DEPARTMENT.

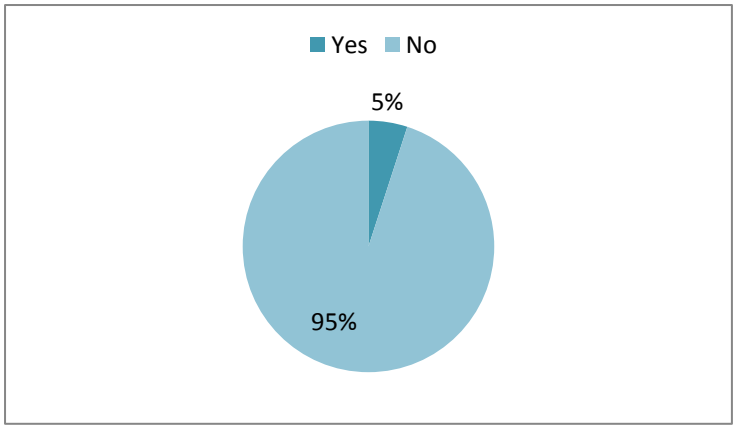

FIGURE 6 PERCENT OF GRENVILLE INHABITANTS THAT BELONG TO A FISHING CO-OPERATIVE (N=200). DATA FROM HOUSEHOLD SURVEYS CONDUCTED IN GRENVILLE.

LESSONS LEARNED

Integrating Vulnerability Assessments across Sectors

As outlined above, the fisheries assessment we conducted in Grenada is embedded in a wider assessment that addresses coastal vulnerability across sectors. Given the dependency of coastal communities on fish and fish-related industries to provide nutrition and jobs, addressing fisheries within the wider climate and disaster risk context will increase not only the adaptive capacity of the fisheries sector but of coastal communities overall. However, in contrast with agriculture and freshwater, fisheries have been largely ignored in climate policy discussions. There is a need to mainstream fisheries considerations in these discussions. Vulnerability assessments such as the one discussed above can be a good vehicle for this. They will help the fisheries sector come to the table with a specific set of needs and recommendations related to risk and facilitate conversations

Filling Information Gaps

Given the close links between the biophysical components of marine ecosystems and the socio-economics of fisheries, understanding climate change impacts on marine fisheries requires integrated assessments across disciplines [9]. For regions largely dominated by small-scale fisheries such as the Eastern Caribbean the availability of appropriate bio- physical information is limited, unless a research program is in place to collect this information (e.g. [5]). In contrast, stakeholder-based methodologies (e.g. fisher focus group surveys) as well as government programs (e.g. census) allow for either access to or relatively rapid collection of socio-economic information on fisheries. This leads to vulnerability assessments that focus on the socio-economic aspects of fisheries vulnerability, and have limited ability to characterize the bio-physical aspects (e.g. changes in fish abundance and distribution). Such has been the case to date for our Grenada efforts. The lack of a clear picture of how access to fish will change in time will limit our ability to help fisher communities adapt to that change.

Conducting spatially explicit assessments

Spatial information plays a key role in the design of adaptation measures as both the effects of climate change as well as many adaptation measures have spatial impacts ([10]). As countries develop adaptation strategies to cope with climate change, there is need for a better spatial understanding of exposure, sensitivity and adaptive capacity and how they contribute to a communities' overall socioeconomic vulnerability. The type of understanding such as the one we developed for Grenada will allow governments and communities seeking to develop and implement fisheries adaptation plans to generate more targeted strategies to reduce vulnerability.

Leveraging a Variety of Information Sources to Represent Multiple Scales

Our aim in Grenada was to describe vulnerability of fisheries at national, sub-national and site levels. However, conducting a vulnerability assessment across scales is not a simple feat. While the framework and general principles used to build indicators are mostly interchangeable, the access to information to describe vulnerability at multiple scales varied in Grenada, as is common in many places. As described in the section on vulnerability of fisheries we used a variety of information types. One of the challenges this presents for a spatial assessment is identifying a common study unit to facilitate comparison across data- types. Some of this information (e.g. government information, information from 3D participatory mapping) is more easily integrated into a spatial platform, than other forms (e.g. fisher focus group interviews).

Involving the Fisher Community

In our efforts in Grenada we have used a variety of stakeholder-based methodologies to collect spatial as well as non-spatial information and engage fisherfolk (e.g. fisher focus groups, participatory mapping). This has been very effective to both rapidly fill key information gaps (e.g. on adaptive capacity), as well as learn about fisher needs and perceptions. Both of these are critical pieces for the design of effective and sustainable adaptation strategies, particularly for small scale fisheries. Also, the more fishers have a full understanding of their vulnerability and help design adaptation strategies, the more these will be effective and sustainable into the future.

CONCLUSIONS

Small-scale fisheries are among the most vulnerable to climate change. As such, their management should address climate and disaster risk. Vulnerability assessments such as the one described above are an excellent tool to help prepare for, cope with and adapt to climate and disaster risk. Climate change is amongst the various stresses that small-scale fishing communities face. Many of these communities are economically, socially and politically marginalized due to poor access to infrastructure, markets and social services.

As climate and disaster risk jeopardize that access, addressing these multiple stressors using cross-sectoral approaches becomes critical. Vulnerability assessments provide a solid foundation for cross-sectoral collaboration. Vulnerability assessment such as the one we conducted in Grenada can also be a strong vehicle for community engagement. The sustainability and ultimately effectiveness of solutions to help decrease vulnerability of small- scale fisheries depends on this. Given the degree to which tropical coastal communities rely on fish for food security and livelihoods, the investments we make on increasing the resilience of small-scale fisheries will benefit resilience of coastal communities overall.

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