ENVIRONMENTAL PRACTICES AND THE VULNERABILITY OF RURAL LIVELIHOODS TO NATURAL DISASTERS: THE DIFFERENTIAL IMPACTS OF HURRICANE JANET AND HURRICANE IVAN UPON MANGROVE-DEPENDENT LIVELIHOODS IN GRENADA

By

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ABSTRACT

ENVIRONMENTAL PRACTICES AND THE VULNERABILITY OF RURAL LIVELIHOODS TO NATURAL DISASTERS: THE DIFFERENTIAL IMPACTS OF HURRICANE JANET AND HURRICANE IVAN UPON MANGROVE-DEPENDENT LIVELIHOODS IN GRENADA

By Steven D. Watts

Abstract: In this thesis I respond to one of Ian Scoones' (2009) identified failures of livelihoods perspectives: a lack of rigorous attempts to deal with long-term change in environmental conditions. I seek to address the increasing prevalence of natural disasters, given, the impediments they pose to development pursuits, and do so through the lens of a hybrid theoretical framework that combines perspectives from the livelihoods framework and political ecology. In order to inform strategies to reduce the impacts of natural disasters, this thesis explores the role of environmental practices in influencing the vulnerability of rural livelihoods to such occurrences. Field research was conducted in Grenada in communities located between Telescope Point and Artiste Point on the east coast in the Parish of St. Andrew's. The events of Hurricane Janet (1955) and Hurricane Ivan (2004) are compared, with the differentiating factor between them being the intensity in which beach sand was extracted; with small-scale sand removal occurring in the Hurricane Janet era, and large-scale, capital-intensive sand mining taking place in the Hurricane Ivan era. It is found that mangroves recovered far more quickly following Hurricane Janet than Hurricane Ivan, and in turn, so too did the viability of mangrove-dependent livelihoods; thereby, revealing the influence of environmental practices on the vulnerability of rural livelihoods to natural disasters.

June 23, 2011

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LIST OF ABBREVIATIONS AND ACRONYMS

CAD$	Canadian Dollars
EC$	Eastern Caribbean Dollars
GBS	Grenada Bureau of Standards
GCEPC	Gravel, Concrete, and Emulsion Production Corporation
GRACP	Gravel, Rock, Asphalt and Concrete Products
IDS	Institute of Development Studies
NaDMA	National Disaster Management Agency
NERO	National Emergency Relief Organization
NGO	Non-Governmental Organization
RGPF	Royal Grenada Police Force
SEPs	Sustainable Environmental Practices
SST	Sea Surface Temperature
UEPs	Unsustainable Environmental Practices

CHAPTER 1: INTRODUCTION

1.1 POSING THE PROBLEM

A frequent concern in development discourse is the notion of maintaining both continuity and consistency in development pursuits. For this reason, developing countries must seek to avoid major setbacks in their development efforts. Under the appropriate conditions, what would potentially result in a significant impediment or prolonged cessation to development, may present itself as a mere temporary interruption. With this in mind, it is necessary to establish an understanding of the conditions that ensure the stability of development, in order to mitigate the likelihood of prolonged development derailments, in favour of more manageable interruptions.

Natural disasters are a reality that have plagued humanity throughout time. According to de Villiers (2009, p. 24), "over the past decade, there has been an average of one natural disaster per day – 348 recorded events each year." While it may not be possible to prevent the occurrence of natural disasters, their effects, and the vulnerability associated with natural hazards, could be reduced considerably through proper planning and preparedness (Shili, Zhiguo, Jianping, & Chunyi, 2005, p. 255). Therefore, continuity in development pursuits requires an understanding of the factors that influence natural disaster vulnerability.

The sustainability and viability of rural livelihoods is a cornerstone of the development process. However, natural disasters are capable of significantly debilitating rural livelihoods; thus, prompting Kelman (2008, p. 113) to claim that, "addressing the

root causes of large-scale disaster means tackling vulnerability as part of the usual, day-to-day processes of living and pursuing livelihoods."

1.2 STUDY OBJECTIVE

As outlined in his 2009 paper, *Livelihoods Perspectives and Rural Development*, prominent livelihoods scholar Ian Scoones highlights four recurrent failings of livelihoods perspectives.[1] This study is oriented towards addressing Scoones' (2009) third identified failure: a lack of rigorous attempts to deal with long-term change in environmental conditions. More specifically, this study interprets "long-term change in environmental conditions," as the growing prevalence of natural disasters. In addressing this shortcoming of livelihoods perspectives, this study is interested in finding an avenue upon which to reduce the vulnerability of rural livelihoods to natural disasters. Doing so requires an understanding of the factors that render livelihoods vulnerable to natural disasters. In relation to natural disasters, an emphasis is often placed upon the damage incurred by physical infrastructure and production equipment that is utilized in livelihood pursuits (e.g. damage to fishing boats). However, a livelihood dimension that is often not considered is the affect of natural disasters upon the so-called "natural capital" that is the foundation for many rural livelihoods.[2] Allocating significant attention to the relationship between natural capital and natural disasters is important, given the

[1] The four failings will be discussed in Chapter 2.

[2] The terms "natural capital" and "natural asset" are used interchangeably throughout this study.

dependence of rural livelihoods upon the environment.[3] Fittingly, this begs the following research question.

1.3 RESEARCH QUESTION

How do environmental practices influence the vulnerability of rural livelihoods to natural disasters?

1.4 METHODOLOGY

1.4.1 THEORETICAL FRAMEWORK

The theoretical structure of this study relies heavily upon the paradigms of sustainable rural livelihoods and political ecology. Unpacking the livelihoods framework and political ecology demonstrates the relative strengths and weaknesses of the respective theoretical perspectives. Indeed, both paradigms possess weaknesses; however, their application in conjunction with one another, given their complementary nature, provides an effective theoretical tool. Therefore, I suggest the utilization of a hybrid theoretical framework of analysis which derives out of the amalgamation of the livelihoods framework and political ecology; and, when applied to the empirical component of this thesis, proves to be efficacious in explaining the series of events that have materialized in the location of study.

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[3] While numerous forms of capital work in conjunction with one another to successfully formulate a rural livelihood, this study focuses upon the contributions of natural capital to livelihoods. By extension, this study is specifically interested in natural capital-dependent livelihoods.

1.4.2 Context in Relation to the Research Question

In order to answer the research question, a historical comparative analysis was conducted within the context of Grenada. The location of study, situated on Grenada's east coast in the Parish of St. Andrew's, includes the communities and coastal region stretching from Telescope Point to Artiste Point. In 1955 Hurricane Janet struck Grenada as a Category 3 hurricane, and in 2004 Hurricane Ivan also struck the island as a Category 3 hurricane. Grenada has a history of using sand extracted from the country's beaches in their construction initiatives; however, the methods of extraction greatly vary over time. Prior to Hurricane Janet the removal of Grenadian beach sand was small-scale in nature, while in the years leading up to Hurricane Ivan, sand mining had become a large-scale and capital-intensive activity. In the location of study, many community inhabitants rely upon the mangrove system in their livelihood pursuits. Mangrove-dependent livelihoods considered in this study include: charcoal production, farming, fishing, crab hunting, beekeeping, and cattle rearing.

In order to answer my research question, I compare the recovery rates of mangrove-dependent livelihoods following Hurricane Janet (1955) and Hurricane Ivan (2004). This comparison pays particular attention to the differential methods of sand extraction (the environmental practice focused on in this study) that were in place prior to each respective hurricane.

Upon answering the research question, this study asks: why were such environmental practices utilized? Undoubtedly, developing an understanding of the influential factors behind the institution of certain environmental practices is a necessary

undertaking if future efforts oriented towards maintaining the long-term viability of rural livelihoods are to be successful.

1.4.3 Data Collection

Data collection for this study took place primarily through empirical research.[4,5] Field research was conducted during two separate trips to Grenada. The first trip was from April 21, 2010 to April 30, 2010, and the second trip took place from July 28, 2010 to August 26, 2010.

During my initial trip to Grenada I fortified ties with local officials whom I had previously been in contact with via e-mail and telephone. In search of a location to conduct my study, I was accompanied by a member of the Forestry Department to various locations around Grenada. Some preliminary interviews were conducted, and further contacts in the field were established. This proved to be extremely fruitful, as it allowed me to develop a greater understanding of many of the local issues that would eventually factor into the more rigorous stages of my field research.[6]

The majority of my field research took place during my second trip to Grenada. Semi-structured interviews were held with two groups that were segmented by age. I conducted 14 semi-structured interviews with members of the "elder generation" who

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[4] Ethics approval was obtained from both the Saint Mary's University Research Ethics Board, situated in Halifax, Nova Scotia, Canada, and the Saint George's University Institutional Review Board, located in St. George's, St. George's Parish, Grenada.

[5] To maintain research participant anonymity, pseudonyms have been assigned to each interview respondent, and are used throughout this study.

[6] I also travelled with a member of a local non-governmental organization (NGO) to the nearby island of Carriacou, in pursuit of potential study locations. Once again, some preliminary interviews were conducted. The visit to Carriacou proved to be a learning experience; however, it did not yield a desired location upon which to carry-out my study.

were between the ages of 59 – 85. Most of the interviewees had previously pursued a mangrove-dependent livelihood and were no longer working given their age, while a few were still pursuing a mangrove-dependent livelihood. These interview respondents were capable of speaking through lived experience about a variety of issues, including sand removal practices pre and post-Hurricane Janet and Hurricane Ivan, beach and mangrove conditions, and the viability of mangrove-dependent livelihoods. I also conducted 15 semi-structured interviews, and 3 semi-structured group interviews with community inhabitants from the "younger generation," who were between the ages of 21 – 58. The majority of these interview respondents were actively pursuing a mangrove-dependent livelihood. While they had no firsthand knowledge of events surrounding Hurricane Janet, the younger community members were able to speak about the pre and post-Hurricane Ivan methods of sand extraction, the conditions of the beach and mangrove system, and the viability of mangrove-dependent livelihoods in more recent years.

Furthermore, I conducted one semi-structured interview with a community inhabitant who did not pursue a mangrove-dependent livelihood but was previously involved in attempts to derail large-scale sand mining efforts. I also conducted one semi-structured interview with a community inhabitant who was formerly involved in small-scale sand removal. A semi-structured group interview was also held with a group of local workers who utilize sand in their construction initiatives.

Overall, 31 semi-structured interviews and 4 semi-structured group interviews were held with community inhabitants.

A total of 11 semi-structured interviews were also conducted with officials from the following organizations:[7]

- (1) Ministry of Environment, Foreign Trade, and Export Development
- (1) Ministry of Works
- (1) Ministry of Tourism and Civil Aviation
- (2) Ministry of Agriculture, Forestry and Fisheries
- (1) Royal Grenada Police Force
- (1) Grenada Gravel, Concrete, and Emulsion Production Corporation
- (2) Grenada Bureau of Standards
- (1) National Disaster Management Agency
- (1) St. George's University

Furthermore, documents obtained in Grenada provided numerous forms of primary and secondary data. Some documents were retrieved from officials representing the aforementioned organizations, while the rest were gathered from the following locations:

- St. George's University Library
- Grenada Forestry Department Library
- Grenada Public Library
- Grenada National Archives
- Grenada National Museum
- Government of Grenada Printery

It is also important to acknowledge that data was collected through the observations I made while in the field, and the following impressions that such observations had upon me.

[7] The number beside the name of the organization denotes the number of interviews conducted with representatives from that organization.

1.5 THESIS STATEMENT

In response to my research question, I offer the following thesis statement that will be developed in the subsequent chapters of this document.

Environmental practices greatly influence environmental vulnerability. In turn, the degree of environmental vulnerability is a key determinant in the amount of damage hurricanes inflict upon natural capital. By extension, the same environmental practices that shape the degree of environmental vulnerability, also greatly influence the viability of mangrove-dependent livelihoods, as the said livelihoods are equally as vulnerable to hurricane strikes as the natural capital they depend upon.

1.6 THESIS OVERVIEW

This thesis consists of six chapters. In the following chapter I provide an overview of existing literature, and in doing so, establish the theoretical components of this study; specifically, the livelihoods framework and the paradigm of political ecology, culminating in the construction of a hybrid theoretical framework of analysis. In this chapter I further discuss the interconnection between environmental practices, environmental vulnerability, and natural disasters. The foundation for my case study is established in Chapter 3. In this chapter I provide background information on Grenada, describe the communities in which I conducted field research, and explain why these communities were chosen as the location of study. In Chapter 4 I present my research findings, which entails an outlining of the mangrove and mangrove-dependent livelihood conditions in both the Hurricane Janet and Hurricane Ivan eras. An analysis of my

research findings and recommendations is presented in Chapter 5. In Chapter 6 I conclude the thesis.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter I provide an overview of existing literature, and in doing so, lay the theoretical foundation upon which the following chapters take shape. The initial component of this chapter is oriented towards creating a greater understanding of natural disasters, their prevalence, and the effect they have on humans. The chapter then delves into the dimensions of, and debates surrounding, the livelihoods framework and political ecology. The result of this theoretical "unpacking" is the construction of a hybrid theoretical framework of analysis which will be used in the following chapters to bring understanding to the series of events that have transpired in the location of study. I then outline the terms "sustainable environmental practices" (SEPs) and "unsustainable environmental practices" (UEPs), and explain how environmental practices influence the degree of environmental vulnerability. The chapter culminates with a revelation of the intersection between environmental vulnerability and natural disasters.

2.2 UNDERSTANDING NATURAL DISASTERS

2.2.1 NATURAL HAZARDS

In order to effectively analyze the intricacies of "natural disasters," one must first develop an understanding of the term "natural hazards." Understanding this distinction is important, as the National Incident Management System (2011) accurately highlights the fact that the terms "natural disaster" and "natural hazard" are often confused for one

another, despite their different meanings. According to McGuire, Mason, and Kilburn (2002, p. 1), natural hazards are "extreme natural events that pose a threat to people, their property and their possessions." Keller and Blodgett (2006, p. 6) offer further clarification by emphasizing that the "event" itself is not a natural hazard, but rather when the event is coupled with a threat to human interest, natural hazard classification is warranted.

There is a wide array of natural hazards that exist, and they generally fall under one of the following three categories of a "geophysical hazard:" geological hazard, atmospheric hazard, and hydrological hazard (McGuire et al., 2002, p. 1).[8] Geological hazards may include earthquakes, volcanoes, landslides, avalanches, and fire. Atmospheric hazards consist of hurricanes, tornadoes, blizzards, droughts, hail storms, and heat waves. Hydrological hazards are made up of floods and debris flows. In some cases, certain types of natural hazards possess characteristics which would fall under more than one of the above-mentioned categories. For example, McGuire et al. (2002, p. 1) describe that tsunamis "can be regarded as hydrological hazards in the sense that they form and are transported within the hydrosphere. Their origin, however, is almost invariably geological, and usually the result of a large submarine earthquake."

[8] McGuire et al. (2002, p. 1) claim that natural hazards that are geophysical in nature, "arise from the normal physical processes operating in the Earth's interior, at its surface, or within its enclosing atmospheric envelope." Natural hazards may also be "biological" in nature, rather than "geophysical." Biological hazards include insect infestations or epidemics. This being said, this study focuses predominantly on geophysical hazards.

2.2.2 NATURAL DISASTERS

A natural disaster on the other hand, is the effect of a natural hazard on society, usually as an event that occurs over a limited time span in a defined geographic area (Keller & Blodgett, 2006, p. 6).[9] The term "disaster" is used when the interaction between humans and a natural process results "in a serious disruption in the functioning of a society, causing widespread human, material, or environmental losses which exceed the ability of the affected area to cope using their own resources" (Gomez, 2005, p. 260). Anderson (1990) describes a natural disaster as a temporary event triggered by natural hazards that overwhelm local response capacity, and seriously affect the social and economic development of a region. Susman, O'Keefe, and Wisner (1983) claim that natural disasters are the interference between an extreme physical environment and a vulnerable human population. Along these lines, Smith (2004, p. 12) effectively describes natural disasters as a "social phenomena." del Moral and Walker (2007, p. 17) put forth the idea that "disaster" is an "emotionally laden" term that focuses on the negative impact of a disturbance, thus effectively emphasizing that impacts are widespread and/or severe.

Therefore, according to Rasmussen (2006, p. 181), "whether an event will develop into a natural disaster depends on its physical force, its location, the vulnerability of the population and infrastructure, the level of preparedness, and a host of other factors." As revealed by de Villiers (2009, p. 25), the Centre for Research on the Epidemiology of Disasters claims that in order for a natural hazard to obtain disaster

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[9] It is interesting to note that Kelman (2008, p. 94) claims that the term "natural disaster" might be "a misnomer because disasters tend to require human input to occur, making few disasters be truly 'natural.'"

status it must lead to at least ten fatalities, affect one hundred or more people, and necessitate a call for international assistance, or the declaration of a state of emergency. As Gad-el-Hak (2008, p. 2) describes, "what makes a large-scale disaster is the number of people affected by it and/or the extent of the geographic area involved. Such disaster taxes the resources of local communities and central governments and leads those communities to diverge substantially from their normal...structure."

2.2.2.1 HURRICANES

Hurricanes, which are the type of natural disaster to be focused on during the empirical component of this study, are effectively described in Figure 2.1, while Tables 2.1 and 2.2 outline the various hurricane categories on the Saffir-Simpson Hurricane Scale.[10]

[10] The term hurricane is used for tropical cyclones that occur in the Northern Hemisphere and east of the International Dateline to the Greenwich Meridian. The term typhoon is used for Pacific tropical cyclones that occur north of the Equator and west of the International Dateline (National Hurricane Center, 2010).

Figure 2.1: Hurricanes: Formation, Characteristics, Naming, and Classification

Hurricane Formation

To be called a "hurricane," which is a Caribbean Indian word for "evil spirit and big wind," a storm must have sustained winds of at least 119 km/h somewhere in the storm. Hurricanes require tremendous amounts of heat to form. They gain this energy from tropical or subtropical ocean water, which has a surface-water temperature of at least 26.5°C (80°F).

Most hurricanes start out as a *tropical disturbance*, a large area of unsettled weather that is typically 200 to 600 km in diameter and has an organized mass of thunderstorms that persists for more than 24 hours. The disturbance is associated with an elongated area of low pressure called a *trough*. Air in the disturbance has a weak partial rotation caused by the Coriolis effect.

As winds increase and complete their rotation of the area of disturbed weather, a low-pressure cell forms. Low-pressure cells are generally circular areas of lower than normal atmospheric pressure that are usually associated with cloudy and rainy weather. At this point the disturbance is classified as a *tropical depression*. Warm moist air being drawn into the depression behaves like a spinning ice skater who draws their arms towards their body, thereby increasing their rate of spin. Once maximum sustained wind speeds increase to 63 km/h, the depression is upgraded to a *tropical storm* and receives a name. It may then increase in intensity to become a hurricane; however, the majority or tropical storms never make the final transition to hurricanes.

Hurricane Characteristics

Hurricanes rely on a precise set of conditions to maintain their strength. For example, if the supply of warm water is cut off, the storm will weaken and die. Thus, Atlantic hurricanes weaken as they move north over cooler water or once they strike land. A hurricane must be fed by a thick layer of warm ocean water; if the storm remains stationary for too long, all of the available warm water can evaporate and expose cooler water at the surface.

During a hurricane, winds of 119 km/h or greater are generally recorded throughout an area of about 160 km in diameter, whereas gale-force winds, which are winds greater than 50 km/h, are experienced throughout an area of about 640 km in diameter. Hurricane winds blow in a large spiral surrounding a relatively calm central area known as the *eye*. In the Northern Hemisphere, the winds circulate in a counterclockwise direction around a low-pressure cell; this rotation gives hurricanes their characteristic circular appearance when they are viewed on weather maps or in satellite images.

Naming Conventions

Hurricanes have been given names since the 1940s. Initially they were given only women's names, but beginning in 1978, Pacific cyclones were given both male and female names. A year later this practice was adopted in the Atlantic Ocean and Gulf of Mexico. There are six standard lists of hurricane names for the Atlantic Ocean – each list is used alphabetically and then reused six years later. If an Atlantic hurricane is particularly noteworthy, the name may be retired and replaced with a new name. For example, the name "Mitch" was retired from the Atlantic hurricane list after Hurricane Mitch became a destructive Category 5 hurricane in 1998. Other ocean basins have similar lists.

Classification of Hurricanes

Like earthquakes and tornadoes, hurricanes are ranked on a scale that indicates their potential for damage and flooding. Hurricanes are ranked on the Saffir-Simpson Hurricane Scale, from Category 1, the lowest, to Category 5, the highest, depending on the intensity of the storm. A Category 5 hurricane is a massive storm capable of catastrophic damage and loss of life.

Source: Keller and Blodgett (2006). Used with Permission.

Table 2.1: The Saffir-Simpson Hurricane Scale

Saffir-Simpson Category	Maximum Sustained Wind Speed (m/s, kn, km/h, mph)	Storm Surge (m)	Range of Central Pressure (mb)	Relative Potential Destruction
1	33-42 m/s 64-82 kn 119-153 km/h 74-95 mph	1.0-1.7	980	1
2	43-49 m/s 83-95 kn 154-177 km/h 96-110 mph	1.8-2.6	965-979	10
3	50-58 m/s 96-113 kn 178-209 km/h 111-130 mph	2.7-3.8	945-964	50
4	59-69 m/s 114-135 kn 210-249 km/h 131-155 mph	3.9-5.6	920-944	100
5	$\geq$ 69 m/s $\geq$ 136 kn $\geq$ 250 km/h $\geq$ 156 mph	$\geq$ 5.6	< 920	250

Source: Gray, Sheaffer, and Landsea (1997). Adapted by Author.

Table 2.2: Saffir-Simpson Scale Unit of Measurement Symbols

Unit of Measurement	Unit Symbol
metres per second	m/s
knots	kn
kilometers per hour	km/h
miles per hour	mph
metres	m
millibars	mb

Source: Author.

2.2.3 The Prevalence of Natural Disasters: Hurricanes

According to Hilhorst and Bankoff (2004, p. 2), "the total number of reported disasters rose from 368 in 1992 to 712 in 2001 – an increase of over 93% in a decade. More telling, however, is the doubling of the number of people affected over the same period – raising from 78,292,000 in 1992 to 170,478,000 in 2001." Furthermore, the number of deaths as a result of natural disasters since the 1950s has increased 50% per decade, while the corresponding population growth rate has only increased by 20% (Kreimer & Munasinghe, 1991, p. 3). Interesting figures to consider are those in South East Asia and Bangladesh, as over the last century 700 disasters have occurred in the region. 158 (23%) of the said disasters occurred between 1900 and 1979, compared to 542 (77%) between 1972 and 1996 (Sivakumar, 2005, p. 4).

Regarding the Caribbean, the region is highly susceptible to hurricane strikes. Given their topographical and climatological conditions (Rodriguez, 1997, p. 122), hurricanes have become the most deadly hazard to threaten the islands (Boruff & Cutter, 2007, p. 32). Specifically, the geographical location of the Caribbean "small island developing states" places the region in direct line of the Atlantic hurricane belt. With the inevitable return of the annual hurricane season from June 1 to November 30, disaster in the region is a frequent occurrence.

Interestingly, various conceptions currently exist surrounding the frequency and strength of hurricanes. It is widely believed that the world is in a "period of accelerated warming," which provides the basis for climate change conceptualizations. Many academics argue that with the onset of climate change, the frequency and intensity of

natural disasters is increasing (del Moral & Walker, 2007, p. 22). As Holland and Webster (2007) reveal through their historical look at hurricane activity, which starts in the year 1855 and gains greater focus following 1945 due to the advent of aircraft reconnaissance and hence better tracking from that point forth, there has been a steady rise in annual hurricane activity. Holland and Webster (2007) further highlight that greater hurricane frequency has been accompanied by an increase in "sea surface temperature" (SST), and state that, "there has been an average of one additional tropical cyclone for each 0.1°C increase in SST and one hurricane for each 0.2°C increase." At the same time, scholars such as Bender et al. (2010); Emanuel (2005); and Knutson et al. (2010) maintain that as a result of current climatic conditions, brought about by both anthropogenic influences and natural climatic variation, hurricane frequency will not increase, but rather the strength of hurricanes is increasing; thus, resulting in less Category 1,2, and 3 hurricanes, and more Category 4 and 5 hurricanes. Regardless of what model is correct (whether hurricanes will increase in frequency or intensity), decadal variation in hurricane frequency and activity is of sufficient magnitude to warrant attention in its own right (Lugo, 2000, p. 248). If these issues are addressed now, human-dominated landscapes will be better prepared to deal with the effects of global climate change on hurricane activity, whichever they may be (Lugo, 2000, p. 249).

2.2.4 Who is Affected?

According to de Villiers (2009, p. 276), natural disasters result in approximately 80,000 deaths per annum, and as Rasmussen (2006, p. 184) reveals, "of the more than 7,000 natural disasters recorded during 1970-2004, 75% of the events and 99% of the

people affected were in developing countries." Undoubtedly, these figures validate Clay's (2008, p. 231) belief that "disasters typically impact most severely on poorer disadvantaged groups and areas," as groups are differentially vulnerable or resilient to disasters depending upon their position in the stratification system (Tierney, 2006, p. 110). Whether they are situated in developing or developed countries, the poor are consistently located at the "margins;" be it in coastal communities below sea level, on barren mountainsides, or in areas with unreliable infrastructure.[11] Along these lines, Barnett, Lambert, and Fry (2008, p. 104) effectively argue that the outcomes of environmental change greatly vary according to class, gender, ethnicity, and location. For example, with many parts of New Orleans being located below sea level, the damage inflicted by Hurricane Katrina in 2005 was most greatly felt by the city's poor inhabitants who lived on "low ground." As Hartman and Squires (2006, p. 5) describe:

> Various processes of racial segregation have resulted in middle – and upper – income whites being concentrated in the outlying (and in New Orleans, literally higher) suburban communities, while blacks have been concentrated in the central city, where the flooding was most severe...

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[11] Developed countries may also have a large population of "poor" inhabitants. Jones-DeWeever and Hartmann (2006, p. 86) describe how poverty goes unacknowledged in developed countries in the following excerpt:

> For most Americans, imagining the struggles of the poor in this country is quite difficult, if not disturbing. Poverty is typically tucked away, either confined to an urban enclave avoided by those who aren't within its boundaries by accident of birth, or dispersed broadly, on a lonely country road far away from neighbors, jobs, and in many respects, opportunity. In the lives of most Americans, one's only brush with poverty is the occasional discomfort felt due to the outstretched hand of a stranger on the street who claims to be homeless, or the annual newscasts from the local food bank come Thanksgiving or Christmas. In this land of opportunity, poverty is hidden from view, like a messy closet one hopes goes undiscovered by an important houseguest. Although we all know it's there – somewhere – for most, poverty goes unseen and unacknowledged, as does its implications for everyday life, and ultimately, survival – that is, unless you're the one who is poor.

> Consequently, it should have been no surprise when Katrina hit New Orleans that the areas damaged were 45.8% black, compared to 26.4% in undamaged areas, and that 20.9% of the households in damaged areas were poor, compared to 15.3% in undamaged areas. And if nobody is allowed to return to damaged areas, New Orleans will lose 80% of its black population, compared to just 50% of its white population. (Logan 2006, as cited in Hartman and Squires, 2006, p. 6).[12]

This excerpt from Hartman and Squires (2006) provides a snapshot of the conditions facing the poor worldwide, as they are often most affected by natural disasters. Along these lines, the following question must be asked: if hurricane conditions are worsening, and the poor are already situated in vulnerable locations, in which they currently incur the greatest amount of damage from natural disasters, what does the future hold for their livelihood pursuits? From a development perspective, undoubtedly something must be done to decrease the vulnerability of rural livelihoods to natural disasters. Establishing a theoretical framework of analysis is paramount to addressing this issue.

2.3 ESTABLISHING A THEORETICAL FRAMEWORK OF ANALYSIS

2.3.1 ORIGINS OF THE LIVELIHOODS PERSPECTIVE

Despite lacking the formal classification of "livelihood studies" during its infancy, a plethora of cross-disciplinary contributions provided the foundation for the emergence of contemporary livelihood perspectives. It is believed that livelihood thinking emerged from rural natural resource and food security methodologies, with the

[12] These small passages extracted from Hartman and Squires (2006) hardly exemplify the depth of the issues pertaining to socio-economic status and vulnerability in relation to Hurricane Katrina. There is a plethora of literature which exists on the topic, but delving into such literature within the realm of this study would greatly exceed the purpose of merely presenting some of the well documented social issues surrounding Hurricane Katrina as an example.

latter particularly relating to drought-induced famine in Africa (Sanderson, 2000, p. 52). Early examples include the work of the Rhodes-Livingstone Institute, founded in 1938, in Northern Rhodesia, currently known as Zambia. In a collaborative effort, ecologists, anthropologists, agriculturalists, and economists analyzed changing rural systems, and their development challenges (Fardon, 1990). The initial discoveries resulting from the above-mentioned efforts remained dormant for a few decades (Scoones, 2009, p. 173). At the same time, a degree of haziness surrounds the inherent "rural" connotation of livelihood studies, as such thinking finds "resonance in understanding the complexities of urban poverty" (Sanderson, 2000, p. 52). Consistent with this notion, the efforts of Staples (2007, p. 20) identify the "sustainable livelihoods framework" as initially being devised with a focus on urban settings.

Following the structural perspective of dependency and neo-Marxism in the 1970s and 1980s, development studies adopted a "more productive" actor-oriented perspective (De Haan & Zoomers, 2005, p. 28).[13] Mostly interested in the world of lived experience, on a micro scale (Johnston, 1991),[14] the actor-oriented perspective facilitated the emergence of "household studies." Household studies entailed directing attention towards the behaviour of "low-income people" (De Haan & Zoomers, 2005, p. 28), and highlighted the role played by the poor in providing for their own sustenance (Schmink, 1984, p. 88). Ultimately, these studies showed that households possess an element of free choice, but must exercise it under certain structural constraints (Bebbington, 2004;

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[13] That is to say, a renewed focus upon the agency of the poor.

[14] Relating to the micro elements of the family's network and community.

Schmink, 1984, p. 95). Household studies ended in a degree of pessimism, as they revealed that poor households were marginalized as a result of their exclusion from the benefits of economic growth (De Haan & Zoomers, 2005, p. 28). Nonetheless, household studies played an influential role in contributing to the emergence of livelihood approaches (Scoones 2009), which encompassed a more optimistic household study approach (De Haan & Zoomers, 2005, p. 29).

With the culmination of efforts geared towards household studies in the late 1980s to early 1990s, the conditions were ideal for the gradual emergence of a new "optimistic" approach, which built upon the livelihood component of the "pre-deceased" household studies (De Haan & Zoomers, 2005, p. 29). At the same time, Solesbury (2003) explains that the emergence of the *1997 Bruntland Report* published by the World Commission on Environment and Development, the 1988 International Institute for Environment and Development publication of *The Greening of Aid: Sustainable Livelihoods in Practices*, and the 1990 release of the United Nations Development Programme's first *Human Development Report*, had a significant influence. Elements of these publications contained a focus on poor people and their needs, the importance of citizen participation, the emphasis on self-reliance and sustainability, and ecological constraints. They "subsequently became powerful terms in the lexicon of international development policy and politics, particularly in the work of the United Nation's 1992 Environment Conference in Rio" (Solesbury, 2003, p. 5), and created an appetite for the release of one of the most influential pieces in the historical livelihood puzzle, put forth by Robert Chambers and Gordon Conway in 1992. In their working paper produced for the

Institute of Development Studies (IDS) at the University of Sussex, Chambers and Conway (1992), state that:

> A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets, while not undermining the natural resource base (as cited in Scoones, 2009, p. 175).[15]

At the time, the aims of the paper were far less ambitious, merely concerning itself with "putting the last first" in development practice (Scoones, 2009, p. 175). Despite being widely read upon its initial release, the immediate impact of the paper was minimal. Elements of the paper subtly emerged in and out of various development and foreign policies.[16] This being said, the paper is now regarded as the starting point to what came to be known in the latter years of the 1990s as the "sustainable livelihoods approach" (Scoones, 2009, p. 175).

2.3.2 Current Contributions to the Livelihoods Framework

In order to establish an effective theoretical framework of analysis, it is necessary to elaborate upon many of the components outlined in the Chambers and Conway definition of a livelihood; which have been further explored by various scholars. Doing so will facilitate the development of an appreciation of many of the synergies within livelihood discourse, and along with a consideration of political ecology, will help develop this study's theoretical framework.

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[15] The definition presented here has undergone some slight adaptations by Scoones (1998), as well as Carney et al. (1999).

[16] For a more thorough overview of the timeline of events and influences, both prior to, and following the release of Chambers and Conway's (1992) paper, see Solesbury (2003).

2.3.2.1 ASSETS

According to Sanderson (2000, p. 51), "the key element of a livelihoods approach is that people are the starting point." But what is it that "people" are doing to achieve a livelihood? To answer this question, our attention must first be directed towards the concept of "assets," or to deploy an economic metaphor, "capitals" (Bebbington, 1999; Scoones, 1998). Table 2.3 outlines the four capitals which Scoones (1998) identifies, and briefly describes.[17]

Table 2.3: A Typology of Capitals

Type of Capital	Description
Natural Capital	The natural resource stocks (soil, water, air, and genetic resources) and the environmental services (hydrological cycle, and pollution sink) from which resource flows and services useful for livelihoods are derived.
Economic or Financial Capital	The capital base (cash, credit/debt, savings, and other economic assets, including infrastructure and production equipment and technologies) that is essential for the pursuit of any livelihood strategy.
Human Capital	The skills, knowledge, ability to labour, good health, and physical capability important for the successful pursuit of different livelihood strategies.
Social Capital	The social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies requiring coordinated actions.

Source: Scoones (1998). Adapted by Author.

[17] Scoones (1998, p. 8) explains that this is clearly not an exhaustive list, and other forms of capital can be identified as well. This being said, Bebbington (1999, p. 2022) considers livelihoods in terms of five different types of capital: produced, human, natural, social, and cultural. Furthermore, each form of capital has garnered significant degrees of attention. For example, Boyce (2003) provides an in-depth analysis of many of the current dimensions surrounding natural capital. However, a more detailed analysis of each form of capital is beyond the breadth of this study.

Bebbington (1999), as described in De Haan and Zoomers (2005, p. 32), encompasses the dynamic and holistic nature of livelihoods through his following asset-oriented description:

> A person's assets, such as land, are not merely means with which he or she makes a living: they also give meaning to that person's world. Assets are not simply resources that people use in building livelihoods: they are assets that give them the capability to be and to act. Assets should not be understood only as things that allow survival, adaptation and poverty alleviation: they are also the basis of agents' power to act and to reproduce, challenge or change the rules that govern the control, use and transformation of resources.

Ultimately, assets influence the agency of actors, and are vital to their ability to cope with, challenge, and even transform structures.

2.3.2.2 Capabilities and Well-Being

An important element to extract from Bebbington's description, is the notion of "capability." According to Sen (1997, p. 1959), capability focuses on, "the ability of human beings to lead lives they have reason to value and to enhance the substantive choices they have." Elements of Sen's capability concept can be seen in his earlier works, as he believed that one's employment provides them with the recognition "of being engaged in something worth his while" (Sen, 1975, p. 5). Sen (as cited in Nussbaum, 2003, p. 33) further describes that a capability entails what people can actually do and be with their entitlements. Thus, exceeding the material benefits of capital. Chambers (1995; 1997) adopts a similar approach with his concept of "well-being." He claims that, "well-being can be described as the experience of good quality of life...well-being is open to the whole range of human experience, social, psychological

and spiritual as well as material. It has many elements. Each person can define it for herself or himself" (Chambers, 1997, p. 1748). According to Chambers (1989) (as cited in Scoones, 1998, p. 6), this may lead to a range of sustainable livelihood outcome criteria which not only encompass more conventionally measured material concerns, but also diverse factors such as self-esteem, security, happiness, stress, vulnerability, power, and exclusion. It is fitting to draw upon Bebbington's (1999, p. 2029) claim that assets give people capability. It is through the enhancement of such capabilities that life not only becomes more meaningful, but more importantly influences the dominant rules and relationships governing the ways in which assets are controlled, distributed, and transformed into streams of income (Bebbington, 1999, p. 2039). Therefore, "without the appropriate livelihood capabilities or assets, individuals, households, and resource-dependent communities may find it difficult to cross those critical thresholds that lead to higher-level dynamic equilibria" (Armitage, 2007, p. 65).

To this point, two things have become clear. First off, assets provide the foundation upon which a livelihood is developed. Second, capabilities play an integral role in satisfying the non-material dimensions of a livelihood pursuit. However, in order to obtain both assets and capabilities, people must have "access" to them.

2.3.2.3 Access Resulting in Livelihood Strategies

Bebbington (1999, p. 2022) explains that access "becomes perhaps the most critical resource of all if people are to build sustainable, poverty alleviating rural livelihoods." De Haan and Zoomers (2005, p. 27) further echo this sentiment by arguing that access is the "key issue in the conceptualization of livelihoods." Access is often

detectable as the common theme in instances where a viable livelihood has been successfully composed (Bebbington, 1999, p. 2028). Therefore, rural inhabitants constantly strive to gain wider access to a range of assets (Bebbington, 1999, p. 2023).

Once people have access to assets they will seek to transform them into consumption levels that reduce their poverty, living conditions that imply an improved quality of life according to people's own criteria, human and social capabilities to use and defend assets more effectively, and an asset base that will continue to allow the same sorts of transformations (Bebbington, 1999, p. 2029). Such transformations take place through applying a variety of activities to the accessible assets; more commonly referred to as a "livelihood strategy" (Long, 1984; O'Laughlin, 2004, p. 386; Scoones, 1998, p. 3). Table 2.4, outlines the three broad clusters of a livelihood strategy identified by Scoones (1998).

Table 2.4: A Typology of Livelihood Strategies

Livelihood Strategy	Description
Agricultural Intensification/Extensification	Between capital-led (supported often by external inputs and policy-led) and labour-led (based on own labour and social resources and a more autonomous process) intensification.
Livelihood Diversification	Between an active choice to invest in diversification for accumulation and reinvestment, and diversification aimed at coping with temporary adversity or more permanent adaptation of livelihood activities, when other options are failing to provide a livelihood. Diversification therefore may involve developing a wide income earning portfolio to cover all types of shocks or stress jointly or the strategy may involve focusing on developing responses to handle a particular type of common shock or stress through well developed coping mechanisms.
Migration	Between different migration causes (e.g. voluntary and involuntary movement), effects (e.g. reinvestment in agriculture, enterprise or consumption at the home or migration site) and movement patterns (e.g. to or from different places).[18]

Source: Scoones (1998). Adapted by Author.

Livelihoods are becoming increasingly diversified, as people often collect their income from a multiplicity of sources (De Haan & Zoomers, 2005, p. 38). More specifically, as Ellis (2000) describes, the poor tend to be engaged in the most complex, and multifaceted income generating activities. Quite often a combination of the above-mentioned livelihood strategies is pursued, and identifying the combination of assets, applied to the combination of livelihood strategies, is critical (Scoones, 1998, p. 9). Such combinations often occur in a complex fashion to create more livelihoods in a particular area (Scoones, 1998, p. 10). This combination of activities, commonly referred to as a "livelihood portfolio" (Scoones, 1998, p. 10), may include a range of tactics (such as

[18] Migration could also be a part of livelihood diversification.

stinting, hoarding, protecting, depleting, diversifying, claiming, and moving) (Chambers & Conway, 1992, p. 11). In essence, livelihoods are composed in complex ways, with multiple and dynamic portfolios of diverse activities (Richards, 1989). The incorporation of a diverse livelihood portfolio is viewed as a significant contributor to increasing the survival options of the rural poor (Ellis, 1998, p. 18).

Conversely, limited access to assets, and the following inability to pursue a diverse livelihood portfolio, greatly constrains the viability of rural livelihoods (Bebbington, 1999, p. 2023). Where people have not been able to effectively pursue or improve their livelihoods, the principal reasons appear to derive from a failure or inability to defend and maintain their access to the necessary assets (Bebbington, 1999, p. 2028). Undoubtedly, this begs the question: what is it that controls people's access to assets?

2.3.2.4 INSTITUTIONS

In the late 1990s, the IDS began to investigate the social structures and processes through which some sustainable livelihoods are successful, while others fail (Scoones, 1998, p. 12; Solesbury, 2003, p. 7). This led to a consideration of the "institutional context" imbedded within livelihood pursuits. Institutions, commonly regarded as regularized practices structured by rules and norms (Giddens, 1979), can be "both formal and informal, often fluid and ambiguous, and usually subject to multiple interpretations by different actors" (Scoones, 1998, p. 12).

As De Haan and Zoomers (2005, p. 35) reveal, "access is shaped by institutions," as institutions are the "social cement" that link stakeholders to asset accessibility (Davies, 1996, p. 24). Such institutional processes, often influence the distribution of resources to

individuals and households; thus, defining their capabilities, and legitimating their boundaries of action (O'Laughlin, 2004, p. 386). This being said, access to assets is an extremely complex issue, as the institutional relations that facilitate access are "far from harmonious" (De Haan & Zoomers, 2005, p. 34).

It is interesting to note, that the old adage, "it takes money to make money," can analogously be applied to the interconnected relationship between assets, access, and institutions. As Bebbington (1999, p. 2035) states:

> People's ability to gain access to those spheres (institutions), is in turn greatly affected by the capabilities they have as a result of their initial endowments of the different types of capital asset. For instance, people with significant endowments of land (natural capital) or financial resources (produced capital), or strong social networks (social capital) and university degrees (human capital and social capital) are in general better able to gain access to the institutions of the state and market and thus influence their subsequent effects on patterns of access.

The institutional influence on livelihoods greatly shapes livelihood "pathways," which can be described as the decisions that actors make in response to available options (Breusers, 2001, p. 180). De Haan and Zoomers (2005, p. 43) further expand upon the concept of pathways, by claiming that:

> Pathways are best defined as patterns of livelihood activities which arise from a co-ordination process among actors. This co-ordination emerges from individualistic strategic behaviour embedded both in a historical repertoire and in social differentiation, including power relations and institutional processes, both of which pre-structure subsequent decision-making.

Thus far it has become clear that access to assets and capabilities, allowing the application of various combinations of livelihood strategies, are the fundamental components of a livelihood pursuit. The key element in this equation is access, as it is

often, according to the livelihoods framework, governed by the agency of micro-oriented, ground-level, grassroots, actors; and the resultant institutional processes that derive from the said actors. However, the conceptualization of livelihood issues under micro dimensions has ignited a significant degree of criticism towards the livelihoods framework.

2.3.2.5 CRITIQUING THE LIVELIHOODS FRAMEWORK: WHERE IS THE POWER AND POLITICS?

In returning to the idea of pathways, attention must be focused upon the component of the De Haan and Zoomers (2005) definition that includes "power relations." It is along the lines of "power," that the livelihoods framework has garnered significant criticism.

Both the "outsiders" view of O'Laughlin (2004), and the "insiders" view of De Haan and Zoomers (2005) draw attention to the inherent failure of livelihood concepts to identify the role of macro-oriented, overarching, structural contributions (pertaining to politics and power) as influential elements in shaping access, and ultimately livelihoods themselves. Held, McGrew, Goldblatt, and Perraton (2003, p. 71) reveal that the power of an agent or institution never exists in isolation. Specifically, the micro-orientation of livelihood studies does not challenge, nor consider, larger macro-oriented structures. Livelihoods are often concerned with individual agency, but fail to acknowledge the contingent politics of collective agency (O'Laughlin, 2004, p. 388). O'Laughlin (2004, p. 387) highlights that, "documenting complexity and diversity in the livelihoods of the poor does not assist very much in identifying the relations of inequality that underlie

poverty, most of which extend far beyond the boundaries of local communities and livelihood groups." The emphasis on flexible livelihood strategies is criticized, as the required assets are still bound by the configurations of power. Therefore, the structural features (such as transforming structures, mediating processes, institutions, and organizations) are often downplayed in favour of a more asset-oriented approach (De Haan & Zoomers, 2005, p. 33). It is from this angle that livelihood frameworks are argued to work best for local interventions, as they operate under the modest goal of "helping the poor help themselves" (O'Laughlin, 2004, p. 387).

In moving forward, De Haan and Zoomers (2005, p. 37) claim that "the livelihoods approach should include an analysis of the wielding and yielding process as part of its institutional analysis." This being said, "the livelihoods approach could become more forceful analytically if it improves its theoretical depth; especially on power issues" (De Haan & Zoomers, 2005, p. 32). However, O'Laughlin (2004) cautions that in doing so, it is necessary to not lose sight of the micro processes at play, but rather incorporate them into a macro analysis.

2.3.2.6 The Current Frontier of Livelihoods Perspectives

Unpacking the livelihoods approach thus far has entailed a tracing of many of the origins and logical progressions that have unfolded, including a critical revelation of the framework's inability to conceptualize institutional processes as a construct of overarching power relations. To this end, Scoones (2009) has identified four inherent failings of the "sustainable rural livelihoods approach," which must be addressed through a consideration of four challenges, believed to be capable of re-energizing the approach.

The first failure identified by Scoones (2009) is a lack of engagement with processes of economic globalization. Livelihood approaches were often dismissed as too complex, and so not compatible with real-world challenges and decision-making processes. Idealism, complexity, naivety, lack of political understanding, and incompatibility with existing sectorally-based organizations were all accusations made. Complexity may be misunderstood as an ability to deal with both micro and macro-oriented issues, but rather complexity refers to the livelihood perspective's ground-level intricacies, which are believed to have inhibited the perspective's ability to deal with "big shifts" in global issues.

The second shortcoming relates to the lack of attention to power and politics and the failure to link livelihoods and governance debates in development. Due to the "business" generated by livelihood debates, the livelihood practitioner community (i.e. trainers, NGOs, and researchers) has failed to connect with those concerned with state politics, governance regimes, relations of power, and the emergent discussions around agrarian futures among the social movements. It has in many respects reached both an intellectual and practical sticking point.

The third failure is a lack rigorous attempts to deal with long-term change in environmental conditions. With the emergence of climate change, and the expected increase in impacts upon parts of the world where poverty and livelihood-centered development has been focused, as mentioned above, the livelihoods perspective has done little to adapt. In livelihoods discourse, "sustainability" tended to refer to coping to immediate shocks and stresses, where local capacities and knowledge, if effectively

supported, might be enough. A central future challenge must be integrating livelihoods thinking and understanding of local contexts and responses, with concerns for global environmental change.

The fourth downfall identified by Scoones (2009) is a failure to grapple with debates about long-term shifts in rural economies and wider questions about agrarian change. Specifically, there is a need to look beyond the description of current livelihood complexities, and into the future of livelihoods.

An underlying theme exists within the four failures: failure to engage with macro-oriented structural processes. Therefore, Scoones' (2009) response to these failures is an identification and revelation of four "challenges" which all possess elements of macro-oriented structural consideration.

The first challenge identified by Scoones (2009) is "knowledge." Livelihood perspectives have been widely adopted, appearing in outputs from the World Bank to the most radical social movements. Therefore, an important question to consider is: what are the power relations underlying this new discourse, and how do they, in turn, shape action? When emanating from influential institutions, statements carry with them major consequences. The institutional power behind ideas creates a particular politics of knowledge, thus allowing a livelihoods analysis to serve multiple purposes and ends. Establishing a greater comprehension of these purposes and ends is essential.

Scoones (2009) highlights "politics" as the second challenge. Politics and power must be central to the livelihood perspectives for rural development. This includes a consideration of basic questions of political economy and history. It is important that the

attention to power and politics move beyond the local level, to examine wider structures of inequality. This would require an analysis of theories of power and political economy, and an understanding of processes of marginalization, dispossession, accumulation, and differentiation.

Scoones' (2009) third identified challenge is "scale." Attention to scale issues must be central to the reinvigoration of the livelihoods perspective. The challenge for the future is to develop livelihoods analyses that examine networks, linkages, connections, flows, and chains across scales, but remain firmly rooted in place and context.

The fourth challenge which Scoones (2009) identifies is "dynamics." It is maintained that a picture of local, adaptive coping to immediate pressures, based on local capacities and knowledge, may miss out on long-term shifts that will, in time, undermine livelihoods in fundamental ways. Rather, a greater concern must be focused on sustaining "life support systems," and the capacity of natural systems to provide livelihoods into the future, given likely stresses and shocks.

To summarize, the livelihoods perspective, whose unit of analysis is situated at the household level, focuses on access to both assets and capabilities. Upon obtaining access, assets are transformed, resulting in livelihood strategies. But, what influences such access? Micro-oriented actors, and their institutions, are viewed as the key "governing body." As a result of this micro-minded approach, the livelihoods framework has been the subject of high degrees of criticism. Through such criticism, Scoones (2009) has called for a re-energized livelihoods approach, by identifying four inherent failures in livelihood perspectives, and has outlined four challenges in addressing the said

failures. However, the livelihoods framework does not necessarily have to be re-invented to consider the influence of larger power structures. In fact, such macro considerations already exist within the study of rural inhabitants, but just not under the categorization of livelihood studies. Rather many of the gaps and weaknesses that have been identified within livelihoods discourse can be adequately addressed through a consideration of the paradigm of political ecology. Interestingly, a direct link exists between the two approaches, and their attempts to conceptualize access to assets. Yet, their explanations for the processes that govern such access are starkly different; with the livelihoods framework emphasizing the agency of micro-oriented actors, and political ecology focusing on the structural contributions of macro-oriented actors. Therefore, in establishing a theoretical framework of analysis, an amalgamation between livelihood studies, and political ecology is necessary. Examining political ecology, while maintaining a consideration of the elements of the livelihoods perspective, will reveal how it addresses, or inadvertently responds to, critiques of the livelihoods framework; ultimately, highlighting the complementary nature between both approaches.

2.3.3 Political Ecology

The origins of politics and ecology date back to the 1970s, when the term "political ecology" was coined as a way of thinking about questions of access and control over natural resources (Watts & Peet, 2004, p. 6). It began as a reaction to certain features of human ecology and ecological anthropology, as practiced in the 1960s and early 1970s, and sought to respond to the neglect of political dimensions of human/environment interactions (Vayda & Walters, 1999, p. 167). Blaikie and

Brookfield (1987, p. xvii) explained that a need existed to bring together natural and social scientists more effectively, or as Robbins (2004, p. 12) says, "de-naturalize" social and environmental conditions, to determine why "land managers" (i.e. peasants, pastoralists, commercial farmers, and state forest departments) are often unwilling or unable to prevent accelerated degradation. Early writings in political ecology focused on unequal power relations, and emphasized the role of political economy as a driver of maladaptation and instability (Walker, 2005, p. 74). For example, Wolf (1972, p. 201), highlighted that it is important for "any one household at any one time, to achieve a balance between unimpeded access to an effective combination of resources characterized by such heterogeneity, and the operation of the jural rules concerning who owns what."

At the same time, political ecology offered a response to many popular environmental conceptions (blaming environmental degradation on issues such as population growth, inappropriate technology use, and/or destruction caused by "ignorant" local actors) that have been influenced by Thomas Malthus' (1993) *An Essay on the Principle of Population.*[19] As identified by Robbins (2004, p. 7), the argument is straightforward:

> As human populations grow out of proportion to the capacity of the environmental system to support them, there is a crisis both for humans, whose numbers fall through starvation and disease-based mortality, and for nature, whose overused assets are driven past the point of self-renewal.

This argument would be further echoed in the late 1960s to early 1970s by Hardin's (1968) *Tragedy of the Commons*, Ehrlich's (1968) *The Population Bomb*, and

[19] Thomas Malthus' *An Essay on the Principle of Population* was first released in 1798.

Meadows, Meadows, Randers, and Behrens III's (1972) *The Limits to Growth*, among others. Focusing on environmental problems caused by capital-intensive production in the industrialized world, Malthusian and Neo-Malthusian concerns were dramatically expressed in literature pertaining to developing countries (Stott & Sullivan, 2000, p. 3). However, the Malthusian population model poorly reflects the complexity of global ecological issues (Robbins, 2004, p. 9). Political ecology rejects traditional Malthusian explanations, instead pursuing forces from a global perspective (Robbins, 2004, p. 134). Conditions of inequality are emphasized and considered an essential driving force in the over-use of common resources. This inequality is often underpinned by the influence of larger power structures (such as the privatization of land or disrespect for indigenous notions of rights and governance), which force people to use the commons more intensively, and contributes to the shrinking potential of the commons themselves (Blaikie, 1985, p. 130). Fittingly, Patel (2009, p. 95) states that, "in many instances the commons are not being overrun, but taken over." Blaikie and Brookfield (1987, p. 4) go so far as to argue that marked decreases in population densities have also led to environmental degradation. In essence, issues that were long characterized as the product of ignorant and overpopulated land managers (such as deforestation, soil erosion, and famines), have now succumbed to more systematic explanations (Robbins, 2004, p. 70).

2.3.3.1 Defining Political Ecology

Largely shaping its identity through the rejection of Malthusianism, and revealing that "nature is not nearly so natural as it seems" (Cronon, 1996, p. 25), various definitions of political ecology now exist. One of the most fundamental constructs of the term

political ecology, which has in many ways carried through to today's operational understanding of the term, was put forth by Blaikie and Brookfield (1987, p. 17), who describe political ecology in this way: "the phrase 'political ecology' combines the concerns of ecology and a broadly defined political economy. Together this encompasses the constantly shifting dialectic between society and land-based resources, and also within classes and groups within society itself." Watts (2000, p. 257) further builds upon Blaikie and Brookfield's (1987) definition, by claiming that political ecology "seeks to understand the complex relations between nature and society through a careful analysis of what one might call the forms of access and control over resources and their implications for environmental health and sustainable livelihoods."

2.3.3.2 Power Influences

What is to be stressed about political ecology is that local level decisions are greatly influenced by overarching power structures. As Watts and Peet (2004, p. 10) explain, "locality studies are, thus, subsumed within multi-layered analyses pitched at a variety of regional scales." Therefore, in order to make sense of local level conditions, "the chain of explanation must be followed back to broader socio-economic links" (Blaikie & Brookfield, 1987, p. 45). The social relations, according to Blaikie and Brookfield (1987):

> Are primarily defined by who has control of land, labour, implements, inputs and outputs; who decides upon cropping or grazing strategy, and upon investments, including, in this case, the creation of landesque capital, irrigation, tree planting and the like; and the type and rate of surplus creation and extraction through rents in labour services, cash or kind, usury, or through the employment of wage labour (p. 74).

> It is therefore very common to find that direct decision-making is frequently local, for example, the manager of a sugar plantation or the peasant farm household, but many of the parameters of choice are determined by others, for instance locally by a landlord, centrally by corporate management of a group of plantations, or nationally by government parastatal boards (p. 69).

Through this lens, Robbins (2004, p. 101) argues that, "subsistence communities are not a threat to ecosystem sustainability until larger developments and socio-economic changes alter key elements in their use of the landscape."

2.3.3.3 Critiquing Political Ecology: Where is the Ground-Level Ecology?

While an underlying strength of political ecology is often noted to be its consideration of macro-oriented structures, and the power relations that embody them, at times this has led to criticisms as well. One of the most significant critiques put forth against the paradigm is by Vayda and Walters (1999). As mentioned above, political ecology emerged as a reaction to the lack of consideration of political influences pertaining to human/environment interactions. While Vayda and Walters (1999, p. 168) feel that greater political awareness "is no doubt a good thing," their criticism stems from the fact that, in their opinion, political ecologists regard macro-oriented (political) influences as the most important dimension in a political ecology analysis, ultimately receiving priority in research undertakings. Vayda and Walters (1999) claim that overreaction to the "ecology without politics" of the 1960s and early 1970s has now led to "politics without ecology." This has prompted Walker (2005, p. 73) to question if political ecology will ever fully reclaim its ecological dimension, or if the field has primarily become a social science study of environmental politics. In essence, "what are

actually studied are political controls or political contests over natural resources and not, or at least to any significant extent, how the resources are affected by those controls or contests" (Vayda & Walters, 1999, p. 169). Vayda and Walters (1999, p. 171) argue that this is problematic, as research becomes guided by "*a priori* judgments, theories, or biases." Ultimately, these pre-conceived notions are a "prescription for question-begging research" (Vayda & Walters, 1999, p. 168).[20]

Emerging out of their critique of political ecology, Vayda and Walters (1999), put forth their own alternative to the paradigm, which they call "eventmental ecology" or "event ecology." Their method consists of beginning research with a focus on the environmental events or changes that they want to explain, and then working "backwards in time and outward in space" in order to facilitate the establishment of chains of causes and effects leading to those events (Vayda & Walters, 1999, p. 169). Vayda and Walters (1999) highlight that this approach allows for research to be guided by "open questions" about why events occur, and is therefore not restricted by specific agendas or theories. In exemplifying the application of their approach, Vayda and Walters (1999) look at the causes and consequences of mangrove forest planting and cutting in Bais Bay and Banacon Island, Philippines, and explain that many of their findings would have went undetected had a similar study been attempted by political ecologists.[21]

In response to Vayda and Walters' (1999) criticism of political ecology, Watts and Peet (2004) provide a "rebuttal" in defense of political ecology, predicated upon

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[20] Vayda and Walters (1999, p. 168) describe "question-begging research" as, "concentrating on factors assumed in advance to be important and...thus missing both other factors and the complex and contingent interactions of factors whereby environmental changes often are produced."

[21] For a thorough understanding of the study conducted in the Philippines, see Vayda and Walters (1999).

scrutinizing Vayda and Walters' (1999) notion of "openness." While Vayda and Walters (1999) starkly opposed research built upon the foundation of theoretical assumptions, Watts and Peet (2004, p. 18) argue that theory must be viewed as a "toolkit," as prior assumptions and judgments, which are integral to the composition of theory, are not a flaw, but in fact a "necessity." As Watts and Peet (2004, p. 18) claim, Vayda and Walters' (1999) rejection of theory, and subsequent adoption of a "crude empiricism," lacks the very "openness" that they appear to be seeking. Furthermore, Watts and Peet (2004, p. 19) are critical of Vayda and Walters' (1999) belief that the environmental element has disappeared from political ecology, as it seems that Vayda and Walters' (1999) only expression of the environment is in the form of biophysical events of environmental change. Therefore, Watts and Peet (2004, p. 19) feel that Vayda and Walters (1999) fail to acknowledge the variety of ways in which the environment can be explored. Ultimately, according to Watts and Peet (2004), political ecology remains a discipline focused upon explaining the links between environmental management and power relations, without pre-conceived notions, as it was intended to do.

Undoubtedly, political ecology faces some tensions and debates; as does any theory, concept, framework, or paradigm contested in academia. However, what if political ecology provided the missing puzzle piece to a framework which addresses many of the same issues to those addressed in the livelihoods framework? And, what if the criticisms of political ecology were already addressed (and considered strengths) within that framework? It appears that on numerous grounds, the livelihoods framework,

considered in conjunction with political ecology, would complete the theoretical framework of analysis.

2.3.4 Creating a Hybrid Theoretical Framework of Analysis

Thus far it has become evident that both the livelihoods framework and political ecology offer effective lenses through which rural livelihoods can be viewed. The livelihoods framework, which explains rural livelihoods being impacted by access to assets governed by local actors, and the institutions that flow from these actors, has been criticized for its lack of consideration of influences emanating from larger political and power structures. Conversely, political ecology also explains access to assets (specifically natural assets), but does so from a macro perspective, in which the influences of politics and power are heavily considered. However, critics have highlighted the fact that political ecology may in fact place too large of an emphasis on macro-oriented influences; thus, inhibiting the ability of political ecologists to comprehend important local level events, and the transformative potential of human agency. Interestingly, according to Scoones (2009, p. 183), "what livelihoods perspectives offer...other perspectives often miss out on, with potentially damaging consequences."

Fittingly, an amalgamation of the livelihoods framework and political ecology would provide an effective all-encompassing theoretical tool. Many of the livelihood framework's downfalls, such as its lack of macro-mindedness, are strengths of political ecology. Likewise, shortcomings of political ecology, such as its absence of micro considerations, have been identified as strengths of the livelihoods framework.

Therefore, the hybrid theoretical framework suggests that a consideration of both micro and macro-oriented actors, working in conjunction with one another, given their complementary nature, allows for a more accurate explanation of the factors that influence institutional configurations. In essence, the hybrid theoretical framework is a dynamic construct underlined by a defining characteristic of malleability.

Can such a consolidation provide a useful theoretical tool? Absolutely. In fact, Bebbington and Batterbury (2001, p. 370) argue that a high analytical value exists in grounding macro dimensions of political ecology in the notion of the livelihoods framework (such as scale, place, and network). Scoones (2009, p. 174) claimed that, "at root, political ecology focuses on the intersections of structural, political forces and ecological dynamics...The commitment to local-level fieldwork, with understandings embedded in the complex realities of diverse livelihoods, but linking to more macro-structural issues, are all important characteristics." Critics of each respective school of thought, while stressing change, have emphasized the importance of not losing sight of their micro-orientation (relating to the livelihoods framework), and their macro-orientation (relating to political ecology). For example, Vayda and Walters (1999, p. 168) outline that, "more attention to political influences on human/environment interactions and on environmental change itself is no doubt a good thing." On the other hand, Scoones (2009, p. 191) reveals that, "this does not mean abandoning a basic commitment to locally-embedded contexts, place-based analysis and poor people's perspectives; nor does it mean slavishly responding to the framings provided by dominant disciplines such as economics." It is a commitment to the fundamental elements of the

livelihoods framework and political ecology, while still looking to broaden their horizons, that makes each framework such an effective complementary match.

Conducting an analysis through the hybrid framework requires a narrowing of focus. In discussing the livelihood framework, Scoones (1998, p. 13) describes that, "investigating each element laid out in the framework – from contextual factors through livelihood resources to strategies and outcomes – with an institutional lens is potentially a significant undertaking...even a major field research effort may be insufficient to uncover all aspects of sustainable livelihoods in a given site." Therefore, in moving forward, the focus will be placed upon the third identified failure: a lack of rigorous attempts to deal with long-term change in environmental conditions. The remainder of this literature review will attempt to deal with change in environmental conditions (i.e. an increase in hurricane frequency and/or strength). Such change will be dealt with by focusing on the viability of natural assets, through establishing the important role of SEPs in reducing environmental vulnerability to natural disasters. Naturally, elements of the other three failures will draw into the analysis, but are not to be confused with the primary focus. It is further necessary to establish that the four challenges identified by Scoones (2009), all fall under the category of "macro-orientation." Therefore, throughout the duration of this study, they will be considered together under the macro "umbrella," and not on an individual basis.

2.4 ENVIRONMENTAL PRACTICES

For the purpose of this study an environmental practice constitutes human manipulation of a natural asset. Why does natural asset manipulation occur? Manipulation is in fact the economic "activities" that are required to transform a natural asset, resulting in tangible human benefits.[22] Such benefits exist across a wide spectrum, depending upon the actor who conducts the transformation. For example, the benefit may be the achievement and maintenance of self-provisioning and subsistence, or on a larger scale, market provisioning.

Natural asset transformation can impact the remaining (untransformed) natural asset base in two ways. First off, the transforming activities may be "sustainable" in the sense that the natural asset, and more broadly the ecosystem it is situated in, does not surpass the "threshold" upon which it is incapable of, as Bebbington (1999, p. 2029) puts it, continuing to allow the same sorts of transformations. Such practices formulate the foundation upon which the term SEPs is constructed. Secondly, transforming activities are also capable of being "unsustainable." Unsustainability emerges when environmental practices result in an encroachment upon, and eventual surpassing of, the natural asset threshold; ultimately, resulting in an inability to maintain similar transformations. Practices of this nature are referred to as UEPs.

In further operationalizing the term "sustainability," it is necessary to look towards ecological economist Herman Daly's (2005) description of a "sustainable economy," and his following deployment of the terms "strong sustainability" and "weak

[22] From a livelihood perspective, this would be an element of a livelihood strategy.

sustainability." Daly (2005) describes a sustainable economy as, "one that can be maintained indefinitely into the future in the face of biophysical limits."[23] The maintenance of a sustainable economy is contingent upon the notion of strong sustainability, which follows the belief that natural and human-produced capital should be viewed as complements rather than substitutes. Therefore, seeing that is has become the "limiting factor," natural capital should be maintained on its own (Daly, 2005). Conversely, Daly (2005) highlights that weak sustainability follows the belief that human-produced capital is a good substitute for natural capital, thus leading to a call from neo-classical economists to maintain the sum of the two. Fittingly, along these lines, Costanza and Daly (1992) argue that it is not possible to significantly substitute human-produced capital for natural capital, since the former is in itself made out of the latter. This being said, the following example put forth by Daly (2005) outlines the difference between strong sustainability and weak sustainability:

> The annual fish catch is now limited by the natural capital of fish populations in the sea and no longer by the man-made (human-produced) capital of fishing boats. Weak sustainability would suggest that the lack of fish can be dealt with by building more fishing boats. Strong sustainability recognizes that more fishing boats are useless if there are too few fish in the ocean and insists that catches must be limited to ensure maintenance of adequate fish populations for tomorrow's fishers.

While Daly's concept of strong sustainability emphasizes the importance of maintaining natural capital stocks, Boyce (2003) highlights that sustainability can also include the enhancement of natural capital's quantity and quality. Boyce (2003, p. 11)

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[23] Daly (2005) claims that in order to implement such an economy, what is to be sustained from year to year must be specified. He explains how economists have discussed five candidate quantities: gross domestic product, "utility," throughput, natural capital, and total capital (the sum of natural capital and human-produced capital).

states that, "humans certainly can degrade the environment, but they can also improve it." Along these lines, Folke, Hammer, Costanza, and Jansson (1994, p. 2) claim that the management of natural capital should be proactive rather than reactive. Therefore, Turner, Doktor, and Adger's (1994) belief on sustainability must be considered, as they reveal that, given such high degrees of environmental uncertainty, a minimum safe condition for sustainability is to maintain the total natural capital stock at or above the current level. What is to be emphasized is the concept of operating "above current levels," and Boyce (2003) explains how this can be done through his identification of four main routes to increasing the amount and value of natural assets held by the poor. The first route is "investment," which entails creating new natural capital or improving the natural capital to which the poor already have access. This route is most feasible when the poor already own some natural assets, in which their quality and/or quantity can be increased via ecological restoration or co-evolution. The second route is "redistribution," which consists of transferring natural capital rights from the wealthy to the poor. This is not exclusive to the outright transfer of ownership titles, but may also include the redistribution of subsets of rights, such as the right to share in employment or other benefits derived from the use of natural resources. The third route is "internalization," and involves increasing the ability of the poor to capture benefits flowing from their environmental practices. These benefits are often bestowed upon others in the form of "positive externalities." The fourth route is "appropriation," which includes establishing the rights of the poor to environmental sinks and raw materials that previously were treated as open-access resources.

Consistent with the concept of enhancing the quality and quantity of natural capital through anthropogenic influences, in his book entitled *1491: New Revelations of the Americas Before Columbus*, Charles Mann (2006) exemplifies how this can be the case. Mann describes the discovery of "terra preta do Índio," which is a rich, fertile, "Indian dark earth," found in the Amazon, and reveals that Amazonian Indians effectively created the soil, which was paramount to their subsistence.[24] More specifically, Mann (2006) highlights that terra preta is unique in that, "it has more 'plant available' phosphorous, calcium, sulfur, and nitrogen than is common in the rain forest; it also has much more organic matter, better retains moisture and nutrients, and is not rapidly exhausted by agricultural use when managed well." Terra preta's make-up is high in external nutrient inputs, consisting of excrement and waste such as turtle, fish, and animal bones, and it contains up to sixty-four times more charcoal than the red earth which surrounds it. Interestingly, charcoal is the key "ingredient" in maintaining terra preta's long-term fertility, as organic matter "sticks" to the charcoal, rather than being washed away or attaching to other non-available compounds. The charcoal found in terra preta is not a product of "slash-and-burn" techniques, but rather is created through a process referred to as "slash-and-char." Instead of completely burning organic matter to ash, ancient farmers burned it incompletely to make charcoal, then stirred the charcoal into the soil. This process allows the charcoal to retain its carbon in the soil.

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[24] Mann (2006, p. 345) explains that most big terra preta sites are situated on low bluffs at the edge of the floodplain. Typically, they cover five to fifteen acres, but some encompass more than 700 acres. The layer of black soil is generally one to two feet deep but can reach more than six feet.

With a wide array of contributions to the construction of the concepts SEPs and UEPs, it is fitting to clearly outline a working definition of the terms. Therefore, SEPs can be described as practices that allow for the continuation of similar types of natural asset transformations, as a result of the natural asset stocks being maintained at or above current levels. Maintenance is dependent upon the quantity and form of natural capital extraction. Furthermore, operating above current levels involves the enhancement of natural capital quantity and/or quality, and would subscribe to the concept of strong sustainability. Conversely, UEPs are those practices that result in a surpassing of the natural asset threshold, meaning that similar transformations cannot be maintained. Threshold surpassing is attributable to the quantity and form of natural capital extraction. In some, but not necessarily all cases, UEPs may be linked to the notion of weak sustainability.[25]

2.4.1 The Creation of Environmental Vulnerability

What is the effect of SEPs or UEPs being applied to natural assets? Depending on which practice is deployed, natural asset bases may possess various degrees of vulnerability, referred to as "environmental vulnerability." Vulnerability is the "potential for loss" (Cutter, 1996), or more specifically, "the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard" (Turner et

[25] UEPs can lead to a surpassing of the natural asset threshold, without weak sustainability being the driving force. In following Daly's (2005) fishery example, resource degradation, or threshold surpassing, may not necessarily be influenced by a belief that building more fishing boats is an effective solution to reduced fish yields. Rather, other factors may be attributable, such as a fisherman who catches fish indiscriminately, despite their age, and size; thus, placing a greater importance on current fish catches, and in turn current economic returns, over future fish catches and future economic returns.

al., 2003, p. 8074). Such loss is brought about by "stresses" (Bohle, Downing, & Watts, 1994), which Scoones (1998, p. 6) refers to as "a small, regular, predictable disturbance with a cumulative effect."

Barnett et al. (2008, p. 104) point out that there appears to be a common agreement that human-induced changes in ecosystem structures, including in biological diversity, increase vulnerability.[26] Essentially, "human induced changes" are in fact the environmental practices that are applied to natural assets. The application of SEPs leads to minimal degrees of environmental vulnerability, while UEPs influence high degrees of environmental vulnerability to the remaining natural asset base.[27,28]

2.4.1.1 Direct and Indirect Environmental Vulnerability

When discussing environmental vulnerability, it is necessary to distinguish between "direct environmental vulnerability" and "indirect environmental vulnerability." Direct environmental vulnerability is the degree of vulnerability that is possessed by "primary natural assets," which can be referred to as specific natural assets within an ecosystem. Primary natural assets include trees in a forest, crops in a farmer's field, fish in the ocean, or mangroves in a coastal area. For example, if trees are removed from a

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[26] Within the context of this study, Barnett et al.'s (2008) view on the impacts of human-induced changes to an ecosystem, imply changes that bring about degradation. It is also important to remember that Boyce (2003) maintains that humans can also augment natural capital in order to bring about greater "environmental protection."

[27] If elements of the natural asset base do in fact still remain.

[28] The application of SEPs leads to "minimal degrees of environmental vulnerability," can also be phrased as "environmental resilience." Folke et al. (2002) highlight that resilient ecosystems are capable of accommodating and absorbing stresses and shocks in ways that do not fundamentally alter the ecosystem structure.

forest through "high grading," the remaining trees in the forest will have a heightened degree of vulnerability to potential disturbances.

Indirect environmental vulnerability emerges out of direct environmental vulnerability, and refers to the degree of vulnerability possessed by "secondary natural assets." Secondary natural assets can be described as the components of an ecosystem, and surrounding environment, that do not include those that are classified as primary natural assets. Indirect environmental vulnerability is a spinoff of the direct environmental vulnerability of a primary natural asset. As an example, Kurien (2007, p. 42) observes that, "mangroves are like the roots of the sea, without which the coastal ecosystem would die," and further highlights that, "a well-managed coastal area ecosystem can be the basis of a healthy and economically sound fishing community" (2007, p. 40). Following Kurien's (2007) claims, if the mangroves (the primary natural asset in this example) in a certain coastal area are sparse as a result of the application of UEPs, not only would the remaining mangroves possess higher degrees of environmental vulnerability, but so too would the populations of fish species (the secondary natural asset in this example) that depend upon the mangrove estuaries as a spawning ground.[29] Therefore, this would be a form of indirect environmental vulnerability, as it would be brought about by the direct environmental vulnerability of the mangroves.

[29] In this example, fish are the secondary natural asset. However, fish can also be deemed as primary natural assets in other examples. Overfishing, for instance, may weaken a fish population and consequently increase its vulnerability.

2.5 THE RELATIONSHIP BETWEEN ENVIRONMENTAL PRACTICES AND NATURAL DISASTERS

Thus far it has become clear that both natural disasters and environmental practices exist. Interestingly, to this point in the analysis they have been viewed as distinct issues; however, it is now important to consider them in relation to one another, as environmental practices have been proven to influence the degree of natural disaster damage incurred by humans.

According to de Villiers (2009), "in human history, numberless societies have collapsed through ecological degradation," (such as the Easter Island civilization). Moreover, the Babylonians, Mayans, and Anasazi's were three advanced groups that disappeared or "became ghosts of their former glory" due largely to disturbances after long-term environmental degradation (del Moral & Walker, 2007, p. 8).[30] In 1756, the French philosopher Rousseau became the first to look at the relationship between human practices and natural disasters following the November 1, 1755 earthquake and tsunami in Lisbon, Portugal (Kelman, 2008, p. 97). As further revealed by Kelman (2008, p. 97), in the 1940s geographer Gilbert White viewed flood disasters from the perspective of people's, rather than nature's, behaviour. As a result, he proposed a range of "adjustments" to human behaviour to reduce flood damage. Therefore, it should not come as a surprise that many natural philosophers speak of the "end of nature," implying that no place on earth now escapes significant human impacts (del Moral & Walker, 2007, p. 3).

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[30] It is important to note that Mann (2006) also attributes part of the population decline to European-induced diseases.

In del Moral and Walker (2007, p. 2) it is revealed that "tsunamis and hurricanes are more devastating where protective coral reefs and mangrove swamps have been destroyed. Landslides are more frequent where logging or road building destabilizes slopes. Deforestation also intensifies the severity of natural floods, while grazing semi-arid lands fuels the expansion of desert dunes." This sentiment put forth by del Moral and Walker (2007) is further echoed in current literature.

In considering mangroves in relation to the Indian Ocean tsunami of 2004, a spokesman for Walhi, Indonesia's leading environmental group in Jakarta claims that, "the full fury and wrath of the waves were felt in areas where nature's green belts of...mangroves no longer exist" (Williams, 2005, p. R73). Coral reefs had been removed with dynamite in many parts of Indonesia and Sri Lanka to improve shipping, and mangroves had been converted to facilitate shrimp nurseries, housing, and tourist activities. In the areas where coral reefs and mangroves had been removed, tsunami damage was greater than in areas where they were still intact, given that less of the storm's energy was absorbed (del Moral & Walker, 2007, p. 23). According to Indian reporters, "where mangrove forests remained, the impact was mitigated, and the lives and property of the communities inhabiting the region were saved. It is now found that wherever the mangroves have been regenerated, the damage due to the tsunami is minimal" (Williams, 2005, p. R73). Natural barriers to tsunamis, such as "protective mangroves" (Gomez, 2005, p. 262), barrier reefs, and lagoons should be left intact. These are the same practices that will protect communities from hurricane-caused storm

surges, as hurricanes can raise coastal waters by seven meters, and bring about large battering waves that can be superimposed on a high tide (de Villiers, 2009, p. 286).

In cases where only one row of "protective mangroves" are left in place in order to absorb encroaching ocean activity, "jetting" can still occur (Fernando, Braun, Galappatti, Ruwanpura, & Wirasinghe, 2008, p. 260). If only one row exists, gaps will be present between mangrove plants. As waves crash into the mangroves, pressure will build up and "jet" through the gaps which would have otherwise been cancelled by multiple mangrove rows; thus, suggesting that the maintenance of superficial mangrove populations is an ineffective method to mitigate the encroachment of coastal wave activity.

This tells us that a strong relationship between environmental practices and natural disasters exists, or as Kreimer and Munaisinghe (1991, p. 4) explain, "environmental degradation intensifies the effects of natural disasters." Establishing the presence of this relationship is necessary, but more importantly, we are concerned with the relationship between environmental vulnerability, brought about by environmental practices, and their intersection with natural disasters.

2.6 THE RELATIONSHIP BETWEEN ENVIRONMENTAL VULNERABILITY AND NATURAL DISASTERS

We now know that environmental practices influence the degree of environmental vulnerability. SEPs result in a more resilient natural asset base, while UEPs lead to vulnerable natural asset bases. This being said, what happens when a vulnerable environment, rendered vulnerable by UEPs, is met by more than a "stress"? What if it is

met by a "shock," which Scoones (1998, p. 7) refers to as "a large infrequent, unpredictable disturbance with immediate impact?"

As a result of ecosystem alteration brought about by UEPs, natural disaster strikes can lead to new kinds of systems incapable of returning to their original state (del Moral & Walker, 2007, p. 25). Specifically, Lugo (2000) discusses the impact of hurricanes on vegetation cover, ultimately depicting that the outcome of a hurricane strike on resilient vegetative structures is damaging in itself. When considering hurricane impacts on vulnerable vegetative structures, the damage could prove to be unrecoverable for the ecosystem. Hurricanes are capable of inducing changes in landform, as well as, modifying vegetation cover (Lugo, 2000, p. 244). Results of hurricane activity on forests, identified by Lugo (2000, p. 248), include the following: a larger fraction of the natural landscape is set back in a successional stage (i.e. leading to more secondary forests), decreases in forest aboveground biomass and vegetation height due to impeded vegetation growth, and a change in species combinations. On many occasions, decades are required before the natural system recovers from the passage of a single Category 4 or Category 5 hurricane (Lugo, 2000, p. 247). In a forestry study conducted by Xi, Peet, and Urban (2007, p. 52) in North Carolina's Duke Forest following Hurricane Fran, it was revealed that "understory saplings and small trees often had their stems bent or pinned by their large fallen neighbours but were relatively less damaged than overstory trees, largely due to a possible 'shield effect' from the canopy trees." This exhibits the importance of SEPs, as they maintain the integrity of the forest resource; thus, reducing

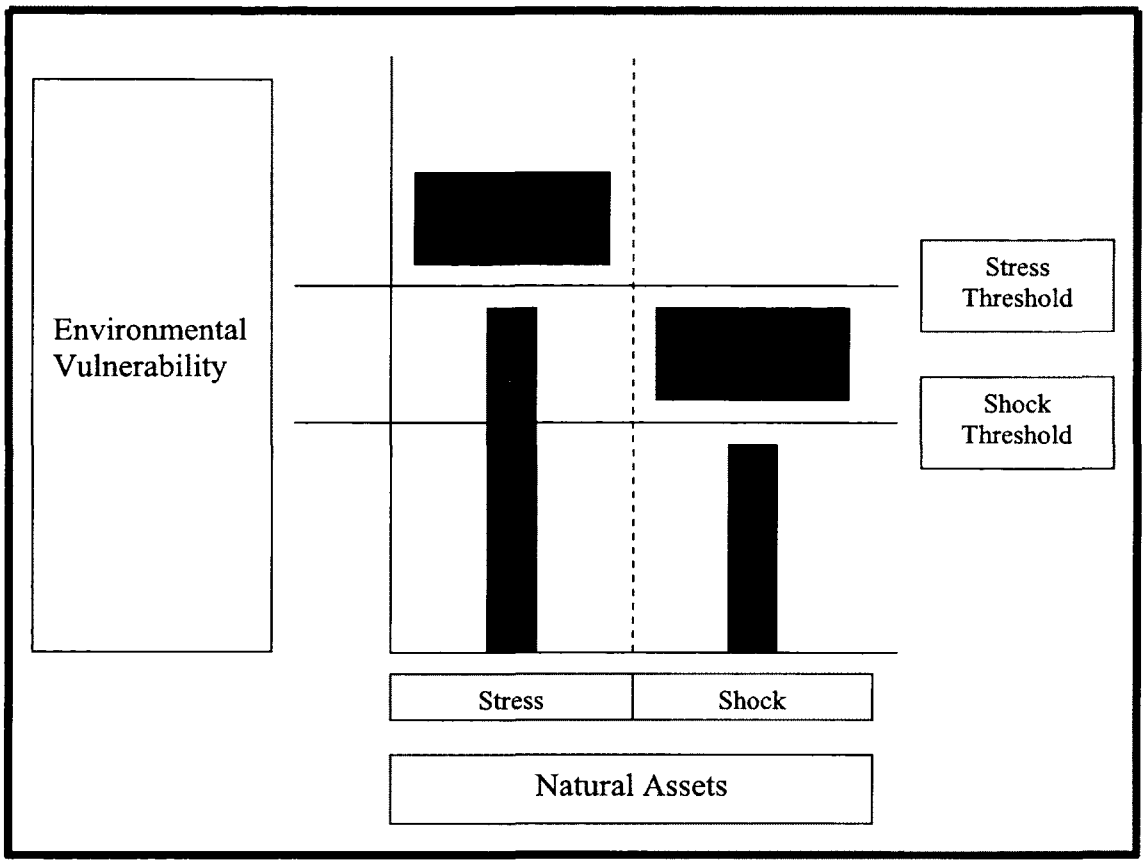
environmental vulnerability, as the forest, when generally left intact, can naturally protect itself.

The intersection between environmental vulnerability and natural disasters is further revealed in the post-Hurricane Mitch studies carried-out by Holt-Giménez (2002; 2006). Holt-Giménez performed an analysis of agroecological resistance between plots on "industrial" and "traditional" farms in Nicaragua. The traditional farms in the study belonged to smallholders working within a multi-institutional farmers' movement for traditional agriculture, known in Central America as farmer-to-farmer, or *Movimiento Campesino a Campesino* (Holt-Giménez, 2002, p. 89). On the other hand, industrial farmers used more industrialized strategies, such as monocropping, which required the use of external chemical outputs. Following the hurricane, it was discovered that traditional plots had 40% more topsoil than industrial plots. In order to reach moist soil, traditional farmers had to dig 10% less than industrial farmers. As it pertains to erosion, "sustainable (traditional) plots lost 18% less arable land to landslide than conventional (industrial) plots and had a 49% lower incidence of landslides" (Holt-Giménez, 2002, p. 93). Instead of industrial farming techniques, traditional farms utilized cover crops and intercrops, agroforestry, intensive in-row tillage, organic fertilizers, and integrated pest management. Furthermore, Holt-Giménez revealed that the greater number of years that a farm abides by traditional farming practices, results in higher degrees of hurricane resistance. For example, resistance to erosion increases steadily for approximately 10 years, before experiencing more dramatic increases. At the same time, vegetation

follows the initial pattern for topsoil, and then doubles after 10 years (Holt-Giménez, 2002, p. 100).

What do these two examples tell us? We know that UEPs create environmental vulnerability, while SEPs lead to lower degrees of environmental vulnerability, as they create, what Lugo (2000, p. 248) refers to as, "green infrastructure." When vulnerable environments are met by natural disasters, significant damage, if not eradication, is inflicted upon the natural asset base. This being the case, two "thresholds" can be identified: the stress threshold, and the shock threshold. The stress threshold of a natural asset is much greater than the shock threshold, as depicted by Figure 2.2. Therefore, under the stress threshold, natural assets can operate at higher levels of environmental vulnerability than natural assets situated under the shock threshold. However, shocks are far less predictable than stresses, thus suggesting that a natural asset is incapable of quickly increasing its shock threshold in anticipation of a shock (such as a natural disaster). Instead, natural asset bases must operate under the shock threshold at all times, rather than the stress threshold, due to the unpredictable nature of natural disasters. Operating under the shock threshold will significantly decrease the level of environmental vulnerability, and allow natural assets to recover more quickly following a natural disaster strike.

Figure 2.2: Environmental Vulnerability to Stresses and Shocks



Source: Author.

2.7 CONCLUSION

The prevalence of natural disasters is increasing. More specifically, in relation to the empirical component of this study, the literature has highlighted that hurricanes will increase in frequency and/or intensity. Given the debilitating societal effects of natural disasters, an unquestionable need exists for the establishment of methods that are capable of reducing vulnerability to such events, and in turn the damage they cause. The establishment of such disaster-reducing avenues responds to Scoones' (2009) third identified failure of livelihood studies: a lack of rigorous attempts to deal with long-term change in environmental conditions. But what are these disaster-reducing avenues? Both

the livelihoods framework and political ecology provide the theoretical foundation upon which disaster reduction notions can be formulated. While the livelihoods framework is micro-oriented and emphasizes agency and institutions, the political ecology approach is more macro in nature, with a greater emphasis upon structures. Combining the two paradigms into a single analytical framework allows for a more holistic and sophisticated treatment of natural disasters and, more specifically, hurricane vulnerability. Given the unquestionable intersection between environmental practices, resulting in various degrees of environmental vulnerability, and natural disasters, the point of interjection lies in developing a deeper understanding of the relationship between environmental vulnerability and livelihood vulnerability. Explanation of the factors that influence the implementation of environmental practices, which of course influence environmental vulnerability, reaches beyond the realm of micro-oriented actors or macro-oriented structures operating as separate entities, as the livelihoods framework and political ecology would respectively suggest. Rather, as highlighted by the hybrid theoretical framework, the agency of all actors plays a role in the formulation of natural asset-transforming institutions. With a lens focused upon this theoretical foundation, it is possible to conceptualize the empirical elements of this study.

CHAPTER 3: LOCATION OF STUDY

3.1 INTRODUCTION

The purpose of this chapter is to introduce the field research location. The chapter commences with background information on Grenada, and brings to the forefront the degree of complacency that Grenadians have historically possessed with regards to hurricane preparedness, given the belief that Grenada is situated outside of the Atlantic hurricane belt. I then proceed to present the region in which fieldwork was conducted, and provide justification for its selection. The chapter also highlights the important role of mangroves in anchoring the quality of coastal ecosystems, and describes the particulars of the mangroves in the location of study.

3.2 GRENADA

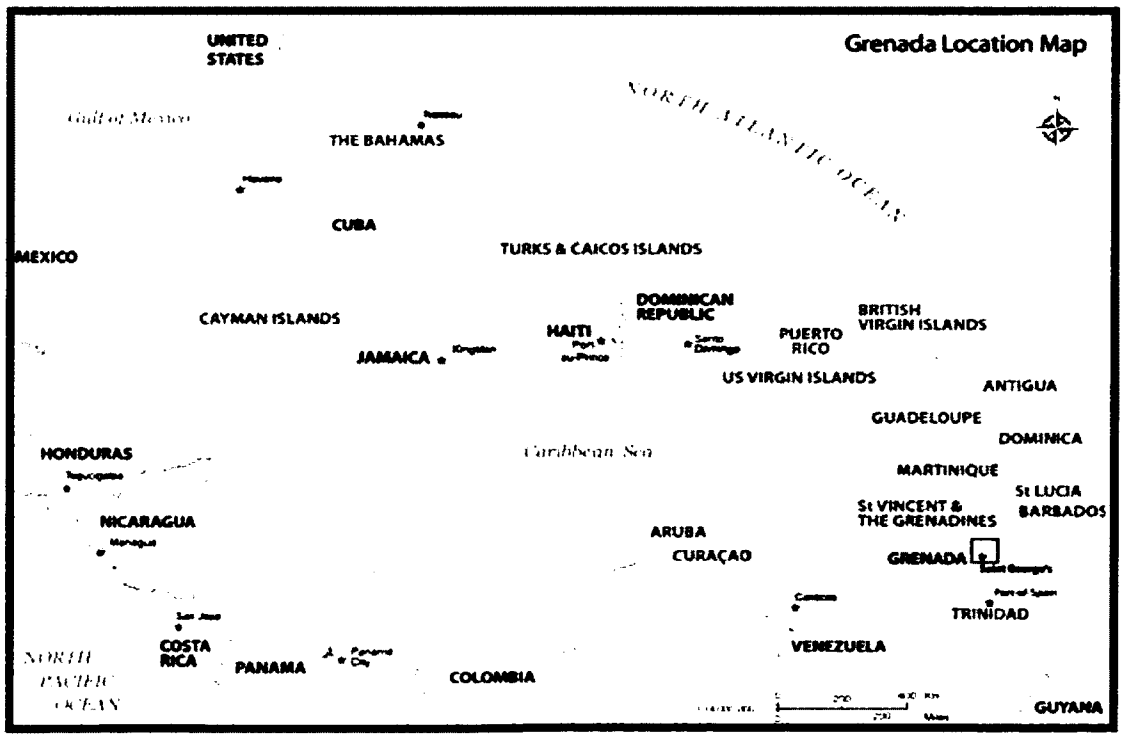
An independent tri-island state, with a population of approximately 100,000 people, Grenada is located at the southern tip of the Windward Islands in the West Indies at 12°07'north and 61°40'west, as revealed in Figures 3.1, 3.2, and 3.3. Grenada is the main island of the three, and is approximately 34 km in length and 18 km in width. Carriacou is the second largest of the three islands at 11 km long and 5 km wide, while Petite Martinique is the smallest island at just 2 km^2.[31] Grenada's interior consists of mountainous terrain, which is a testament to its volcanic origin, with the highest point being Mount Saint Catherine at 833 meters above sea level

[31] At times the word "Grenada" can be used when describing all three islands within the country. However, for the purpose of this study "Grenada" will only refer to the main island of Grenada.

Figure 3.1: Regional Map of the Caribbean (Image 1)

Source: Central Intelligence Agency – World Fact Book (2011). Used with Permission.

Figure 3.2: Regional Map of the Caribbean (Image 2)



Source: Author.

Figure 3.3: Map of Grenada

Source: Central Intelligence Agency - World Fact Book (2011). Used with Permission.

Originating from South America, the Cinoneys first inhabited Grenada around 8 B.C. (Douglas, 2003, p. 1), and prior to its colonization by the French in 1650, Grenada was occupied by the Carib Indians since 1000 A.D. (Smith, 1965, p. 9). In 1796, the British seized control of Grenada, and the country remained a British colony until it became independent in 1974. It is currently a member of the Commonwealth, with a Governor General representing the British monarch as head of state, and has retained a system of parliamentary democracy. Agriculture and tourism have proved to be Grenada's primary economic activities.[32]

[32] Grenada is noted for its nutmeg and cocoa production, and is often referred to as the "Isle of Spice."

Grenada is considered to be outside the Atlantic hurricane belt; however, in recent history it has been impacted by four hurricanes: Hurricane Janet (1955), Hurricane Lenny (1999), Hurricane Ivan (2004), and Hurricane Emily (2005).[33] On September 22, 1955 Hurricane Janet made landfall in Grenada as a Category 3 hurricane and lasted for approximately 8 hours, before finally leaving the island in the early hours of September 23, 1955. Likewise, Hurricane Ivan, which hit Grenada on September 7, 2004, was also a Category 3 hurricane that lasted approximately 8 hours.[34] Both Hurricane Janet and Hurricane Ivan would eventually grow to Category 5 hurricanes as they moved through the Caribbean, and are ranked in the ten most intense Atlantic hurricanes ever recorded, at tenth and ninth respectively (Martin, 2007, p. 120).[35]

3.2.1 COMPLACENCY

As a result of being considered outside the hurricane belt, Grenadians have historically exemplified a degree of complacency in their preparedness for hurricane strikes. McIntosh (1955, p. 9) describes the level of complacency portrayed by Grenadians, by highlighting that prior to Hurricane Janet "the island of Grenada which always made the proud boast of being outside the hurricane belt was rudely shocked to

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[33] Hurricane Lenny and Hurricane Emily will not be discussed in this study, as their impacts on Grenada were far less devastating than Hurricane Janet and Hurricane Ivan. Specifically, the eye of Hurricane Lenny struck hundreds of miles away from Grenada in the Leeward Islands, while Hurricane Emily struck Grenada as a Category 1 Hurricane.

[34] Due to its destructive nature, Hurricane Ivan has also received the moniker "Ivan the Terrible."

[35] Both Hurricane Janet and Hurricane Ivan resulted in hundreds of millions of dollars of damage to Grenada. Hurricane Janet also led to 120 deaths, while Hurricane Ivan caused 28 deaths. Infrastructural damage is outside the scope of this study and will not be discussed, as this study is concerned with damage to natural capital, and in turn, natural capital-dependent livelihoods.

reality, when on the night of the 22nd September, 1955, the heavy and unrelenting hand of a tropical hurricane was felt." To many Grenadians, the arrival of Hurricane Janet seemed like a mere isolated incident, one that could not repeat itself, given, once again, the fact that they were located outside the hurricane belt. However, as Ronaldo, an instructor in Marine Biology and Ecology at St. George's University, described, prior to Hurricane Ivan "we grew a bit complacent." Further along these lines, Alexander (2007, p. 8) argues that:

> The people of Grenada were not fully prepared for Hurricane Ivan's impact on the island due in part to the complacency with which they had come to view the likelihood of an impact from a hurricane. The country had not been directly hit by a hurricane in some 49 years, since Hurricane Janet in 1955, and a generation of Grenadians had never in their lifetime experienced a hurricane nor believed that they would ever be affected by one.

According to Edwin, a Public Relations Officer:

> Ivan left us all in shock. We didn't take any of the warnings seriously. For 49 years, all we heard was a lot of rhetoric about storm warnings. People joked that 'God must be a Grenadian.' The day Ivan came, people were playing football in the stadium, and when the government sent workers home early they treated it as a joke (Dean, 2010, p. 57).

3.2.2 The Location of Study: Telescope Point to Artiste Point

Grenada is divided into six Parishes: St. Mark's, St. John's, St. George's, St. David's, St. Andrew's, and St. Patrick's. This study focuses on the Parish of St. Andrew's, which is located on the east coast of Grenada, and has a population of approximately 25,000 people. More specifically, the focus is not placed on the entire east coast, but rather on the rural coastal communities stretching from the community of Telescope, north to the community of La Poterie. There is approximately 5 km of

coastline from Telescope to La Poterie, with numerous communities along the coast. The 5 km stretch is bookended by Telescope Point (situated near the community of Telescope) and Artiste Point (situated near the community of La Poterie). Moving northward from Telescope, the communities include: Telescope, Simon, Pearls, Conference, and La Poterie. The community of Moya is slightly more inland, and therefore to the west of Pearls. Each of these communities have a relatively small population, as depicted by Table 3.1.

Table 3.1: Population of Communities in the Location of Study

Community	Population
Telescope	1,476
Simon	648
Pearls	1,017
Conference	687
La Poterie	808
Moya	202

Source: Grenada Population and Housing Census (2001).

There are a few reasons as to why this 5 km stretch of coastline was selected as the case study location.

In order to answer the research question, it is necessary to look at a location in which livelihoods are contingent upon human/nature interaction. In the communities of Pearls, Conference, and La Poterie the economic activity of numerous inhabitants is dependent upon the local mangrove system.[36] Mangroves are the form of natural capital selected for this study, as they are a necessity in numerous livelihood pursuits. Mangrove-dependent livelihoods in the region that rely directly upon the mangroves themselves, the primary natural asset, include charcoal production. Furthermore, mangrove-dependent livelihoods that rely upon secondary natural assets include: farming, fishing, crab hunting, beekeeping, and cattle rearing.

Furthermore, the stretch of beach from Telescope Point to Artiste Point was selected as it absorbed the full brunt of both Hurricane Janet and Hurricane Ivan. As mentioned above, both hurricanes struck Grenada as Category 3 storms, and both inflicted damage upon the island for approximately eight hours. In both hurricanes, St. Andrew's was one of the hardest hit parishes. This is important as it allows for a

[36] The majority of interviews conducted for this study with community inhabitants pursuing mangrove-dependent livelihoods took place in Pearls, Conference and La Poterie. A few interviews were conducted in Simon and Moya. Interviews did not take place in Telescope; however, the location of study includes the stretch of beach from Telescope Point to Artiste Point, as this area experienced the highest degrees of sand mining in Grenada (which will be discussed in Chapter 4). Therefore, it is not practical to exclude a part of the beach between the two points, as the condition of one location on the beach, undoubtedly influences the condition of the beach a kilometer or two in either direction between the two points. Furthermore, the greatest concentration of mangrove-dependent livelihoods is in the communities of Pearls, Conference, and La Poterie, hence the majority of interviews were conducted in these communities.

historical comparative analysis to be conducted between two hurricanes that possessed similar characteristics.[37]

3.2.3 Complacency Re-Visited: The National Disaster Management Agency (NaDMA)

In further outlining the similarities between the two hurricane strikes, it is necessary to return our focus to the aforementioned degree of complacency that existed prior to the arrival of both storms. As discussed in Chapter 2, there exists a relationship between environmental practices and natural disasters, as exemplified through the discussion on the Indian Ocean tsunami of 2004. Therefore, we know that the utilization of SEPs would be an avenue upon which natural disaster preparedness could be pursued. The complacency of the Grenadian people prior to both hurricane strikes resonated, and continues to resonate, through the various channels of the Government of Grenada responsible for natural disaster preparedness, as there is an ongoing failure to actively acknowledge the intersection between environmental practices and natural disasters.

In 1985, the Government of Grenada established the National Emergency Relief Organization (NERO), which was the national decision-making authority for disaster relief (Nanton, Crawford, & Kempadoo, 2005, p. 17). In October 2004, a Cabinet decision changed the name of the National Emergency Relief Organization to the National Disaster Management Agency (NaDMA), with "the purpose being to more adequately reflect the mandate of the Agency as one of disaster management and not just response" (NaDMA, 2011). In a letter obtained from NaDMA, written by one of their

[37] It is, nonetheless, important to acknowledge that while Hurricane Janet and Hurricane Ivan possessed many similar characteristics, like all hurricanes, they differed as well.

National Disaster Coordinators in 2005, an emphasis was placed upon the importance of disaster response, rather than natural disaster preparation. An excerpt from the letter states, "following the passage of Hurricane Ivan, the need to have emergency relief plans and policies surfaced as one of our most urgent priorities in disaster relief management."[38] Indeed, disaster relief efforts are necessary, and such efforts have been pursued since the implementation of NERO. However, there has been minimal focus placed on preparedness, specifically through the institution of SEPs. According to Sanford, the Deputy Disaster Coordinator for NaDMA, the implementation of SEPs in order to reduce natural disaster vulnerability is an avenue that had never been explored by NERO, and subsequently by NaDMA, nor is currently being pursued.

Fittingly, NERO's and NaDMA's lack of environmental involvement tells us that there were no government instituted environmental measures in place to reduce hurricane vulnerability in St. Andrew's. Therefore, a comparative analysis of the conditions surrounding Hurricane Janet and Hurricane Ivan is further apropos since environmental, and more specifically mangrove interaction, by the community inhabitants took place on their own accord, and not as a result of government instituted policies and procedures in an attempt to reduce natural disaster vulnerability. However, there exists one exception.

One of the most significant differences between Hurricane Janet and Hurricane Ivan, is that Hurricane Janet struck before the commencement of large-scale, government-instituted sand mining, while Hurricane Ivan struck after the sand mining

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[38] I obtained the letter while searching for documents pertaining to Hurricane Ivan from the NaDMA Head Office at Fort Frederick in St. George's.

had begun. The area of beach from Telescope Point to Artiste Point was subjected to the highest degrees of sand mining in Grenada.[39]

To clarify, the 5 km of coastline from Telescope Point to Artiste Point, and the neighbouring communities, were selected as the case study location for the following reasons:

1. The community inhabitants in this region heavily rely upon the mangrove systems in pursuit of their livelihoods.

2. The region was hit hard by both Hurricane Janet and Hurricane Ivan, which possessed similar characteristics.

3. Environmental practices capable of diminishing natural disaster vulnerability were not imposed by NERO/NaDMA, meaning that all environmental practices taking place in the region were done under the initiative of the local community-based resource users, with one exception.

4. Large-scale sand mining, which began after Hurricane Janet and before Hurricane Ivan, was most common on the beach between Telescope Point and Artiste Point.

Therefore, in order to answer the research question, a longitudinal comparative analysis will be conducted that will consider the environmental/mangrove recovery that followed both hurricanes, and how this may be related to the viability of mangrove-dependent livelihoods.

3.2.4 MANGROVES

Mangroves are, as described by Polidoro et al. (2010, p. 1), an association of plant species that "form the critical interface between terrestrial, estuarine, and near-shore

[39] The issue of sand mining in Grenada will be discussed in greater detail in Chapter 4.

marine ecosystems in tropical and subtropical regions."[40] Mangroves can be regarded as the "foundation" upon which coastal ecosystems are built, as they play "a key role in providing the link between marine and terrestrial ecosystems. This link provides and maintains stability, not only to the mangrove habitat itself, but also to the other related coastal ecosystems" (The World Conservation Union, 2006, p. 2). In essence, mangroves provide a critical habitat for a variety of terrestrial, estuarine, and marine species (Polidoro et al., 2010, p. 1).

3.2.4.1 ESTUARIES

Mangroves are often found in estuaries. Estuaries are narrow, semi-enclosed coastal bodies of water that are connected to the open sea, oftentimes intermittently, and possess a salinity level that is measurably different from the salinity in the open ocean. As Layman, Moore, Dahlgren, and Kramer (2006, p. 7) highlight, "the estuarine environment is a transition zone between the fresh water and sea water worlds. As such, the salinity within estuaries fluctuates frequently, creating stress on the organisms that inhabit these areas." Along these lines, different mangrove species have varying degrees of tolerance to water salinity levels.

3.2.5 MANGROVES IN THE LOCATION OF STUDY

In St. Andrew's, from Telescope Point to Artiste Point, mangrove species are found both along the shoreline and in estuaries, with the largest estuaries in the area

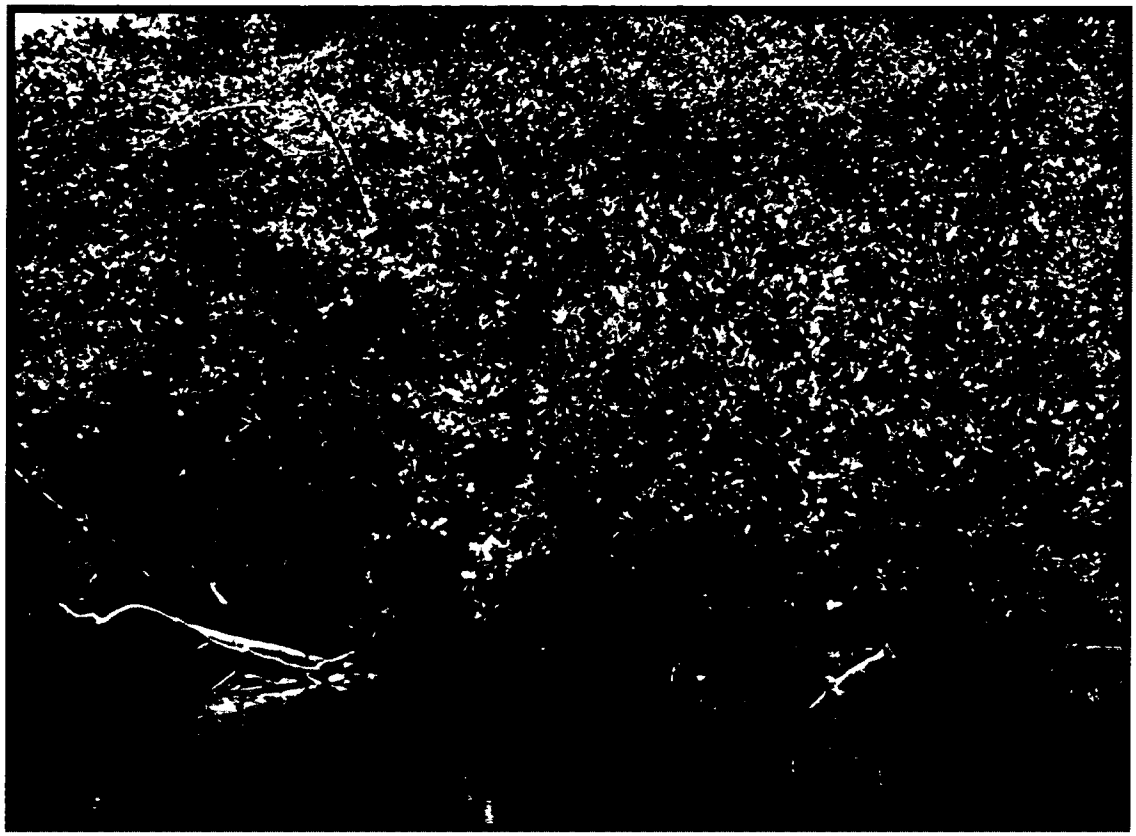
[40] While mangroves were mentioned in Chapter 2 as a means of providing examples for the material that was being discussed, they will now be briefly explained, and then discussed in relation to the location of study.

situated on both sides of the Meadow, which divides Pearls and Conference. Mangrove species in the area include: red mangrove (*rhizophora mangle*), black mangrove (*avicennia germinans*), white mangrove (*laguncularia racemosa*), and buttonwood mangrove (*conocarpus erectus*). Figures 3.4 – 3.9 illustrate the different types of mangroves found in the location of study, while Figures 3.10 and 3.11 provide an estuary view.

Some of the functions of the mangrove system in the location of study are: they provide important breeding and nursery areas for many fish species; they are home to numerous crab species; they act as a buffer to wave activity, thus preventing high concentrations of salinity from washing inland; they trap rain clouds and bring higher degrees of precipitation to low-lying coastal areas; their flowers are a significant source of nectar for bees; and they provide stability to other types of coastal vegetation living in the ecosystem, such as coconuts, sea grapes, and fat pork.[41]

[41] There are numerous ecological benefits brought about by mangroves, and a detailed description of such would greatly exceed the breadth of this study.

Figure 3.4: Red Mangrove in the Location of Study (Image 1)

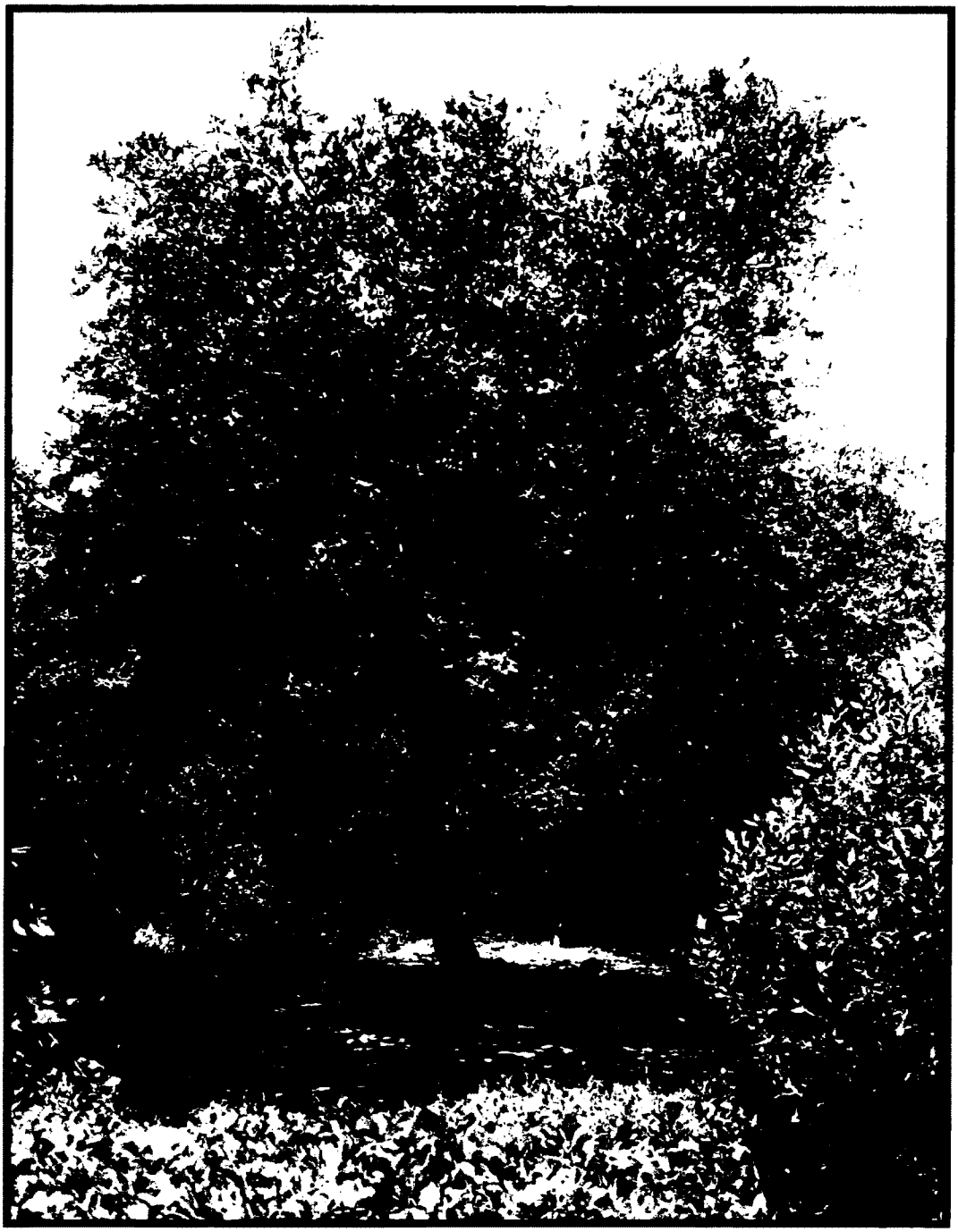


Source: Photo taken by Author in August 2010.

Figure 3.5: Red Mangrove in the Location of Study (Image 2)

Source: Photo taken by Author in August 2010.

Figure 3.6: Black Mangrove in the Location of Study



Source: Photo taken by Author in August 2010.

Figure 3.7: White Mangrove in the Location of Study

Source: Photo taken by Author in August 2010.

Figure 3.8: Buttonwood Mangrove in the Location of Study (Image 1)

Source: Photo taken by Author in August 2010.

Figure 3.9: Buttonwood Mangrove in the Location of Study (Image 2)

Source: Photo taken by Author in August 2010.

Figure 3.10: Estuary in the Location of Study (Image 1)

Source: Photo taken by Author in August 2010.

Figure 3.11: Estuary in the Location of Study (Image 2)

Source: Photo taken by Author in August 2010.

3.3 CONCLUSION

The communities between Telescope Point and Artiste Point serve as an ideal location for a historical analysis of the impact of environmental practices upon mangrove-dependent livelihoods. In part, this is due to the fact that the region was hit by two hurricanes of similar force, and many locals have memories of their respective impacts upon both the environment and livelihoods. Equally important, is that the dramatic change in sand mining practices between the two hurricanes allows for a comparative analysis of how environmental practices impact the stock of natural capital, and thereby the viability of natural resource-dependent livelihoods.

CHAPTER 4: FINDINGS

4.1 INTRODUCTION

Thus far we know that the location of study has been struck by Hurricane Janet and Hurricane Ivan, and possesses mangroves living along the shoreline and in estuaries. As previously mentioned, the location of study has also been subjected to high intensity sand mining. In the first half of this chapter, the relationship between Hurricane Janet, Hurricane Ivan, sand mining, and the mangrove conditions will be revealed through an amalgamation of these events through a historical lens, commencing in the pre-Hurricane Janet era, and concluding at the present time. In doing so, the first half of the chapter will look at the environmental (mangrove) conditions in the location of study up to 1987, which is regarded as the year in which large-scale sand mining commenced. Consideration of the environmental (mangrove) conditions from 1987 to the present time will then be "put on hold," while the practice of sand mining is discussed from its infancy to the present time. Upon doing so, the analysis of the environmental (mangrove) conditions will be resumed, and will include the period from 1987 to the present. The second half of the chapter will then consider how mangrove-dependent livelihoods have shifted throughout time. Understanding this "livelihood shift" requires careful consideration of the events presented in the first half of the chapter.

The interviews that were conducted paint both the pre and post-Hurricane Janet pictures, and span across two large generational clusters. The elder generation, which includes respondents between the ages of 59 – 85 is comprised of community inhabitants

who were capable of speaking through lived experience about the events surrounding Hurricane Janet. The younger generation consists of respondents between the ages of 21 - 58, who do not have firsthand knowledge of the events surrounding Hurricane Janet.

4.2 THE RELATIONSHIP BETWEEN HURRICANE JANET, HURRICANE IVAN, SAND MINING, AND THE MANGROVE CONDITIONS

4.2.1 PRE-HURRICANE JANET

4.2.1.1 ENVIRONMENTAL (MANGROVE) CONDITIONS

Prior to Hurricane Janet, the environmental conditions from Telescope Point to Artiste Point were idyllic.[42] The area possessed a lush mangrove system, with a plethora of diverse vegetation intertwined with the mangroves (such as coconuts, sea grapes, and fat pork). This sentiment was voiced by Oliver, who claimed that "before Janet we had a very nice environment," which was supported by a "very healthy" mangrove system that "kept the environment firm." Patrick described the pre-Hurricane Janet mangrove conditions as, "very good, glorious, beautiful," and Paul explained that the area was "very fruitful" at that time. The mangroves were well developed and mature, "big and tall," according to Shawn, and were "all over," in Godfrey's opinion. As Leron explained, the mangroves stretched "miles away from here...From down there, up here could include 2 miles. Yeah, because it went right up to Conference there, and La Poterie."

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[42] Interview excerpts in section *4.2.1.1 Environmental (Mangrove) Conditions* are only from interviews held with the elder generation.

Before Hurricane Janet, the mangroves were also extremely dense, and as Shawn recalls, "I could hardly go down there at that time," as a result of the density. Three lakes existed through the mangrove system: Middle Lake, Small Lake, and Pearls Lake. Due to the mangrove density, according to Godfrey, charcoal producers would often have to access the mangroves via boats. Furthermore, while interviewing Richard in the Meadow, he explained that prior to Hurricane Janet, "when the rain would come, the entire Meadow was like a big swamp. There was water everywhere." These swamp-like conditions were welcomed, as they played a vital role in contributing to the lushness of the area.

A strong indicator of the quality of the mangrove system, and in turn the coastal region, is the fact that it was heavily relied upon by the community inhabitants as a place of recreation. Swimming, cooking, playing sports, and leisurely consuming the coconuts, sea grapes, and fat pork were activities that locals frequently engaged in. Oliver recalled his appreciation for the fruitfulness of the area by describing that, "in the days gone you have what we call the grapes, and I remember in my young days, you know, when we were going down to the beach, we wonder whether we must pick up grapes from the tree, or whether we must take what fall on the ground." According to Patrick, "before Hurricane Janet the condition of the coast was very very good. Very nice. We played football, cricket. You could run on the beach with no prevention. The beach was very nice." A proud Godfrey explained that "we had one of the greatest beaches around that area, in front of the Pearls airport there," with local people coming by the bus load, and bringing their food to cook on the beach. "As a boy there was a very good beach from

Grenville back to Conference," Paul recalled. "You can walk on the beach right to Conference (from Grenville)."[43]

Furthermore, a main road that went from Grenville, all the way up north to Levera was situated approximately 200 ft from the beach, and ran through a system of thick vegetation consisting of mangroves, sea grapes, and fat pork (see Figure 4.1).[44] Therefore, to the east of the road, the 200 ft of separation from the beach was occupied by vegetation. The mangrove species to the east of the road would have been predominately red mangroves, as they are highly salt tolerant. Vegetation to the west of the road consisted of more black mangroves, which are far less salt-tolerant. To appreciate the separation between the road and the beach, one can look to Karl, who said, "you couldn't stay on the road to throw the ball on the beach." According to a geological survey of Grenada conducted in 1924, "the main road which completely encircles the island is – considering the topographical conditions – an excellent one" (Earle, 1924, p. 2).

[43] Grenville is the second largest town in Grenada, after the capital city of St. George's. It is located along the east coast, in close proximity to Telescope Point.

[44] Levera is located on the northeastern tip of the island in the Parish of St. Patrick's.

Figure 4.1: Map of the Location of Study Showing Coastal Road (1801 - 1824)

Note: The image shows a considerable amount of separation between the road from Grenville to Levera, and the sea.
Source: Image retrieved by Author in August 2010 from the Ministry of Tourism and Civil Aviation. Used with Permission.

4.2.1.2 Sustainable Sand Removal

For numerous years, Grenadians have removed sand from their beaches and used it as aggregate in their construction initiatives. This was common practice well before the arrival of Hurricane Janet in 1955; however, the methods and quantity of sand removal have greatly shifted over time.

Prior to Hurricane Janet, sand removal was guided by what Edward, Environmental Protection Officer with the Ministry of the Environment, Foreign Trade, and Export Development, referred to as the "God Concept." The God Concept operated

under the belief that God had provided the Grenadian people with an abundance of sand for their utilization.

Minimal amounts of sand would be removed from the beaches, and the method of removal was rather simplistic. A man, or a few men, would drive to the beach in a truck, and with a spade remove some sand. As Neil explained, "what I used to do, okay, I have a truck and then I have some work to do, I come and get some sand on my truck and then be gone." For those that did not own a truck, sand delivery rested in the hands of, as Shawn explained, the "Small Man;" meaning members of the community that owned their own truck and would deliver sand for a small fee. Trevor described the process of obtaining sand through a small man. "Sometimes I might have something (work) to do here. I tell a fella, 'hey, I want you to bring some sand to me.' He just go and bring some sand. He tell you, 'give me X dollars.' I pay the fella, and you done." Generally, the cost of purchasing a load of sand from a Small Man, would range from EC$25 to EC$100.[45]

Sand removal with a spade allowed for what Michael referred to as "sustainable harvesting." According to Rohan, who operated as a Small Man, "by the time you took the sand, the waves flushed it back as if you didn't take any at all," while Carlo explained that, "when you take with the spade, and the waves come up, by morning it levels it out, flattens it out. So it was like nothing was removed." Regardless of whether the beach condition returned to its pre-sand removal state in a matter of minutes, or a matter of

[45] As of August 1, 2010: EC$1.00 = CAD$0.38.

hours, there is a consensus amongst the community inhabitants that the removal of sand with a spade was sustainable.

The sustainable removal of beach sand meant that the sand that was being removed was of high quality, specifically pertaining to its salinity level. The sand would generally be removed from higher up on the beach, rather than at the transition point from the beach to the ocean. As a result, the sand would go through a process of natural desalinization, as rainwater would effectively reduce its salt content. This is important, as high levels of salt in the sand would corrode through the steel that was often used in construction undertakings.

Prior to Hurricane Janet, the "God Concept" was effective. The mangrove system was healthy, the beach was not only an area where people truly enjoyed spending time, but it contributed to their identity, and sand removal took place in a sustainable fashion. As Trevor explained, "before Janet, people didn't used to interfere with that (the mangroves and the beach), everybody just leave the thing alone."[46]

4.2.2 POST-HURRICANE JANET

4.2.2.1 ENVIRONMENTAL (MANGROVE) CONDITIONS

4.2.2.1.1 ELDER GENERATION

As a result of being hit by Hurricane Janet, the mangrove system, and coastal region, experienced some damage, as is to be expected. However, in the eyes of those

[46] By "leave the thing alone," Trevor was saying that the coastal region was not being overexploited.

who lived through Hurricane Janet, the environment experienced relatively minimal degrees of damage, and ultimately underwent a rapid recovery. According to Oliver, "after Janet the trees was damaged, especially in the mang area...the mangrove was damaged, but then it rebuild back."[47] To illustrate the re-growth, he further explained that it was not possible to see the mountains, which are situated towards the interior of the island, from the beach, due to the height of the mangroves, which had reached approximately 100 to 120 ft. Along these lines, Paul also mentioned that, "it (Hurricane Janet) was a catastrophe, but it (the mangrove recovery) didn't take long." Godfrey recalled that in some of the more dense locations within the mangrove system, such as those that were only accessible by boat, following Hurricane Janet, even some of the juvenile mangrove plants had survived the hurricane strike and were continuing to grow.

Interestingly, some interview respondents felt that the mangroves recovered so quickly after Hurricane Janet, that they would hardly consider the mangroves to have experienced a decrease in quality. "Well, I don't think it did much to them," Leron explained. "The Hurricane did not do much." According to Trevor, "it (the mangrove system) was there, nobody worry, it was just the same." In their interviews, both of these respondents acknowledged that the mangroves did experience some damage as a result of Hurricane Janet, but their comments indicate that the hurricane did not cause more long-term mangrove debilitation.

In a few short years following Hurricane Janet, community inhabitants all agreed that the coastal region had achieved recovery. Not only were the mangroves healthy, but

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[47] "The mang," or "mang wood," are terms often used by Grenadians when talking about mangroves.

so too was the surrounding vegetation, such as the coconut trees, sea grapes, and fat pork. Philip said that the mangroves were, "big and green in the top," while Karl, and Patrick both used the adjective "beautiful" to describe the conditions. As Karl stated, "oh yeah, here was beautiful," while Patrick cheerfully exclaimed, "well it was beautiful...what a nice piece of mang, nice mang!"

4.2.2.1.2 Younger Generation

Thus far, the post-Hurricane Janet conditions have been described from the perspective of community elders; individuals who lived in the communities prior to the arrival of Hurricane Janet. However, in order to develop a comprehensive understanding of the mangrove conditions in the years following Hurricane Janet, up to the present time, it is necessary to also consider the perspective of those community inhabitants who were born after Hurricane Janet.

In the years following Hurricane Janet, the coastal region, and more specifically the mangroves, saw a return to the pre-Hurricane Janet "lushness levels." Many respondents expressed that the mangrove trees were approximately 100 to 120 ft in height. As Gordon described, there was "lots of green vegetation," while Emmanuel explained that, "there were really a lot of big huge mangroves all over the place." Running through the mangroves, the lakes were also in good condition. So much so, that during an interview, Henry used his machete to illustrate in the dirt road, in an attempt to effectively convey the size and health of the lakes.

The beach was also in good condition. Running through Pearls is an airstrip, known as Pearls Airport, which is no longer in use.[48] While still operational, departing aircraft would fly over a few hundred feet of vegetation and beach, prior to flying over the open sea. As Simon repeatedly described, "where the airstrip end, there was a lot of land after the airstrip. A lot, a lot of lands outside the airstrip." The amount of land at the end of the airstrip was so plentiful that Douglas recalled a "long walk" from the end of the airstrip to the sea.

Perhaps most fittingly, Carlo's description captures the ideal environmental conditions:

> When you go down by the beach, there was this line of grapes and fat pork. Naturally grown, lush, green, just protecting the coconuts. Protecting the beach. There was the beach, wide area with sand, the row (coconuts, sea grapes, and fat pork), then the mangroves. Then you go and look at mangroves, and you watch up and watch the trees, like the trees were moving with the clouds, for they were that tall. You could go down there and get wood to maybe replace a telephone post. They were so straight and strong...We are talking about the trees moving with the clouds. Yeah, like they were moving and tall...Way up. And I tell you, in those days, mangroves, the sea, everything was almost what you could call perfect, nice, a beauty to behold. Yes, it was real nice.

Consistent with the ideal environmental conditions, many community inhabitants also heavily relied upon the coastal region as a place of recreation. Carlo compared the atmosphere on the beach to that of Grand Anse, and Emmanuel explained that on holidays there would be no less than 200 to 300 people on the beach.[49] The wide beach

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[48] This used to be the main airport in Grenada prior to the construction of the Maurice Bishop International Airport (formerly known as the Point Salines International Airport) between 1979-1985, which is located at the southwest tip of the island in the Parish of St. George's at Point Salines.

[49] Grand Anse is a 3 km beach situated in close proximity to the capital city, St. George's, and provides a place of recreation for numerous Grenadians and visitors.

provided an ideal location for sports to be played, as community members often engaged in cricket, and football matches. According to Emmanuel, when playing cricket, the beach was so wide that "you couldn't lose a ball." When asked about the beach conditions, James reminisced about the times he and his 5 friends often wanted to know who was the best runner, so they would go down to the beach and run because of all the open area that existed. The lakes also provided a place for many community inhabitants to bath, as well as explore the beauty of the mangrove system via canoe. As Stacey explained:

> We used to do canoeing there. It was very important for us. You could canoe into the mangrove, just to see what was inside. Yeah, we used to go through the mangrove canoeing. In the mangrove there were lots of birds and wildlife, and ducks. You don't get that in Grenada (it is very rare). It was really nice to see the water ducks. It was so nice.

The road from Grenville to Levera was also in good condition, and was, as Martin recalled, surrounded by "land on both sides of the road." According to Simon, "the road used to go pass in below the airstrip." This means that the end of the airstrip was met by vegetation, the road, more vegetation, the beach, and then finally the sea.

Thus far, the data reveals many similarities between the conditions prior to and following Hurricane Janet. Following Hurricane Janet, just as before Hurricane Janet, the God Concept continued to prevail, meaning that sand removal with a spade continued as well. Upon suffering some damage, the mangrove system recovered, and the coastal area remained a place where community inhabitants could enjoy recreational activities. Community inhabitants had minimal impact on the environment, and in the words of Gordon, the people "just left things alone."

4.2.3 The Commencement of Large-Scale Sand Mining: The Gravel, Concrete, and Emulsion Production Corporation (1987)

As a consequence of the construction of the Pearls Airport in 1944, a quarry in Telescope, producing construction materials, came into operation, and was run by the government-controlled Gravel, Rock, Asphalt and Concrete Products (GRACP) (GCEPC, 2011). The GRACP did not interfere with the spade-oriented sand removal process by community inhabitants, as discussed above. Essentially, the GRACP and Small Man both functioned as separate entities.

In 1979, however, the Government of Grenada passed the Beach Protection Act; "an act to prohibit the unauthorized removal of sand, stone, shingle and gravel from the seashore." According to Section 2 of the Act, "if any person digs or takes and carries away any sand, stone, shingle or gravel from the seashore, he is guilty of an offence and liable, on summary conviction, to a fine of five hundred dollars and to imprisonment for six months."

This Act spelled the end of the stark division between the GRACP and the Small Man. Under the Act, the process of sand removal with a spade continued; however, it had now become government controlled. In order to legally remove sand, community inhabitants owning their own truck and collecting their own sand, or the Small Man who was distributing sand, were required to pay a fee at the Telescope Quarry, receive documentation of payment, and then continue with the sand removal process as they had done prior to the imposition of the Act. As Rohan recalled, "you had to get a paper from the office to say you want 1, 2, 3 yards (of sand) and they charge you for that." While community inhabitants despised the idea of paying a fee for the very sand they had

previously been able to use without restriction, many saw the process as a mere inconvenient formality, and nonetheless abided by the law. At the same time, those who continued to remove sand, as they had always done, without the required documentation, were in effect committing an illegal act.

Seeking greater regulation, and ultimately involvement in the process of sand removal, the Government of Grenada passed the Gravel, Concrete and Emulsion Production Corporation Act (1987), which can be described as, "an Act to establish a Corporation to be known as the Gravel, Concrete and Emulsion Production Corporation to manage the exploitation of naturally occurring aggregate material and bituminous resources and the manufacturing of products and by-products for supplying the needs of Government and satisfying private demands."[50]

By 1989 the Government of Grenada passed the Standards Act, which is, "an Act to provide for the preparation and promotion of Standards in relation to goods, services, processes and practices by the establishment and operation of a Bureau of Standards to define the powers and functions of the Bureau of Standards and for connected matters."

For the Government of Grenada, all the pieces were in place for them to possess a monopoly over the removal of beach sand. They had legislation to prohibit the unregistered removal of sand, a corporation in place to carry-out the sand removal and distribution process, and a standards bureau to ensure that the sand they were distributing was of specific quality. According to Rohan, "by and by, gradually, Gravel and Concrete (GCEPC) come in with the tractor and try to push you away...then they say you don't do

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[50] The Gravel, Concrete and Emulsion Production Corporation (GCEPC) is overseen by the Ministry of Works, Physical Development and Public Utilities.

anymore (sand removal)." As Shawn bluntly described, "then the government didn't want you to pick up sand, you had to buy it from them." By the late 1980s and early 1990s, large-scale sand mining was underway in Grenada.

4.2.3.1 How it was Done

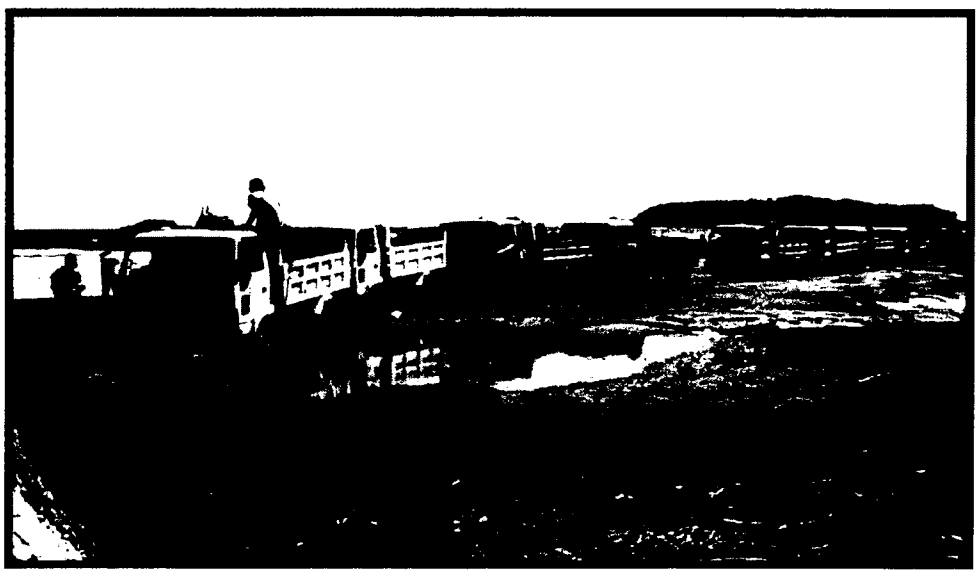
The sand from Grenada's east coast is said to be the highest quality of sand available on the island. When discussing the sand quality, James, enthusiastically explained that, "the sand is good here man, the sand is good!" The desirability of the sand from the east coast, lies in the fact that it is, according to Oliver, amongst many others, "the best sands for plaster...for finishing works," thus resulting in a smooth finish. Along these lines, Marvin referred to the sand as "Grade 1 sand."[51]

Consequently, operating out of the Telescope Quarry, GCEPC heavily concentrated their sand mining efforts on the stretch of beach between Telescope Point and Artiste Point. This entailed a shift in the methods of sand extraction from the previously-deployed spade, to machinery capable of removing far greater quantities of sand. Once removed from the beach, the sand would usually be stockpiled at the Telescope Quarry, and in order to meet the specifications established by the Grenada Bureau of Standards (GBS), was washed prior to being sold (Ruitenbeek & Cartier, 2001, p. 11). On a daily basis, GCEPC would load multiple trucks ranging from a 10 to 30 ton carrying capacity (see Figure 4.2), in order to meet, as Monique, Manager Secretary with GCEPC confirmed, their average annual baseline of 120,000 tons of sand per annum (see

[51] According to Edward, on the west coast of Grenada, the sand is black, and therefore not as appealing for building. As well, the black sand beaches are much more metallic, with a high iron content, thus making black sand harder for workers to use.

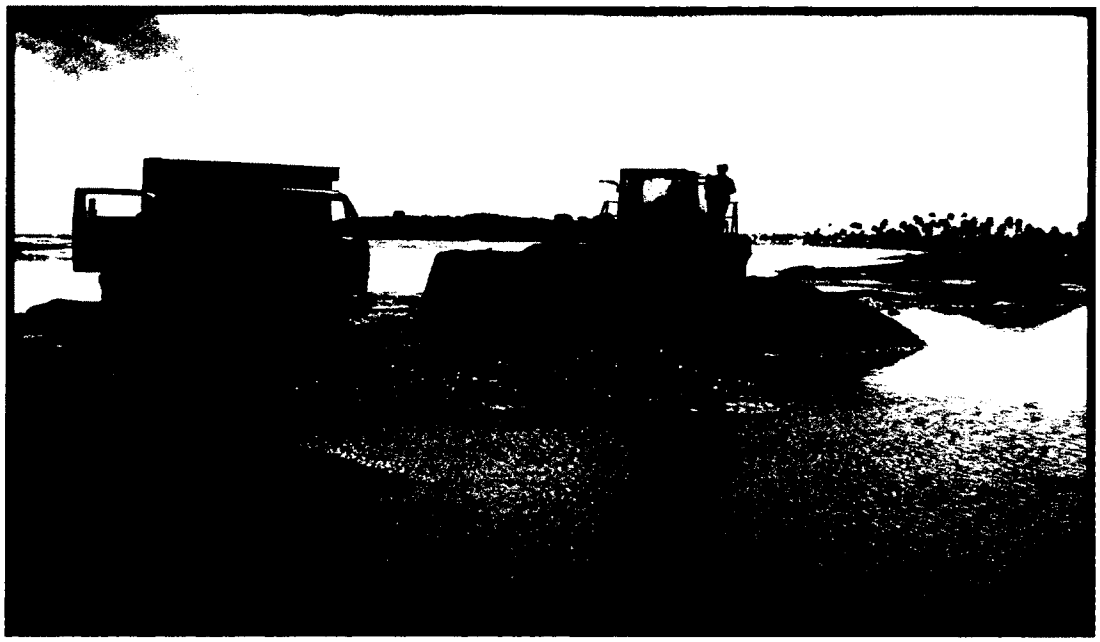
Table 4.1). Doing so required the constant presence of sand miners, and according to Michael, "sometimes there were so many trucks lined up in a day trying to get sand that some of them couldn't even get a load." The removal of sand on such a large scale necessitated the utilization of front end loaders and excavators, which many interview respondents generalized as "tractors" (see Figure 4.3; Table 4.2). In their continual search for sand, GCEPC would encroach upon, and eventually surpass, the shoreline. According to Martin, "when the sand get low on the beach, they use an excavator, and go in the sea and scrape the sand." As Carlo recalled, "sand mining really got serious when Gravel and Concrete (GCEPC) moved to Telescope and they started using the front end loader and started stockpiling sand...and I tell you sand mining became a big business."

Figure 4.2: GCEPC Trucks Removing Beach Sand



Source: Photo taken by GCEPC in 2008. Image retrieved by Author in August 2010 from GCEPC Head Office. Used with Permission.

Figure 4.3: GCEPC Using a Front End Loader to Remove Beach Sand



Source: Photo taken by GCEPC in 2006. Image retrieved by Author in August 2010 from GCEPC Head Office. Used with Permission.

Table 4.1: Amount of Sand Harvested (1997 – March 2009)

Measurement	Year	Sand (tons)	Source
Amount of Sand Removed	1997	102,600	Rutinbeek and Cartier (2001)
	1998	109,350	
	1999	91,800	
	2000	128,250	
Amount of Sand Used	2000	87,292.96	GCEPC
	2001	65,107.15	
	2002	69,281.53	
	2003	94,323.86	
	2004	60,196.15	
	2005	92,390.62	
	2006	74,009.78	
	2006	106,727.71	
	2008	61,272.10	
	January 2009 – March 2009	34,984.60	

Note 1: The figures obtained from Ruitenbeek and Cartier (2001) are much higher than those obtained from GCEPC. An important distinction between the two figures is that the ones from Ruitenbeek and Cartier (2001) include the amount of sand "removed" by GCEPC, while the ones from GCEPC include the amount of sand "used." Therefore, the figures retrieved from GCEPC do not include the full amount of sand "removed."

Note 2: Ruitenbeek and Cartier (2001) converted from cubic yards to tons by Author using the following conversion presented by Rutinbeek and Cartier (2001): *1 cubic yard of sand = 1.35 tons of sand.*

Source: Ruitenbeek and Cartier (2001), and GCEPC. GCEPC figures obtained from GCEPC Head Office by Author in August 2010. Used with Permission.

Table 4.2: Criteria Associated with Varying Sand Extraction Intensities

Level	Equipment/Persons Involved	Estimated Quantity Removed Per Trip
Small-Scale	Shovel, buckets, pushcart/wheelbarrow, small pick-up truck	50 - 1,400 lbs
	Usually requires 1-2 people	
Medium-Scale	Shovel, small trucks (<5 tons)	2.7 – 6.75 tons
	Usually requires 3 people	
Large-Scale	Shovels, front end loaders, large trucks (>5 tons)	6.75 – 21.6 tons
	Usually requires 4-6 people	

Note: Estimated Quantity Removed per Trip converted to tons using the following conversion presented by Rutinbeek and Cartier (2001): *1 cubic yard of sand = 1.35 tons of sand.*
Source: Isaac (1997). Adapted by Author.

4.2.3.2 THE COST OF SAND FROM GCEPC

According to Isaac (1997, p. 69), "the existence of these beaches (on Grenada's East Coast) has meant a ready supply of fine aggregate for use in the production of concrete for building and road construction...the mining of beach sand in Grenada...provided...100% of the requisite for fine aggregate." This excerpt from Isaac (1997) is important in that it highlights the dependence upon sand in the Grenadian construction industry. With a heavy reliance upon sand, and the regulation of sand mining by GCEPC, an increase in the cost of sand was inevitable. Being distributed out of the Telescope Quarry, sand prices increased to approximately EC$200 – EC$350 per load. For residents in the location of study, who are situated in close proximity to the

Telescope Quarry, the cost of transporting sand from the Telescope Quarry to their work site was relatively minimal.[52]

4.2.3.3 THE EMERGENCE OF ILLEGAL SAND MINING

As outlined in the Beach Protection Act of 1979, the removal of sand from Grenada's beaches by any party other than GCEPC was illegal. This being the case, increased sand prices with the arrival of GCEPC, created a demand for cheaper sand, and ultimately led to the rise of illegal sand mining. According to Brenda, GBS Standards Compliance Officer, illegal sand mining was of small-scale. However, as Emmanuel explained, "apart from the government, there was a lot of illegal sand mining." Sand would usually be extracted with a spade, as it had traditionally been done, and the prices of illegally-mined sand remained relatively constant to those of the pre-GCEPC era. With the overwhelming presence of GCEPC trucks on the beaches during the daytime hours, illegal sand mining became a nighttime activity.

4.2.3.4 COMMUNITY REACTION

With excessive sand removal occurring on a daily basis, some community inhabitants became disenchanted. As a result, a group of community members began blocking roads with concrete slabs, and iron bars, thus preventing beach access for GCEPC trucks. As Marvin described, "we fought feverishly to put a halt to the (sand mining)." However, this proved to be ineffective in the long-run. According to Stacey, "what they did, they came and they make new roads (around the blocked roads to access

[52] Many interview respondents referred to this as "truckage."

the beach)." As Stacey further explained, the Government of Grenada did not respond to the request of the community group members to cease GCEPC-led sand mining. Rather, as Emmanuel recalled, signs began to emerge in the communities that sought to put a halt to illegal sand mining, as revealed by Figure 4.4.

Figure 4.4: Sign Against Illegal Sand Mining

Source: Photo taken by Author in August 2010.

4.2.3.5 The Cessation of GCEPC-led Sand Mining (December 2008)

In recent years, the issues surrounding sand mining in numerous countries have increasingly received attention. In response to growing concerns, Tillman Thomas, the leader of the National Democratic Congress party, focused his 2008 Prime Ministerial

campaign on the banishment of sand mining in Grenada. Upon winning the general election on July 8, 2008, Prime Minister Thomas ensured that GCEPC would no longer remove sand from Grenada's beaches after December 31, 2008.[53]

4.2.3.6 Sand Alternatives: Domestic Quarry Sand and Imported Sand from Guyana

With Grenada's high demand for sand, the country offered two alternative options: domestic quarry sand, and imported sand from Guyana.[54] Quarry sand, which is produced by GCEPC, is made by finely crushing stone. The importation of sand from Guyana, which commenced in March 2009, required a more rigorous process in its infancy. Tests were conducted on the sand to determine its quality, as well as to search for pathogens and pests that could be imported with the sand. As outlined on the GCEPC website (2011):

> Prior to our first importation, a team from Grenada consisting of specialists from the Grenada Pest Management Unit, and Laboratory Personnel from Gravel, Concrete & Emulsion Production Corporation visited the sand pit to conduct a series of tests including chemical analysis and inspections for the presence of pests, diseases or any other item or pathways that could introduce harmful impacts to our Country.

Currently, according to Brenda, all imported sand is tested by GBS, and must meet certain particle size specifications, as exemplified in Figure 4.5.

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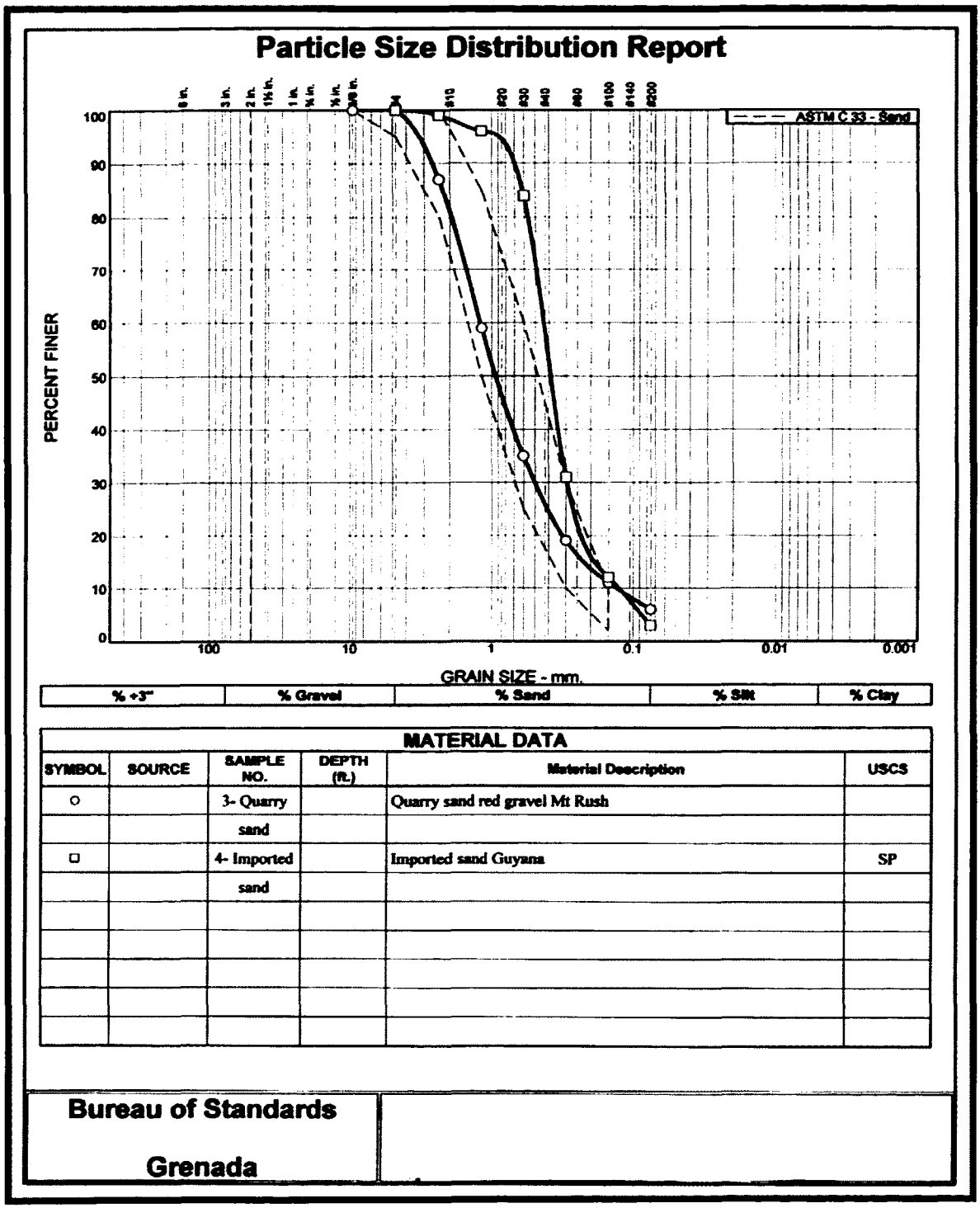
[53] GCEPC stockpiled sand and used it from January 2009 to March 2009, as shown in Table 4.1.

[54] Unlike the beach sand from Grenada, Guyana's sand comes from inland and does not possess salt.

Figure 4.5: GBS Particle Size Distribution Report



Note: The figure provides an example of the sand standards that are sought by GBS. In this example, quarry sand and imported sand from Guyana are added together to ensure that the correct particle size is met.
Source: Figure obtained from GBS Materials Laboratory by Author in August 2010. Used with Permission.

4.2.3.7 Disenchantment with Domestic Quarry Sand and Imported Sand from Guyana

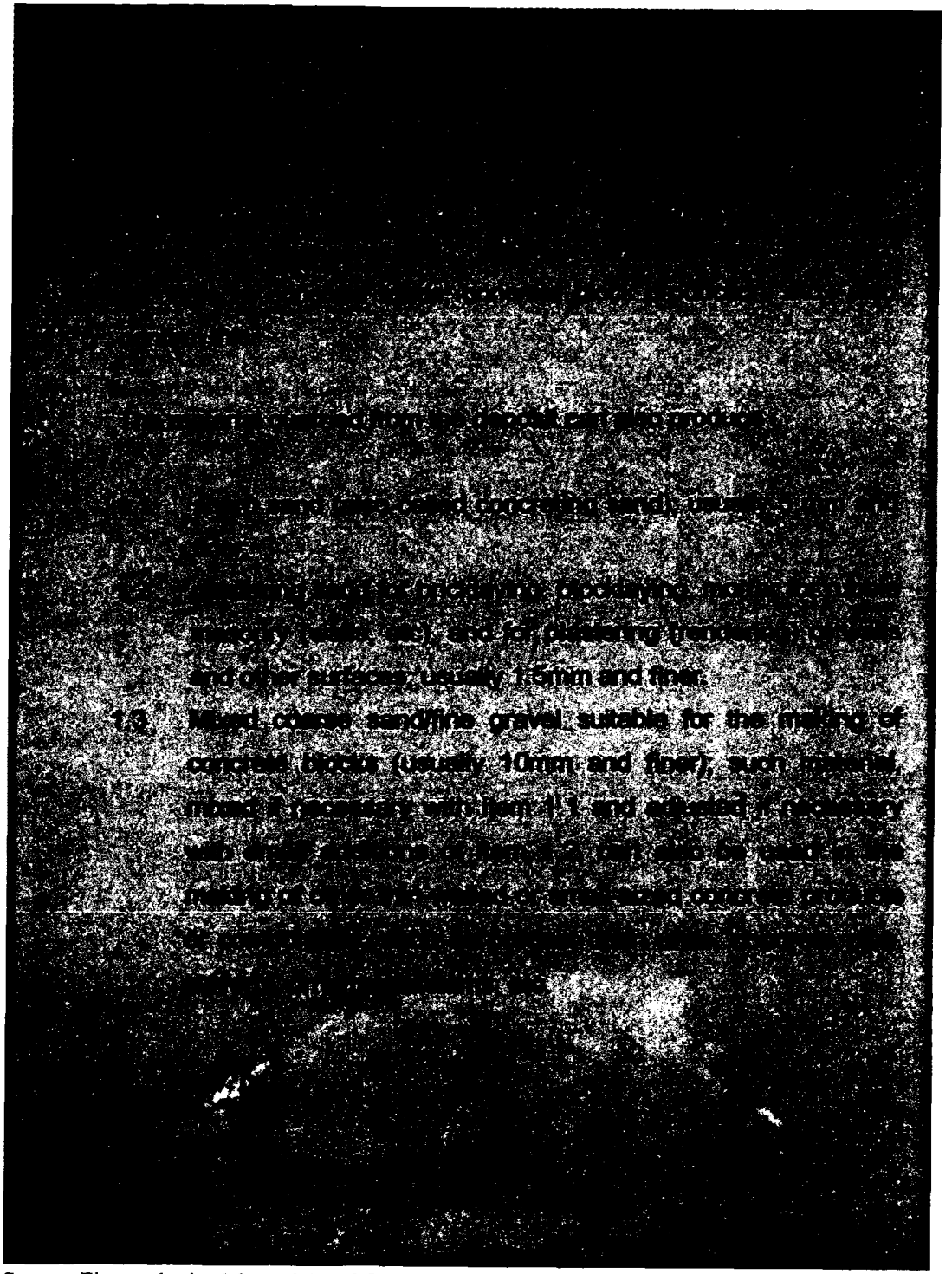
Throughout Grenada, contractors, workers, and individual sand users (i.e. a person who needs a small amount of sand to do some work on their property), have expressed their displeasure with the two sand options currently being offered by GCEPC. According to Edward, Environmental Protection Officer with the Ministry of the Environment, Foreign Trade, and Export Development, at times there are shortages in the amount of quarry sand that is available for sale, and "from the contractors' perspective, this means that the quarry sand is unreliable, as they still have jobs that they have to get done." Furthermore, it is argued that both the quarry sand and imported sand are of lesser quality than the beach sand in Grenada. As discussed by Philip Isaac, Head of the GCEPC Telescope Quarry, in *Info-View*, many masons and contractors feel that quarry sand and imported sand does not allow for as "smooth" of a finished product as the Grenada beach sand does (Government Information Service, 2010).

The greatest amount of unrest amongst sand consumers, lies in the fact that sand prices have, as Brenda phrased it, "skyrocketed." Transportation of the sand from Guyana to Grenada, and processing of the sand by GBS are factors that have contributed to the increase in sand prices. However, one of the most significant factors, for those situated in the location of study, is that the cessation of sand mining on Grenada's east coast means that sand is no longer sold from the Telescope Quarry. Rather, all sand is now sold out of GCEPC's Queen's Park location, which is situated in St. George's. According to Martin, "you have to carry it (the sand) up from St. George's and you have to pay the truck. When they were doing it (sand mining) here (in the location of study) it

was not expensive for the people in the communities in St. Andrew's." Therefore, the cost of "truckage" has significantly increased the sand prices. Numerous interview respondents claimed that a load of sand, including truckage, currently costs anywhere from EC$1,000 – EC$2,000.

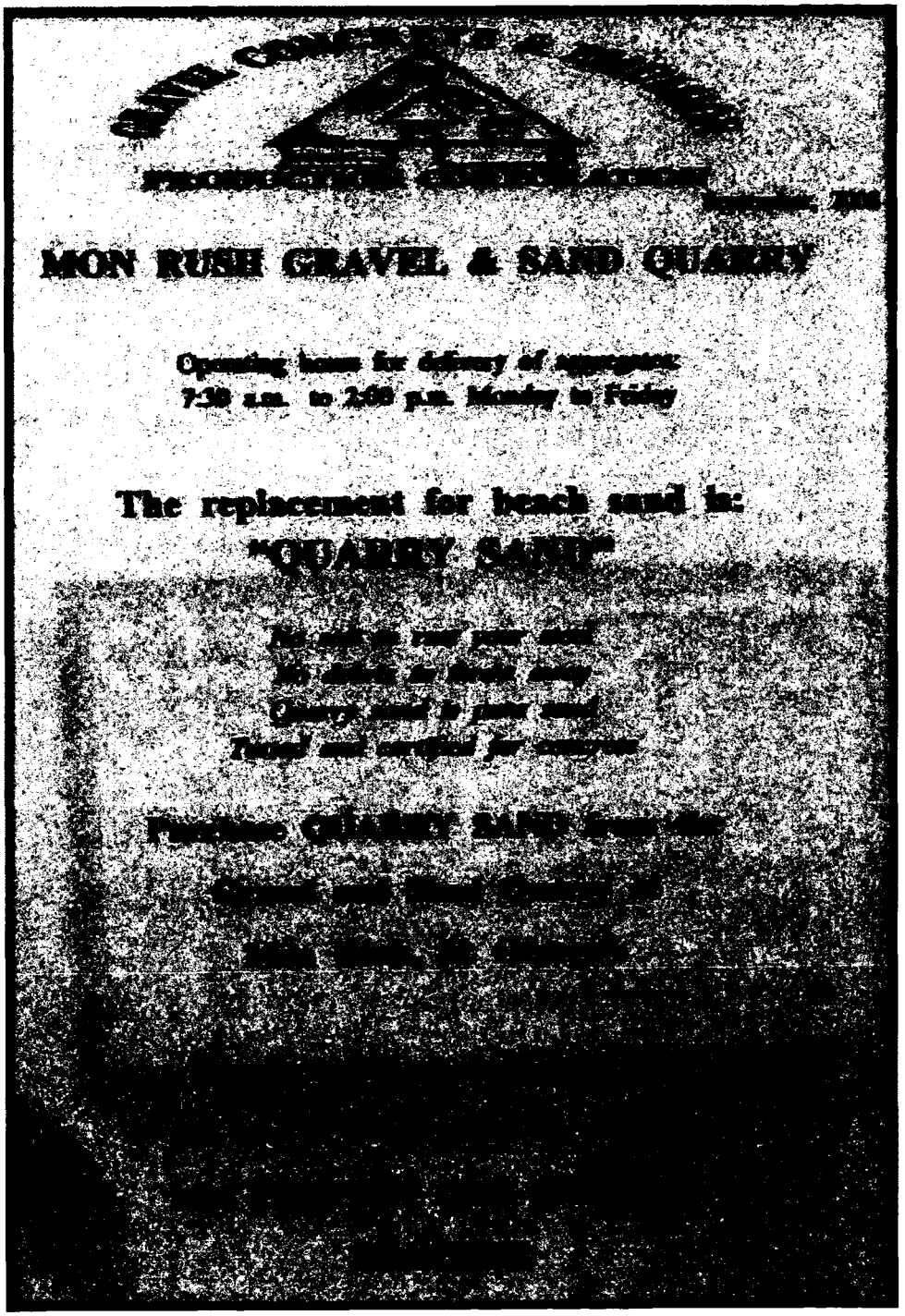
As Edward explained, in response to the displeasure amongst the Grenadian people with the increased sand prices, the Government of Grenada has tried to convince sand users that Grenada's quarry sand is of equal of greater quality in comparison to Grenada's beach sand. Upon visiting the GCEPC Head Office at Mon Rush, situated in St. George's, some of the framed items hanging on the wall confirmed Edward's claim, as quarry sand was advertised as a high quality product (see Figure 4.6; Figure 4.7). Furthermore, GCEPC produced a pamphlet entitled *Inland Quarry Sand vs. Beach Sand*, which outlines the "advantages" of quarry sand and the "disadvantages" of beach sand.

Figure 4.6: Letter to GCEPC Regarding Quarry Sand Quality



Source: Figure obtained from GCEPC Head Office by Author in August 2010. Used with Permission.

Figure 4.7: Notice from GCEPC Regarding Quarry Sand Quality



Source: Figure obtained from GCEPC Head Office by Author in August 2010. Used with Permission.

4.2.3.8 The Growth of Illegal Sand Mining

The unreliability of quarry sand, the perceived decreased quality of both quarry sand and imported sand, and the significantly increased sand prices, have created ideal conditions for the growth of illegal sand mining. Sgt. Franklin, of the Royal Grenada Police Force (RGPF) explained that, "it (illegal sand mining) has picked up, especially after 2008. Since they started importing sand, people thought that the sand that was coming was too expensive." According to Carlo, "it's so expensive that the people that used to sand mine before with the spade see it as the government don't want them to take the sand because they want (all the money) themselves. Because they don't see the spade as serious as the loader, they continue to go and steal the sand at night." Along these lines, almost every interview respondent, when asked about the illegal sand mining, attributed it to the high prices of quarry sand and imported sand. Currently, a load of illegal sand can be purchased from anywhere between EC$200 to EC$800 depending on the load size, and personal connections with the illegal sand miners.

4.2.3.8.1 How it Works

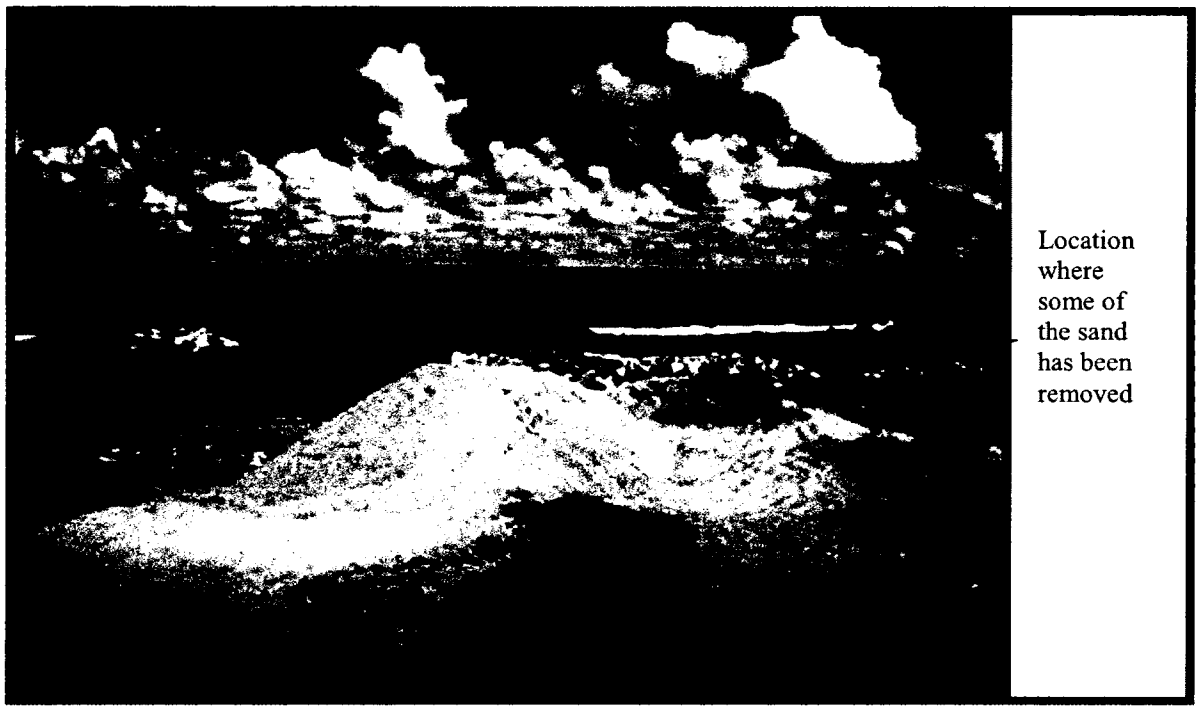
Illegal sand mining in Grenada, is said to be "rivaling the already growing illegal drug trade" (The New Today, 2010). Operating like "nocturnal animals," illegal sand miners have developed an intricate network in practicing their trade. Specifically, "sand miners have become more organised in terms of their strategies and in some cases move into locations with dogs and people to scout out the area to ensure that the beach is clear before carrying out their illegal trade" (The New Today, 2010).

The following interview excerpts reveal the intricacy of the illegal sand mining network:

> In fact it's a big network now, they have people with cell phones...In Conference they have people at the Junction so that they can inform the people at the beach when the police is coming (Sgt. Franklin).
>
> Night time. They are so smart now that they are approaching at all hours of night time and they storing the sand way up on land. So if you want a load of sand, you don't have to go to the beach again, they go somewhere where they have sand, and take a load of sand and just drop it for you (Sgt. Franklin).
>
> So you will see for example somebody in the house or the veranda, it's dark out. But they will be there with a cell phone and you don't see them, they don't normally come out at night but you will see them, then (you know) something's going on, but only when they are doing something...And then they will call and let them know. They will have like somebody in the Junction waiting in case police coming to a call, and then the man at the beach has a phone too. It's like a network (Stacey).
>
> You don't see the truck when it's going down, you see them coming up. You don't know the road that they using (Stacey).
>
> So they hustle, so when you see them down by the road, they don't idle, they are waiting on a job, waiting on a truck. So then people up the road now, there is a lot of people involved in the business. People with cell phones, before the police come they call (and say), 'the police coming' so the truck can hide, they drop the sand, or they swing down inside behind my garden and hide the truck (Carlo).

According to Sgt. Franklin, police have information on approximately 7 – 10 people that are involved in heading up the illegal sand mining, each possessing their own trucks. Out of those 7 – 10 people, they each hire people to load the trucks. As Emmanuel explained, "they give them sometimes EC$30 a load...they just have to spade it and throw it up on the truck...guys tell me sometimes they make up to EC$700 a night just loading up the truck." Figures 4.8 - 4.10 show current signs of illegal sand mining.

Figure 4.8: Mound of Sand with Evidence of Sand Removal



Note: A mound of sand sitting on the beach in the location of study, with noticeable signs that some of the sand has already been removed.
Source: Photo taken by Author in August 2010.

Figure 4.9: Bags of Sand Lying on the Beach

Source: Photo taken by Author in August 2010.

Figure 4.10: Half-Full Bag of Sand Lying on the Beach

Source: Photo taken by Author in August 2010.

4.2.3.8.2 A LACK OF TRANSPARENCY

With a flurry of illegal sand mining activity occurring, some community members have taken it upon themselves to patrol the area and notify police immediately of any potential sand mining activity. Jeremy explained that, "they use their cell phone to call the police right away if they are out and about, and come across some activity that they think might be sand mining." However, many community inhabitants are reluctant to call the police both out of fear for their own personal safety, and a lack of trust in the police force. As revealed in the above interview transcript excerpts, illegal sand miners will at times hide their trucks behind Carlo's garden. Out of fear for his property and own safety, he explained that, "I will never call the police. No way, never. No Way. Because you see down there, down there is risky for me...I go down there night and day. So I have to be careful. Even though I don't talk, they still have eyes on me."

There appears to be a disconnect between many community inhabitants and the police force. According to Henry, "if I see a man take sand, I don't call the police now, because I don't find the police do their work." As Joel explained, he sees the illegal sand miners "every other day," but is beyond the point of trying to notify the police. Carlo said that the illegal sand miners will often "give you (the police) a couple of drinks. Give you a little something," thus prompting him to call the system "corrupt." This fact is not lost on Sgt. Franlkin, who revealed that "some police, I think, they may be benefitting from the trade too." He further explained that police officers receiving sand mining calls from community inhabitants often deter future calls, as they ask for specific details on the caller, and attempt to determine the caller's identity. According to Sgt. Franlkin, "all you

need is information, and then you just move on it. Directions, and you just move. The name of the person calling isn't important at all. But it's very hard to get that into some of them (police officers), because some of them do benefit."

The current penalty in place, a fine of EC$500 and 6 month imprisonment does not substantially deter illegal sand mining. Sgt. Franlkin explained that, "they (the illegal sand miners) will take another load of sand just to pay that $500." If imprisoned, "when they come out, it's like they missed a job, so they will go back immediately." In fact, according to Henry, "people come out of prison bigger, stronger, and healthier, and go back to their crime, but are more physically able to do so."

4.2.4 A Shift in Environmental Conditions Since 1987

At this point in the chapter we know that prior to Hurricane Janet the field site had a lush mangrove system. Community inhabitants used local beach sand in their construction endeavours, and the sand was extracted with a spade, which proved to be sustainable, as the beach would naturally recover within a matter of hours. As expected, Hurricane Janet inflicted some damage upon the coastal region, and more specifically the mangrove system within the location of study. Within a few years following Hurricane Janet the mangrove system recovered, and the coastal environment was healthy. At the same time, sand removal with a spade continued until the late 1980s, when the Government of Grenada began large-scale sand mining. This brought an increase in sand prices, and Grenada experienced the early stages of illegal sand mining. By 2009 the Government of Grenada had officially ceased its sand mining efforts, and began offering quarry sand and imported sand from Guyana as alternatives. Once again, this led to an

increase in the cost of sand, and created an even greater niche for illegal sand mining to not only continue, but to experience a significant degree of growth. This being the case, the coastal environment and the health of its mangroves have only been discussed up to the 1980s. It is now necessary to consider the impact of state-led sand mining on the environment, while factoring in the arrival of Hurricane Ivan in 2004.

4.2.4.1 Land Loss Between 1987 and September 6, 2004

GCEPC's large-scale sand mining had immense impacts on the stretch of beach in the location of study. In 1995, Cambers released a study that looked at beach change figures at various locations around Grenada from 1985-1991. Three of the beach sites in Camber's study were situated in the location of study, between Telescope Point and Artiste Point. Two of the beach locations were near Telescope Point, and the other was located further north on Conference beach. At the Telescope locations, it was found that "there was dramatic erosion resulting from the beach sand mining by the quarry" (Cambers, 1995, p. 19). More specifically, Telescope 1, which was measured from 1985 – 1990, showed consistent erosion, as the beach area decreased by -15% and narrowed at a rate of -0.7m/yr. Telescope 2, measured from 1987 – 1990, also eroded on a consistent basis, with the beach decreasing by -22%, and narrowing at a rate of -1.1m/yr.[55] However, at the Conference location, between 1985 – 1990, very little beach change was observed. In the early stages of sand mining by GCEPC, more sand mining took place in closer proximity to the Telescope Quarry. Yet, as the sand mining continued, it moved further north in the location of study.

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[55] For the purpose of this study, the sites were renamed "Telescope 1" and "Telescope 2."

As discussed above, GCEPC-led sand mining occurred on a daily basis. According to Jeremy, "as a result of over mining, the sand quality was so bad that they (GCEPC) were just collecting stone." This perspective was echoed by numerous interview respondents, including Trevor, who explained that, "they dig right down until they make it hard." The current stony conditions of the beach are revealed in Figures 4.13 and 4.14. Over time, the intensity of the sand mining greatly diminished the beach size, and when asked how much beach has been lost, Oliver spiritedly responded, "plenty plenty plenty plenty!" Each interview respondent acknowledged that a great deal of beach had been lost, and emphasized that prior to the GCEPC-led sand mining, the sea was approximately 100 - 300 ft further out than it is now. Simon felt that between Telescope Point and Artiste Point, over 100 acres of land have been lost. As he explained, "it stretches from Pearls right back to Conference. And then you are talking about back down Paradise, and Telescope. So it's a lot of land. It could be over a hundred acres." Figures 4.15 – 4.17 highlight the significant amount of beach erosion that has taken place, while Figure 4.18 reveals the potential for erosion to continue.

In describing the loss of land, many interview respondents identified that the sea is now situated in much closer proximity to them. As Godfrey described, "the sea take a lot of lands," and Karl stated that, "it (the sand mining) make Grenada come very much smaller than it was. The sea come in a lot." "Every day, gradually, it (the sea) keeps coming in more and more and more and more," explained a concerned Douglas.

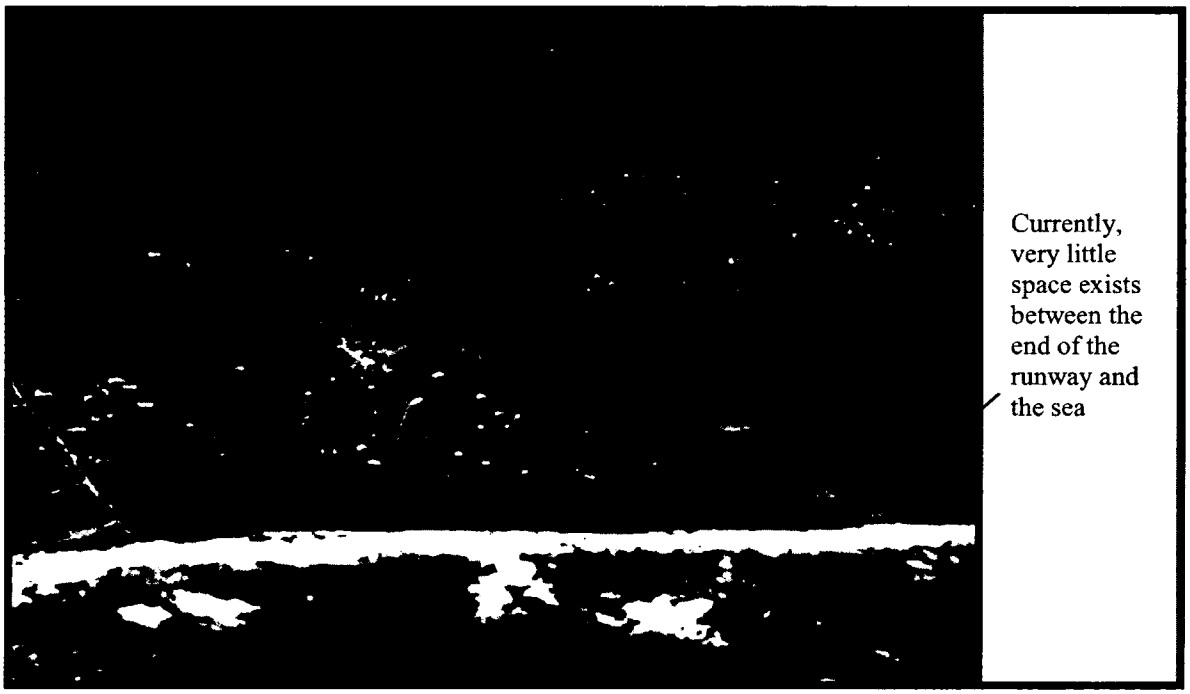
In highlighting just how much of the beach has been lost, numerous interview respondents revealed that the coast is no longer a place of recreation, despite formerly

acting as the social gathering hub. Cooking, bathing, and playing sports are activities that no longer take place on the beach. As Latoya recalled, "I used to go on the beach and bath, and now I'm not going." Carlo explained that, "the size of the beach, the width of the beach. I used to go down there as a little boy and play football. You could play football on the beach, you could play cricket on the beach, yeah that massive wide area of sand, beautiful, and now it's no more." Speaking about her childhood, Stacey recalled, "I remember as a little girl, the husbands go out and fish with the boats and stuff, and then the wives go down and the children, so that we used to go down after and meet them on the beach, so that whatever they catch, was not only for sale, but we eat on the beach. The wives would have a little pot, and we would cook on the beach. These things don't happen anymore. All that's gone." Furthermore, I observed that it is no longer possible to walk from Telescope Point to Artiste Point, as the water level is too high. This loss of recreational opportunities has prompted Douglas (2003, p. 91) to state that, "the village is no longer a source of entertainment."

In further exemplifying the amount of land that has been lost, the sea is now located much closer to the end of the Pearls airport runway, as shown in Figure 4.11. As Simon described, "where the airstrip ends, there was a lot of land after the airstrip. If you go down there now, you notice that the airstrip and the sea are one thing." In fact, the sea is now so close to the airstrip that large stones have been dumped at the end of the runway in an attempt to keep the water from flooding it. Moreover, in discussing the road from Grenville to Levera (mentioned above), Philip observed that, "when they started taking the sand...the road started breaking." Eventually the road condition

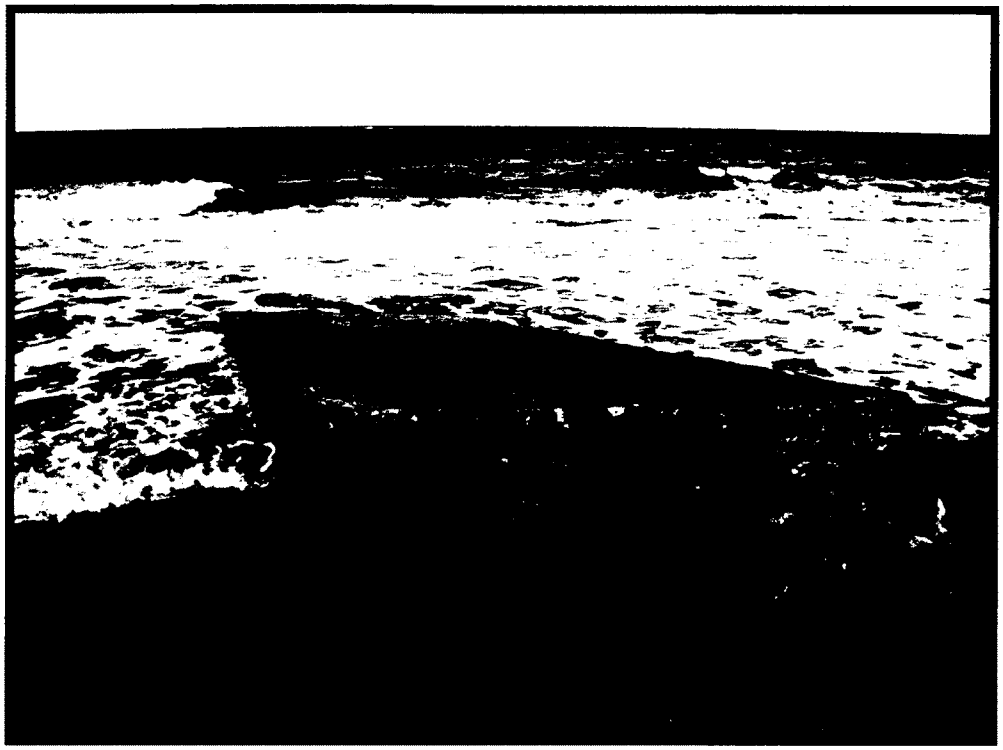
deteriorated to a point that it was no longer usable, and currently the road no longer exists, as the land on which it was once situated has been lost (see Figure 4.12). As Karl described, "the sea pass there where the road was."

Figure 4.11: Aerial Image of Pearls Airstrip



Note: Aerial image of the Pearls Airstrip showing very little separation between the end of the runway and the sea. In the past, the end of the runway and the sea were separated by a few hundred feet of vegetation, the road from Levera to Grenville, more vegetation, and the beach.
Source: GCECP website (2011). Used with Permission.

Figure 4.12: Remnants of the Road From Grenville to Levera

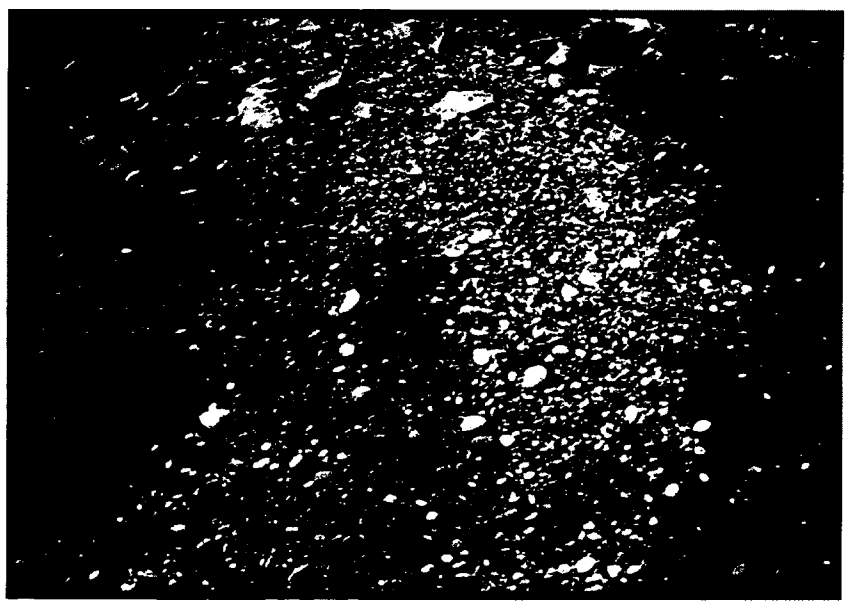


Note: The road was formerly separated from the sea by a few hundred feet of vegetation and beach.
Source: Photo taken by Author in August 2010.

Figure 4.13: Beach Near Telescope Quarry (Image 1)

Source: Photo taken by Author in August 2010.

Figure 4.14: Beach Near Telescope Quarry (Image 2)

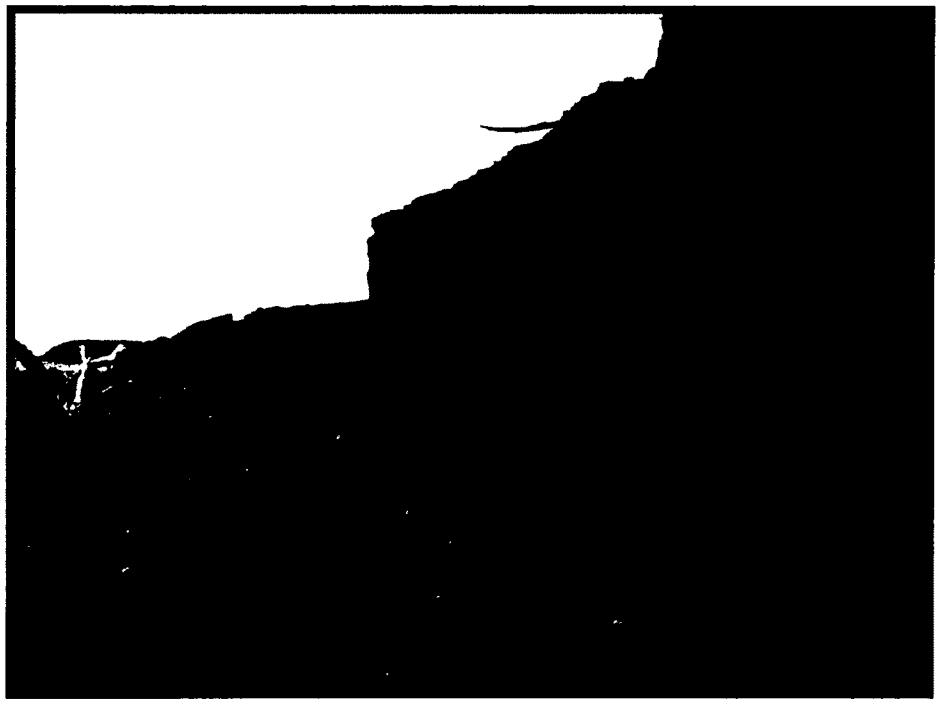


Note: Some beach areas in the location of study have had such high amounts of sand removed that the beach is now mostly comprised of stone.
Source: Photo taken by Author in August 2010.

Figure 4.15: Evidence of Coastal Erosion (Image 1)

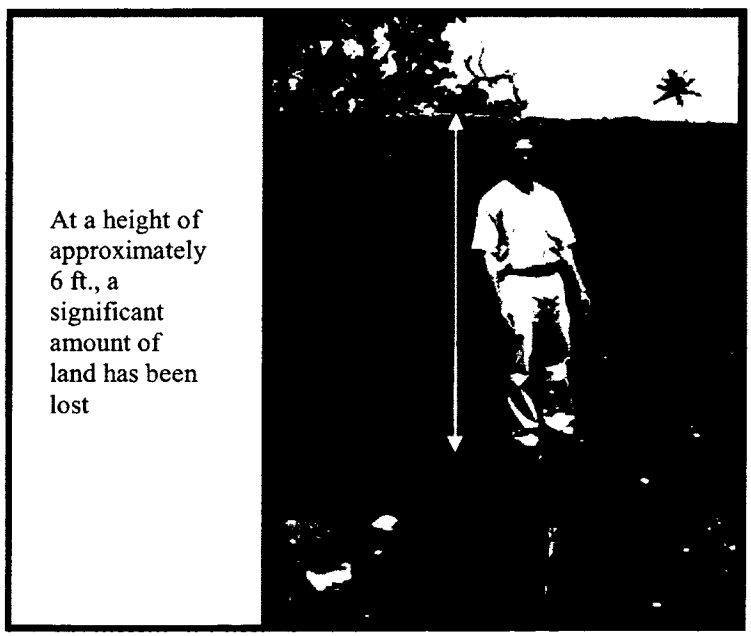
Source: Photo taken by Author in August 2010.

Figure 4.16: Evidence of Coastal Erosion (Image 2)



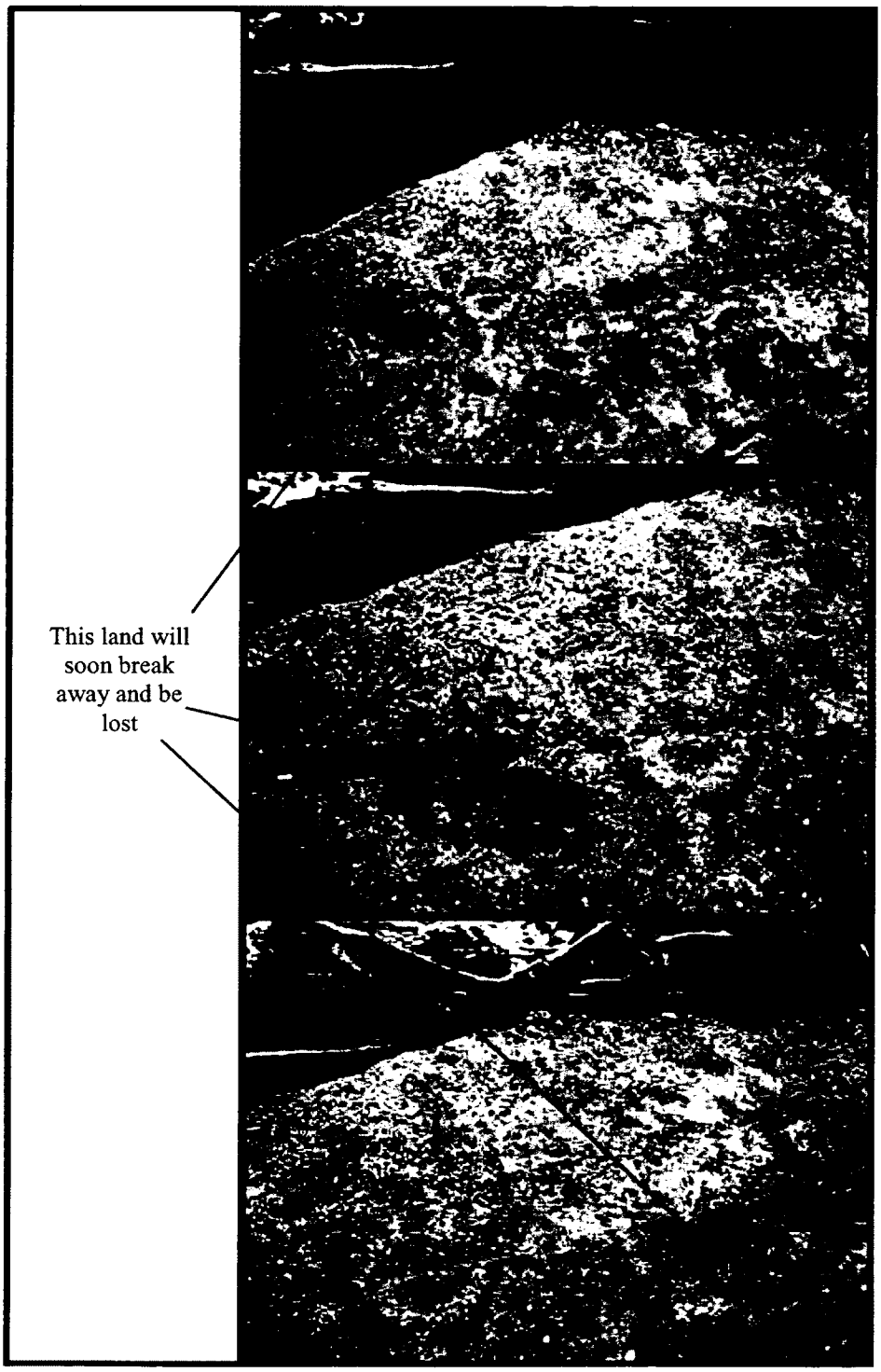
Source: Photo taken by author in August 2010.

Figure 4.17: Evidence of Coastal Erosion (Image 3)



Source: Photo taken by Author in August 2010.

Figure 4.18: Indication that Coastal Erosion will Continue



Source: Photos taken by Author in August 2010.

4.2.4.1.1 Mangrove Damage Between 1987 and September 6, 2004

How has this significant loss of land affected the mangrove population? In looking at the health and quality of the mangrove system, it is necessary to do so in two periods of time. The first period of time is from 1987 (the early stages of GCEPC-led sand mining) – September 6, 2004 (the day before Hurricane Ivan). Therefore, this time period stretches from the sand mining commencement right up to Hurricane Ivan. The second period of time is September 7, 2004 – present. This is the post-Hurricane Ivan period.

As discussed above, plenty of land was lost due to extensive sand mining. As a result of the land loss, the sea progressively infringed upon the mangrove system. According to Carlo, "it (the sea and the mangroves) come together." Without any beach separating the sea and the mangroves, Martin explained that, "with the push up of the sea, and that sand mining, you have plenty sea water going inside the mangroves." At the same time, the sand mining impacted the mangrove root system in two ways. First, as Marcus explained, "the roots got dry and loose, as a result of the sand mining." Essentially, the sand removal resulted in excessive sun exposure, and salt exposure, beyond the tolerable levels for the mangrove root systems, thus causing them to weaken. Secondly, the sea encroachment began to overbear the damaged root systems with high

quantities of sand, as wave activity continually pushed the remaining sand closer towards the mangrove system. Ultimately this began to suffocate the root system, and as Neil explained, "the sand around the roots, they killed it. (Mangroves) can't survive because of the sand. They can't survive because they get no air, no oxygen." In fact, the land loss, and sea encroachment, caused, according to numerous interview respondents, the three lakes (Middle Lake, Small Lake, and Pearls Lake) to "shrink in."

With the sea essentially flooding the mangrove system, "more salt has come in," according to Leron. This increased salinity "shocked" many of the "frontline" mangrove plants, and according to Philip, as the sand mining progressed, and the sea increasingly encroached upon the land, "they (mangroves) started falling into the sea." This began to cause a shift further inland for the various types of mangrove species, and seeing that the red mangrove is more tolerant to sea salt, red mangrove plants progressively began to grow further inland.[56]

Therefore, between 1987 and September 6, 2004, the condition of the mangrove system experienced progressive deterioration, thus leading the mangrove population to become less diverse and more sparse. However, despite the changes that were taking

[56] As previously mentioned, the road and sea were divided by vegetation consisting primarily of the more salt tolerant red mangrove plants. As the land, and subsequently the road were lost, the red mangrove plants moved further inland, and began to encroach upon the far less salt tolerant black mangroves, as discussed by Jeremy.

place in the coastal environment, the mangrove system still remained, albeit in a somewhat altered form.

4.2.4.1.2 Mangrove Damage Between September 7, 2004 and the Present Time

Hurricane Ivan had a great impact on the mangrove system. As Simon explained, "Ivan helped contribute to that problem too (the deteriorating mangrove conditions). It increased the problems together with the sand mining." More bluntly, Quinton described that "Ivan did a hell of a lot!" Pertaining to the mangrove conditions following Hurricane Ivan, the following interview excerpts highlight the damage that was inflicted upon the mangroves:

> The mangrove was destroyed, and a lot of it got broken down and tangled up (Marvin).
>
> Everything was wiped out (Daniel).
>
> Ivan threw down a lot of big trees. There used to be some huge trees in that area (Simon).
>
> Ivan did a lot of mashing up. Ivan flattened the place (Shawn).
>
> I tell you, after Ivan...the whole mangrove was flat...the strength of the wave pushed sand all inside (the mangroves), I think that helped get rid of the lagoon (lakes) too. It was choked by the sand...so that the body of water (the lakes) that was seen, is no more. If it's there, it was very little (Carlo).
>
> It (Hurricane Ivan) mashed it (the mangroves) down. Sent the sea right inside (the mangroves)...flattened the place (Marcus).
>
> It (Hurricane Ivan) threw down a lot of trees (Godfrey).
>
> It (Hurricane Ivan) damaged it all up. Mashed it (the mangroves) up (Eric).

> Plenty sand went inside the mang. Far far inside. About 200 ft inside (James).

The above interview responses, along with others not included, revealed that Hurricane Ivan damaged numerous mangrove trees, resulted in increased mangrove suffocation by displacing, and moving further inland, large amounts of sand, and caused further flooding to the mangrove system. Essentially, in the immediate aftermath of Hurricane Ivan, the mangrove conditions were far worse than they were prior to Hurricane Ivan.[57] This is attributable to the fact that the coastal environment, and more specifically the mangroves had a decreased ability to resist Hurricane Ivan, as a result of the sand mining. "It (the sand mining) weakened the barrier," Marvin explained. As a consequence, according to Trevor, "the reason why I believe Ivan make so much damage, is because it have nothing to break it down." Specifically, the two quotations above are applicable to both the beach, as well as the mangroves. As revealed above, leading up to Hurricane Ivan, the stretch of beach in the location of study had greatly diminished in size, and the quantity of sand greatly decreased. When Hurricane Ivan hit, as Martin outlined, "the sand was already flat...(there was) no push or anything from the sand." Therefore, the beach was not capable of acting as a buffer against increased wave activity brought about by Hurricane Ivan, and ultimately was unable to protect the mangrove system. According to Godfrey, "the sand was not there to back the sea from coming up into the land." Furthermore, not only was the beach incapacitated in its ability to offer some degree of protection, but the mangroves as well proved to be unable to effectively

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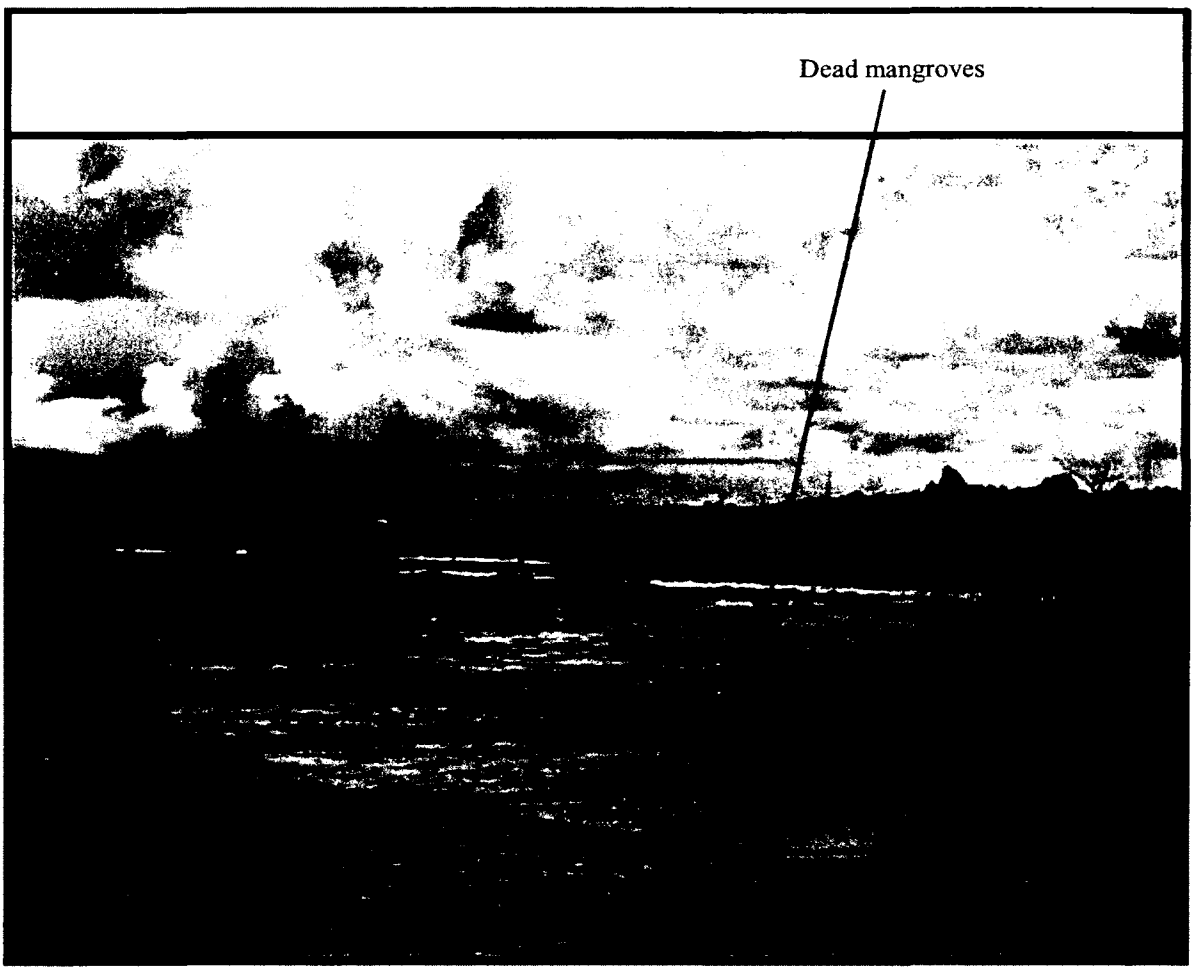
[57] As discussed above with Hurricane Janet in 1955, undoubtedly some mangrove damage is expected upon a hurricane strike; however, the mangrove damage as a result of Hurricane Ivan was far greater than the mangrove damage caused by Hurricane Janet.

protect themselves against Hurricane Ivan. As a result of their weakened state, and pre-Hurricane Ivan sparsity, the mangroves proved to be incapable of offering much resistance. Along these lines, Emmanuel described his view on the series of events. He revealed that the sand mining had weakened the soil that the mangrove root systems were imbedded in. Therefore, "when Ivan came in, it uprooted a lot of mangroves." Moreover, as Robert described, "the wind came right through. (There was) nothing to break the wind." Many mangroves were in a "standalone position," meaning they experienced the full brunt of Hurricane Ivan, without receiving an element of protection from neighbouring mangrove plants. Fittingly, Jeremy stated that, "what happened pre-Ivan was exacerbated by Ivan."

Following Hurricane Ivan, the mangrove conditions continued to decline. As Marcus explained, "after Ivan, it got more worse." With Hurricane Ivan bringing more water and sand inland, the balance of mangrove species continued to change. As mentioned, prior to Hurricane Ivan, red mangroves had already continued to grow further inland. After Hurricane Ivan this pattern continued, as the increased salinity further inland led to an increased mortality rate amongst the far less salt tolerant black mangroves. Furthermore, the three lakes have greatly decreased in size, and hardly exist. According to Stacey, "here, right now, it's drying up. You can't canoe there anymore. Mangroves are destroyed, and the lagoon (lakes) are destroyed." Along these lines, Shawn explained, "you can't even see the lakes now." Further exacerbating the post-Hurricane Ivan environmental quality decline is the fact that, as previously discussed, GCEPC-led sand mining did not stop until December 31, 2008, meaning that it continued

for 4 years following Hurricane Ivan. As well, since the cessation of GCEPC sand mining, illegal sand mining has become more prevalent. Figures 4.19 – 4.21 indicate the poor mangrove conditions in the location of study.

Figure 4.19: Poor Mangrove Conditions in the Location of Study (Image 1)

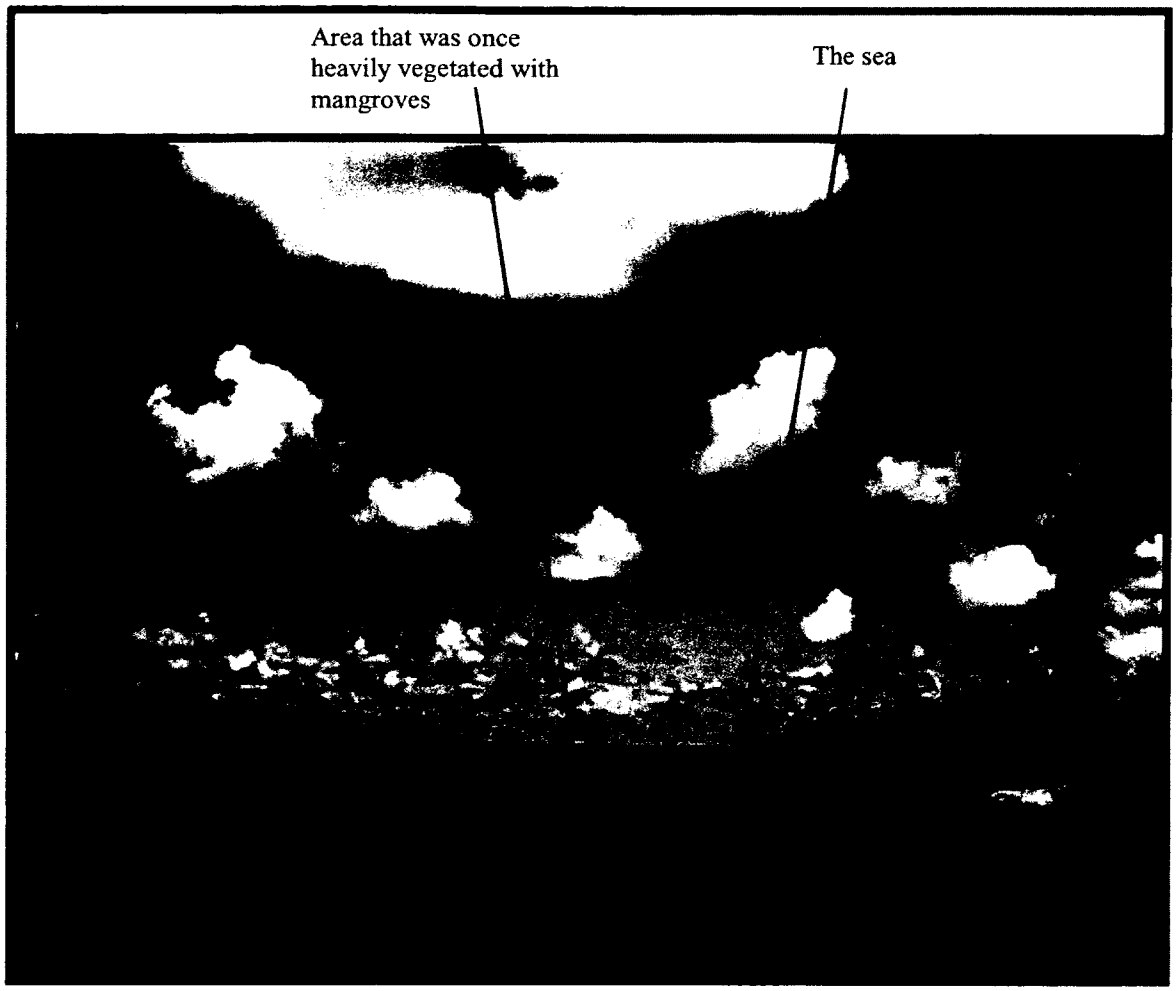


Note: The beach is hardly visible, and dead mangrove debris can be seen in the water.
Source: Photo taken by Author in August 2010.

Figure 4.20: Poor Mangrove Conditions in the Location of Study (Image 2)

Note: Dead mangrove debris litters the beach.
Source: Photo taken by Author in August 2010.

Figure 4.21: Looking Towards the Sea from the Meadow



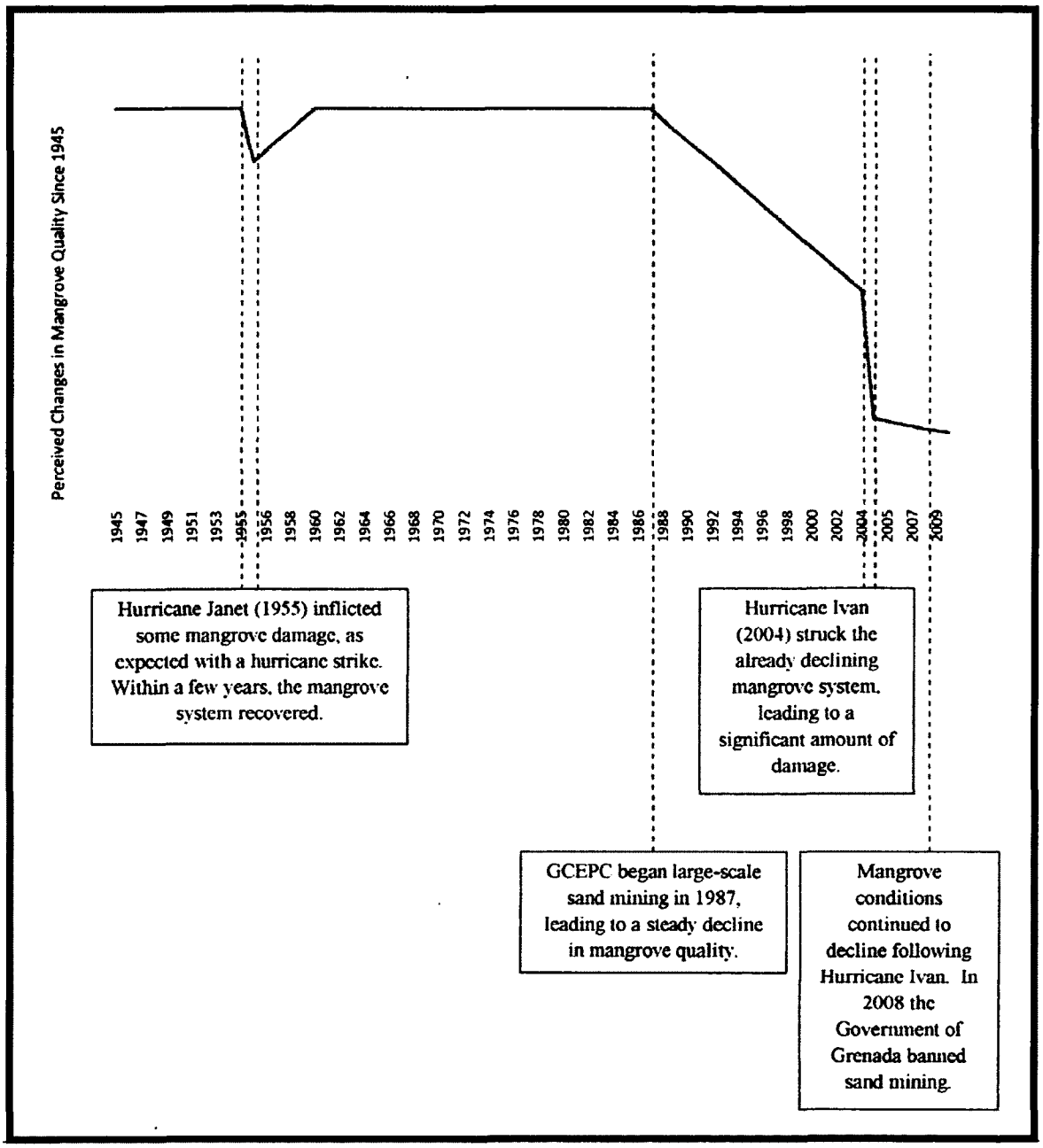
Note: Richard, a cattle rearer, explained that from this position, at one time the sea was not visible, as the area possessed think mangrove vegetation.
Source: Photo taken by Author in August 2010.

4.2.5 A GRADUAL DECLINE

Ultimately, Grenada's mangrove system has experienced substantial changes since the inception of government regulated sand mining. From 1987 to September 6, 2004, the coastal environment, and more specifically the mangrove system, was weakened by large-scale sand mining initiatives. The arrival of Hurricane Ivan on September 7, 2004 inflicted a great deal of damage upon the mangroves in the location of study, and has further degraded the health of the mangroves, as both their quality and quantity have decreased. Figure 4.22 draws upon informants' descriptions to illustrate how the quality of mangroves in the location of study has evolved since 1945.[58]

[58] 1945 is used as the beginning period in this time span, as the majority of elder interview respondents could speak to this date in time, with some of them, such as Leron being able to speak as far back at 1925 – the year of his birth.

Figure 4.22: Perceived Changes in Mangrove Quality Since 1945



Source: Author.

4.3 THE CHANGING VIABILITY OF MANGROVE-DEPENDENT LIVELIHOODS

Historically, many of the livelihood strategies pursued by inhabitants in the location of study have depended upon the mangrove system. Thus far, we know that the quality of this system has significantly decreased. It is now important to consider what effect this has had on mangrove-dependent livelihoods.

As previously mentioned, mangrove-dependent livelihoods in the location of study can either be directly connected to mangroves (the primary natural asset), or indirectly connected to mangroves. In the case of an indirect connection, the type of natural asset relied upon is considered a secondary natural asset. In the location of study, charcoal production is the only type of mangrove-dependent livelihood that is directly dependent upon mangroves, while farming, fishing, crab hunting, beekeeping, and cattle rearing make-up the livelihoods with an indirect mangrove dependence.

4.3.1 MANGROVE-DEPENDENT LIVELIHOODS WITH A DIRECT RELIANCE ON MANGROVES: THE PRIMARY NATURAL ASSET

4.3.1.1 CHARCOAL PRODUCTION

Historically, charcoal has been a main source of fuel in Grenada. Upon being cut, wood is placed in a pit, and set ablaze. The burning pile is then covered with a mound of soil and left to smolder.[59] Figure 4.23 shows charcoal that is ready for sale.

[59] A charcoal mound may also be referred to as a "kiln."

Figure 4.23: Charcoal Ready for Sale

Source: Photo taken by Author in April 2010.

4.3.1.1.1 How Mangroves are Important to Charcoal Production

In producing charcoal, community inhabitants have a direct reliance on the wood extracted from the mangrove system. Specifically, the black mangrove is the preferred species in charcoal production. The way in which a charcoal producer cuts the mangrove allows it to grow back, and "expand more," Shawn explained. Oliver described that the most effective way to cut the mangrove is low to the ground and at an angle, in order to foster future outward growth. He further explained that his adherence to this method allowed it to "continue to grow back."

4.3.1.1.2 A Shift in the Success of Charcoal Producers: From the Pre-Hurricane Janet Era to the Present Time

In pursuing their livelihood, charcoal producers were successful both prior to, and subsequent to, Hurricane Janet. With a healthy mangrove system, and an abundance of black mangroves, charcoal production thrived. In congruence with the success experienced by charcoal producers, charcoal was produced in a sustainable fashion, and as Martin described, at that time "you had a lot of coal burners." Charcoal producers, who directly extract the mangrove in pursuit of their livelihood, both functioned in harmony with the mangrove system, and were successful in their livelihood pursuits.

From 1987 to 2004, charcoal producers experienced altered conditions. A decrease in the overall mangrove population, and more specifically the black mangroves, led to a shift in both the quality and quantity of charcoal that was produced. According to Barriteau (2000), "the use of wood-sourced fuels does not appear to be growing." As explained by Oliver, he decreasingly extracted the black mangrove, and predominately harvested the red mangrove as a result of "the increased supply." At this time, some charcoal producers were accused of further damaging the mangrove system, and as Marvin disclosed, "some guys, they were destroying the mangrove area for charcoal."

In the aftermath of Hurricane Ivan, as Leopold explained, with a severely damaged mangrove population, and decreased size in the mangrove plants, charcoal production dropped even further. Consequently, producing at the pre-Hurricane Ivan levels would require that he work even harder; however, he felt that he was already working at his maximum capacity. Along the same lines, Shawn expressed that his charcoal production output levels experienced yet another decrease with the advent of

Hurricane Ivan. Charcoal producers have once again received criticism for causing further damage to the mangrove system. Undoubtedly, this is attributable to the fact that the mangroves have been continually cut by charcoal producers, who must do so to produce charcoal. However, the sparsity of the mangrove system has limited its ability to recover from the extraction of wood for the purpose of charcoal production.

4.3.2 MANGROVE-DEPENDENT LIVELIHOODS WITH AN INDIRECT RELIANCE ON MANGROVES: SECONDARY NATURAL ASSETS

4.3.2.1 FARMING

Grenada is generally known for its tradition of plantation agriculture. Currently in Grenada, long-term crops, or "cash crops," consist of bananas, cocoa, and nutmeg. However, in the location of study there exists an abundance of annual, or short-cropping, activity. "Short-crops," which reach maturity in a relative short time period, consist of, but are not limited to: watermelon, okra, peas, beans, tomatoes, cucumbers, cantaloupe, honeydew, peppers, and pumpkins (see Figures 4.24 and 4.25).[60,61]

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[60] Cash crops such as nutmeg, could take between 8 – 10 years to mature. Short-crops can generally mature in anywhere from 3 – 6 months.

[61] This study focuses on short-crops, as they are much more prevalent in the location of study in close proximity to the sea.

Figure 4.24: Melons Grown on a Farm in Close Proximity to the Sea (Image 1)

Source: Photo taken by Author in August 2010.

Figure 4.25: Melons Grown on a Farm in Close Proximity to the Sea (Image 2)

Source: Photo taken by Author in April 2010.

4.3.2.1.1 How Mangroves are Important to Farming

In the location of study, low-lying agricultural plots are significantly connected to the mangrove system. Mangroves play a vital role in minimizing coastal erosion, thus preserving the surface area upon which crops are grown. Furthermore, they offer protection from sea blast encroachment upon farmland, thereby mitigating salinization of the soil and helping to minimize the prevalence of pest and disease infestation. Mangroves (more specifically the black mangrove) trap rain clouds, thus bringing precipitation to coastal agricultural plots.

4.3.2.1.2 A Shift in the Success of Farmers: From the Pre-Hurricane Janet Era to the Present Time

Prior to Hurricane Janet, farmers in the location of study were very successful in the pursuit of their livelihoods. As Robert recalled, "it was easier to do farming then," while Trevor enthusiastically emphasized that he was successful as a farmer in the pre-Hurricane Janet days. Leron proudly explained that, "I would grow my crops!" The following excerpt from the *Tim Tim Tales*, which is a children's story book that tells old "tales" from Grenada, highlights a time of agricultural affluence:

> Mary, Mary
> What to buy with our penny?
> Your tray's piled so high
> With ripe fruits of all kinds,
> We won't tell a lie
> We can't make up our minds
> (A.C.W., 1974, p. 41).

As previously discussed, prior to Hurricane Janet the coastal environment was in good condition. Consistent with this notion, Oliver explained that the crops would be

"naturally watered." He maintained that, "these mangroves pay a great tribute, because any time the weather came over the horizon, by the time the winds blow it towards the land, you will get a touch of rain." Fittingly, Trevor felt that, "when it (the mangrove system) was in good health, people lived better, when the trees and them was around. People lived better, easier. Because the rainfall is more regular."

With the arrival of Hurricane Janet, farming livelihoods experienced some damage; however, they recovered within a few short years to their pre-Hurricane Janet levels. Robert recalled that his farming "recovered quickly," and when asked why he thought this was the case, his response was rather straightforward, "the coast was good." According to Leron, within approximately 2.5 – 3 years, his farming had completely recovered to the pre-Hurricane Janet levels.

In the period following Hurricane Janet, leading up to the commencement of GCEPC-led sand mining in 1987, numerous interview respondents expressed that this was the time they were "happiest" as farmers. This happiness derived out of the fact that crops produced greater yields, and as Patrick explained, farming at that time "was easier." As was the case prior to Hurricane Janet, the coastal farms continued to receive regular amounts of rain. Marvin explained that, "it is because the rain levels remained intact." According to Karen "the crops didn't get diseases like they catch now," and Daniel explained that high salinity in the crops wasn't an issue. Latoya expressed that farming was much more "economical," as her output was higher based on the amount of input required. At that time, in a week, Latoya produced approximately 1,000 lbs of okra, 1,000 – 2,000 lbs of melons, and 800 lbs of tomatoes, which she expressed as being "very

good." Likewise, Karen would produce between 1,000 – 5,000 lbs in a week depending on what crops she was harvesting. Ultimately, numerous interview respondents felt that their farming livelihoods were much more secure at that time.

Following 1987, the farming conditions continued to deteriorate. Latoya explained that once the sand mining started, "it (farming) was good for a few years, then after, when everything changed, it (her farming livelihood) began to fall down." Consistent with Latoya's revelation, for numerous farmers, as the conditions deteriorated, so too did their farming livelihoods.

Crippling for farmers was the fact that precipitation patterns started to become more inconsistent. Robert noticed that farmers, "couldn't get the rain as you want it. The rain clouds would go up into the mountains." Furthermore, increased salinity levels began to appear in farmers' fields. Jeremy explained that many of the crops were irrigated with pumped well water and that, during this time, "there started to be more salt content in the wells, and so the pumps were pumping salt water onto the crops and damaging them." Carlo also revealed another method in which salt started to infiltrate his crops. "The salt from the sea, when the waves hit the rocks, it sent up that mist, and that mist used to carry all the way back up to the back of the garden." As well, disease began to emerge in the crops, as "it was harder...and then you plant and don't get the same results," a defeated Robert conceded.

Consequently, the output levels of numerous farmers dropped. Latoya, who was previously producing thousands of pounds of produce a week, claimed that her output

had "dropped significantly." In fact, her soil had become so overrun with salt that tomatoes would no longer grow, and she had to stop tomato production altogether.

With the arrival of Hurricane Ivan, conditions for farmers continued to deteriorate, and according to Paul, "from Ivan time, I still don't see much recovery." Essentially, the arrival of Hurricane Ivan further exacerbated the already declining condition of many farming livelihoods. Simon explained that, "the hurricane basically changed around everything. If you look at what happened around the area, no longer can we really depend on most of the area."

Undoubtedly Hurricane Ivan led to high degrees of crop destruction. Latoya explained that, "it damaged a lot of my crops, and then I had to start over again." A lot of crop destruction is attributable to increased saltwater intrusion brought about by Hurricane Ivan. As Marvin recalled, "I had to start all over again because all my cultivation had been burnt. It looked like somebody passed...and they just burned down the whole vegetation, the whole entire area was burnt." As well, Hurricane Ivan brought even larger amounts of salt water to the wells, in comparison to the pre-Hurricane Ivan amounts. Consequently, this led to even greater crop destruction.

Following Hurricane Ivan, water scarcity became an even greater concern. Simon explained that, "you now have longer periods of drought." Once again, this is attributable to the significant decrease in rainfall. Currently, according to Oliver, there is a great deal of unknown with regards to rainfall expectations, as he highlighted that, "the wind takes it (the clouds) and you don't know when the rain will fall." Trevor felt that the rain clouds are a "tease" to many drought stricken farmers. He described how the

rain clouds will come rolling in, but then will continue to move inland towards the mountainous terrain without dropping rain on the coastal farms.

Many farmers have suffered because of the amount of land that has been lost. According to Edward, some community inhabitants have lost up to 30 ft of their own private land. As a result, they possess less land to grow their crops. Many of the pests formerly living on the lost land, and in the mangrove system, have had to look for a "new home." In turn, a great challenge for farmers is the increased prevalence of pests and diseases striking their crops. As Simon described, pests have become a significant problem, by stating that, "some of the animals (pests)...lost their habitat, so they turn to alternatives which would be the farmer...especially the rats...It has become a major issue too...Things have become scarce...you know we used to depend on those areas (the lost lands)."

Consequently, farmers have become disenchanted with their work. According to Patrick, "after Hurricane Janet I was happy, but after Hurricane Ivan (my happiness declined even more)." When asked if he feels that he faces greater challenges in producing his crops, Marvin exclaimed, "definitely, definitely, definitely!" As well, numerous farmers acknowledged that their production costs have greatly increased, as they are now forced to spend greater amounts in an effort to find alternative water sources. Simon explained that, "you now have to spend more on irrigation." Perhaps most telling is the fact that Karen, who formerly produced between 1,000 – 5,000 lbs of produce in a week prior to 1987, now only produces a fraction of that amount. She

claimed that, "now we make a couple hundred pounds. But now we don't do as we used to do before. Not like before."

4.3.2.2 FISHING

As Martin (2007, p. 78) explains, "Grenada's marine resources are a means of livelihood for fishermen (and their families) who venture out in small boats...each day in search of fish." Fittingly, there is a long history of fishing in the location of study. Fishing techniques generally consist of line fishing, sein fishing, diving, and the utilization of fish pots and traps. Many fishermen in the location of study pride themselves on the sustainability of these techniques. According to Karl, "we try to do our best to keep the crop coming. You see, because we don't take the extra small ones," as shown in Figures 4.27 and 4.28. Through the deployment of the above-mentioned techniques, fishermen are able to practice "selective harvesting." Along these lines, Martin stated that, "we don't fish with nets...we do fishing with lines...if you watch my boat, you will see no nets (see Figure 4.26). (Nets kill) ¾ of the small ones just for ¼ of the big ones." As well, Eric explained that, "it don't make sense to take that little one. It's too young. If you throw it back, there will be more fish to hole (catch) because they multiply."

Figure 4.26: Small-Scale Fishing Boats

Source: Photo taken by Author in August 2010.

4.3.2.2.1 How Mangroves are Important to Fishing

As explained in *Grenada: First National Communication on Climate Change – Executive Summary*, "mangroves...have proven to be of crucial importance in the formation and sustenance of other resources including near-shore fisheries" (Grenada National Climate Change Committee, nd., p. 4). Many fish species have a great dependence upon mangrove systems. Situated in estuaries, mangrove root systems provide both a nursery and a refuge for fish. High in nutrients, the conditions in a mangrove system are ideal for fish breeding. To exemplify the relationship between

mangroves and the fish population, one can look to the fact that mangroves provide "the breeding ground of 17 of the main species of demersals, (which provides about 43% of the total fish catch in Grenada)" (Grenada National Climate Change Committee, nd., p. 19).

4.3.2.2.2 A Shift in the Success of Fishermen: From the Pre-Hurricane Janet Era to the Present Time

Prior to Hurricane Janet, fishing conditions in the location of study were ideal, or as Tony phrased it, "before Janet that fishing was so nice, eh." In fact, the fish abundance was so great that fishermen often had to return some of their catch to the sea. As Tony further explained, "we used to hole real fish (lots of big and healthy fish)...Too much fish, I can't bring it in...sometimes you hole 100 lbs. Tons of fishes." On a consistent basis, he filled a 100 lb fish pot approximately 2 – 3 times per week. Furthermore, Oliver explained that there would be so many fish living in the estuaries, that when the tide went out you could simply grab them, as they would be situated around the mangrove roots. As Emmanuel recalled, his Grand Uncle, who spent his entire life as a fisherman, honed his skills as a diver (fishing technique) in the lakes that once existed (Middle Lake, Small Lake, and Pearls Lake).

Following Hurricane Janet, after a few years, the fishing conditions returned to those of the pre-Hurricane Janet era. According to Karl, "the times weren't rough...shortly after the hurricane (Janet) we used to go and fish...there was much more food (fish)." Up until 1987, the fishing conditions were desirable. According to Eric, at that time he would catch 100 lbs of fish per day, while Martin explained that a few hours

of fishing would yield approximately 40 – 50 lbs of fish. The abundant fish catches allowed community inhabitants to set-up small market operations in the communities, such as the market that formerly existed in the Junction. As Carlo recalled, "in the evening time, about after 4 o'clock, you see the guys coming up with the fish on their shoulder. They put the fish in wire and put it on wood...and come up with the fish into the Junction and sell it right there." Many fishermen expressed that they were "happy" pursuing their livelihood at this time, and also felt secure. With security not only pertaining to their livelihood, but their safety as well. Martin explained that engine failure would be more of an inconvenience, rather than an event inflicting fear of one's personal safety, as boats often did not have to travel too far from shore to catch fish. In the event of an engine failure, the predictability of the currents allowed the fishermen to know that they would drift back to shore.

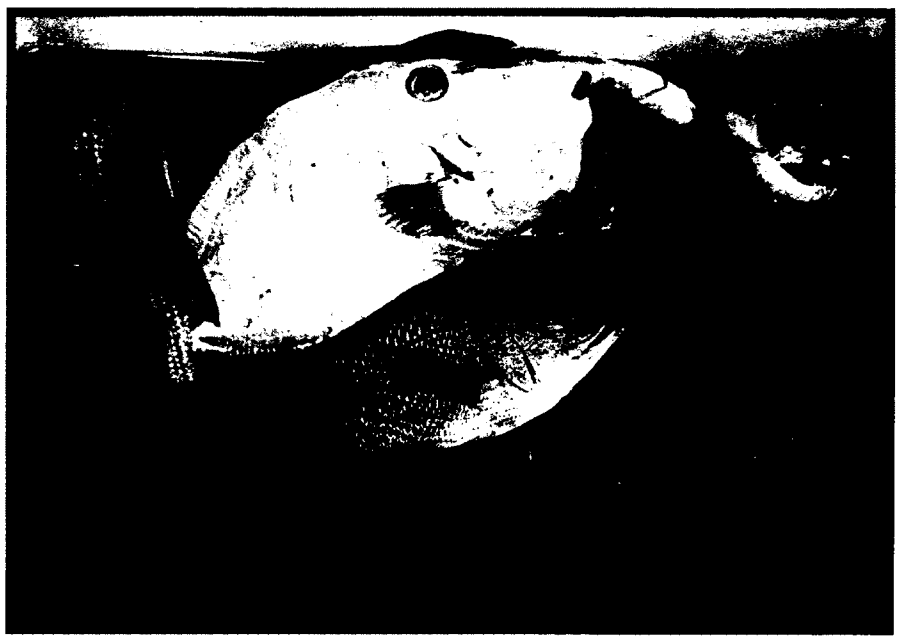
From 1987 onward, as the sand mining continued, the fish catches, in the words of Karl, "dropped a lot," as a day of fishing would bring in approximately 30 lbs of fish. According to Martin, the species of fish that he would once catch on the coral reef, began to appear further out at sea. As sand mining efforts increasingly claimed land, and brought damage to the mangroves, a disconnect began to emerge between the mangroves and the fish species, thus contributing to a shift in the locations where they were traditionally found. Furthermore, the sea increasingly became more rough, and along with the increased distances that must be traveled by boat to catch the fish, fishermen were required to spend more money on gasoline for their small boat engines. As Martin bluntly stated, "it cost you more in gas to go far."

Following Hurricane Ivan, the conditions deteriorated for fishermen once again. According to Eric, "for 3 years about (after Hurricane Ivan) you have a lot of dead fishes on the beach." From the arrival of Hurricane Ivan to the present time, fish catches have remained extremely low in relation to the 100 lbs of fish that were formerly caught on a daily basis. Fittingly, Tony stated that "before and now is not the same." Currently, Eric catches approximately 20 lbs a day, Martin catches 8 - 15 lbs a day, and Karl catches roughly 4 – 15 lbs a day. The sense of security amongst fishermen has greatly decreased as well, as fishermen are required to venture further away from the shore in increasingly rough waters. According to Martin, it has become "harder to float," meaning that in the case of engine troubles, he does not necessarily know if he will be able to drift back to shore. As well, the further distances have once again led to increased fuel expenses for the fishermen, which makes his form of livelihood even less economical. Martin, in a tone of frustration, explained that, "you buy EC$80 of gas and come back with 10 lbs of fish."

With the disappearance of the lakes that once existed, the skill of dive fishing is being lost, as fishermen no longer have a safe haven to practice. As Emmanuel reveals, practicing in the sea is not an option, "because you don't have the kind of depth of water here that you used to have. People cannot really practice here. The water here has too many currents." According to Tony, with the current fish scarcity, some fishermen have abandoned their sustainable practices of returning the juvenile fish to the sea, as they feel that they are left with no other choice. He explained that, "before they (dive fishermen) used to choose to shoot big fish, but now they shoot anything." Along these lines, even

those fishermen who currently abide by sustainable harvesting practices are catching smaller fish, as shown by Figures 4.27 and 4.28; given that, the overall fish sizes have greatly decreased.

Figure 4.27: Fish Caught by Small-Scale Fishermen (Image 1)



Source: Photo taken by Author in August 2010.

Figure 4.28: Fish Caught by Small-Scale Fishermen (Image 2)

Source: Photo taken by Author in August 2010.

As a consequence of the declining fish catches, many fishermen find it challenging to support their families. Despite comments such as, "I won't give up," the fish yield remains extremely low. As Carlo observed, "they (fishermen) are more leaning on the poverty side...that background is gone, that history. No more fishing background, we don't have that." For all fishermen, in the words of Karl, "now things are real rough."

4.3.2.3 CRAB HUNTING

Grenada supports numerous marine and terrestrial species of crabs along their beach and in their mangrove systems (Martin, 2007, p. 59). Crab hunters either catch

crabs by going out at night with a light, called "torching," and catch the crabs while they are feeding, or place traps over crab holes, as shown in Figure 4.29. In order to ensure a steady crab population, female crabs yet to lay their eggs are not caught. In the location of study, community inhabitants have a direct reliance on the crabs as a source of food. According to Emmanuel, "(the location of study) is one of the poorer communities around here, so they would depend on these foods here to a larger extent than elsewhere. For instance, people who live in the higher region, they will just buy up 2 crabs now and then when they want to make a cookout or soup. But these people here, they don't go a week without eating crabs...That's one of their main sources of food. At least once per week, some of them eat it more."

Figure 4.29: Crab Trap

Source: Photo taken by Author in August 2010.

4.3.2.3.1 How Mangroves are Important to Crab Hunting

Many crabs make their home in the mangrove system. Not only do they require protection from the sun, which the mangroves offer, but crabs also need soft areas to dig their holes. Crabs are dependent on the plethora of nutrients available in the mangrove system, and the mangrove system provides ideal conditions for crab eggs, and subsequently larvae, to flourish.

4.3.2.3.2 A Shift in the Success of Crab Hunters: From the Pre-Hurricane Janet Era to the Present Time

In the years before Hurricane Janet, crabs were abundant. Philip recollected that, "when I was younger there was a lot of crabs...plenty...you just had to come walking through and could find them." As Oliver described, "they were like a beauty on the beach. They were the life of the face of the sand."

Following Hurricane Janet, the crab population recovered. Similar to the pre-Hurricane Janet conditions, at nighttime, the mangrove system had plenty of crabs. As well, the crabs were much larger in size, and crab hunters would choose to only keep the larger crabs in order to allow the more juvenile ones to grow. When asked about their crab catches in the period following Hurricane Janet, and before the GCEPC-led sand mining commenced in 1987, an ecstatic Douglas responded, "hundreds of crabs, bags of crab. Bags of crabs! You go in and come out with a bag of crabs." Consistent with this claim, Joel highlighted the fact that he used to catch approximately 200 crabs a day during this time.

From 1987 to September 6, 2004, crab catches progressively decreased. As Oliver identified, "before Ivan it (the crab population) started diminishing because the sand mining was before Ivan." During this time, Joel witnessed a drop in the number of crabs he was able to catch, as 150 crabs, rather than the 200 he was previously catching, became the norm.

From September 7, 2004 to the present time, the crab population has experienced even greater declines. Joel explained that an outing usually only produces about 50 crabs, while Douglas emphasized that they are usually only able to find approximately 30 crabs. As a result, crab hunters do not feel that their livelihood is secure, and some have resorted to catching any crab they can find, regardless if it is a juvenile crab, or a female crab carrying eggs. In the following interview excerpt, Douglas reveals the rational from the perspective of a desperate crab hunter:

> Right now, right now...according to how I want my morning to read, I take whatever crabs I can get, because nobody know how I getting a dollar to put in my pocket. Nobody looking at that. You understand. I actually know what to do to get a dollar. Wash it out and then say it's the same as them other crabs.

He is describing a situation in which a crab hunter, catches a female crab carrying eggs, and then washes the eggs out, in order to sell the crab. This indiscriminate mentality has also led to increased competition amongst crab hunters, reaching potentially dangerous levels. As Douglas described, "right now, where the world is today, you understand, you have to expect anything when you go in trees (mangroves). You could be walking and somebody could just pull a knife on you...you never know. Especially in the night. Very dangerous, but we live with that you know."

4.3.2.4 BEEKEEPING

It is believed that the honey bee was introduced in Grenada around 1688 (Grenada Association of Beekeepers, 2011). Bees in Grenada rely on the flowers from various plants to provide them with their sources of pollen and nectar.

4.3.2.4.1 HOW MANGROVES ARE IMPORTANT TO BEEKEEPING

Bees heavily rely on the black mangrove flowers as a source of pollen and nectar (see Figure 4.30).

Figure 4.30: Black Mangrove Flower

Source: Hawthorne, Jules, and Marcell, (2004). Used with Permission.

4.3.2.4.2 A Shift in the Success of Beekeepers: From the Pre-Hurricane Janet Era to the Present Time

Leading up to the commencement of GCEPC-led sand mining in 1987, the honey produced in the location of study was high in both quality and quantity. As Gordon recalled, at that time, the amount of honey was so plentiful that he "couldn't keep up with it." According to Emmanuel, apiarists in the area used to produce "a nice dark honey."

Following 1987, beekeeping and honey production continued.[62] Gordon explained that he won a beekeeping competition in England, and emphasized the fact that quality honey came out of the location of study at that time. As Emmanuel outlined:

> Even before I used to do red bees, we used to be hunting them, and we used to have a lot of bees through the mangroves. We used to go in and take them out to collect the honey you know. And after which then I started to take care of them. We used to be hunting, wild hunting. Yeah, sometimes we used to have up to five, 5 gallon buckets, we used to get that much comb from one hive. Before Ivan I was more looking forward to it because when you look at what you were getting, you know you could make well.

However, as time progressed, and the mangrove population continually suffered, according to Jeremy, the "honey production dropped." Approximately 2 - 3 years ago the dark honey that came out of the location of study, according to Emmanuel, was almost completely lost.

After Hurricane Ivan, from Gordon's perspective, "there was a total decrease in the honey production." As the mangrove system has become increasingly sparse, the black mangrove flowers no longer receive the same amount of protection from the sun. Consequently, according to Emmanuel, "the sun dries up the nectar even faster, so the

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[62] The black mangrove flower, while greatly contributing to honey production, is only one of the sources of pollen and nectar for bees. Numerous other flowers contribute as well.

bees often cannot get to it." In stark contrast to the five, 5 gallon buckets Emmanuel once collected from one hive, he is currently able to only collect approximately 3 - 7 gallons from one hive.

4.3.2.5 CATTLE REARING

There is a long history of cattle rearing in Grenada. Cattle are raised for the manure they produce which is then sold, or the cattle themselves can be sold. In the location of study, numerous cattle are raised in the Meadow, as shown in Figures 4.31 and 4.32.

Figure 4.31: Cattle Grazing in the Meadow (Image 1)

Source: Photo taken by Author in August 2010.

Figure 4.32: Cattle Grazing in the Meadow (Image 2)

Source: Photo taken by Author in April 2010.

4.3.2.5.1 How Mangroves are Important to Cattle Rearing

As previously discussed, mangroves act as a buffer, offering protection against high amounts of sea salt moving inland. As a result, the buffer protects vegetation that is less tolerant to salt. This vegetation is often grazed upon by cattle. Furthermore, rain, which is brought about in greater abundance by a healthy mangrove system, is a necessity to ensuring that cattle constantly have fresh vegetation to graze upon. Finally, the ability of mangroves to prevent coastal erosion, and ultimately maintain the amount of land in a given location is important, as it ensures that cattle have enough room to properly develop.

4.3.2.5.2 A Shift in the Success of Cattle Rearers: From the Pre-Hurricane Janet Era to the Present Time

Prior to Hurricane Janet, rearing cattle as a livelihood proved to be, according to Godfrey, "very successful." At that time, cattle had plenty of room to roam, and there was abundant vegetation for them to graze on.

In the aftermath of Hurricane Janet, the vegetation upon which the cattle grazed had suffered from some salt exposure; however, the protection offered by the mangrove system minimized the amount of salinity found inland. With frequent rainfall, the salt that did remain was soon washed away, and within a few years after Hurricane Janet, cattle rearing returned to its pre-Hurricane Janet affluence. According to Richard, after Hurricane Janet, his cattle rearing "was good," and Hurricane Janet "didn't really affect him." Godfrey explained that his cattle rearing "still continued," and that Hurricane Janet "didn't really worry (him)." At the time, with lots of healthy land available, the cattle had room to roam.

In the period of time prior to 1987, when asked about his cattle rearing livelihood, James exclaimed, "it was easier!" As he recalled, some farmers owned approximately 15 heads of cattle, while he himself owned 8 heads. Cattle sold more frequently at the time, as the favourable conditions allowed it to develop quickly. Generally, a bull could be sold for approximately EC$3,000 – EC$4,000, and would require a year of development before being ready for sale.

With the advent of sand mining by GCEPC in 1987, rearing cattle became more challenging. Greater salinity was found in the grazing vegetation, rainfall became more infrequent, and lands were lost. As a consequence, cattle had to be tied up to ensure that

they would not roam onto farmer's crops. These factors hindered the cows' development. According to Richard, prior to Hurricane Ivan, the decreased quality of cattle meant that they could only be sold for approximately EC$1,000 a head.

Following Hurricane Ivan, as Richard described, "it's a different system (now)...it's much harder to make a living." The increased salinity has proved to be problematic, and as Jeremy explained, "the cattle can't graze on the salty conditions which have overtaken the Meadow." Furthermore, the increased loss of land has, in James' mind, created even greater challenges. As he explained:

> What makes it more rough on me now, is the farming close to my cattle. They need proper room to develop. (There is) less room for the cattle to run and get strong, especially the young cattle...An adult size now, is the same size that a 6 month old cattle used to be, so they are much smaller...Now it takes 3 years to sell one because they aren't developing as quickly. Their size is not the same as it used to be. It takes much longer for them to get to the ideal size.

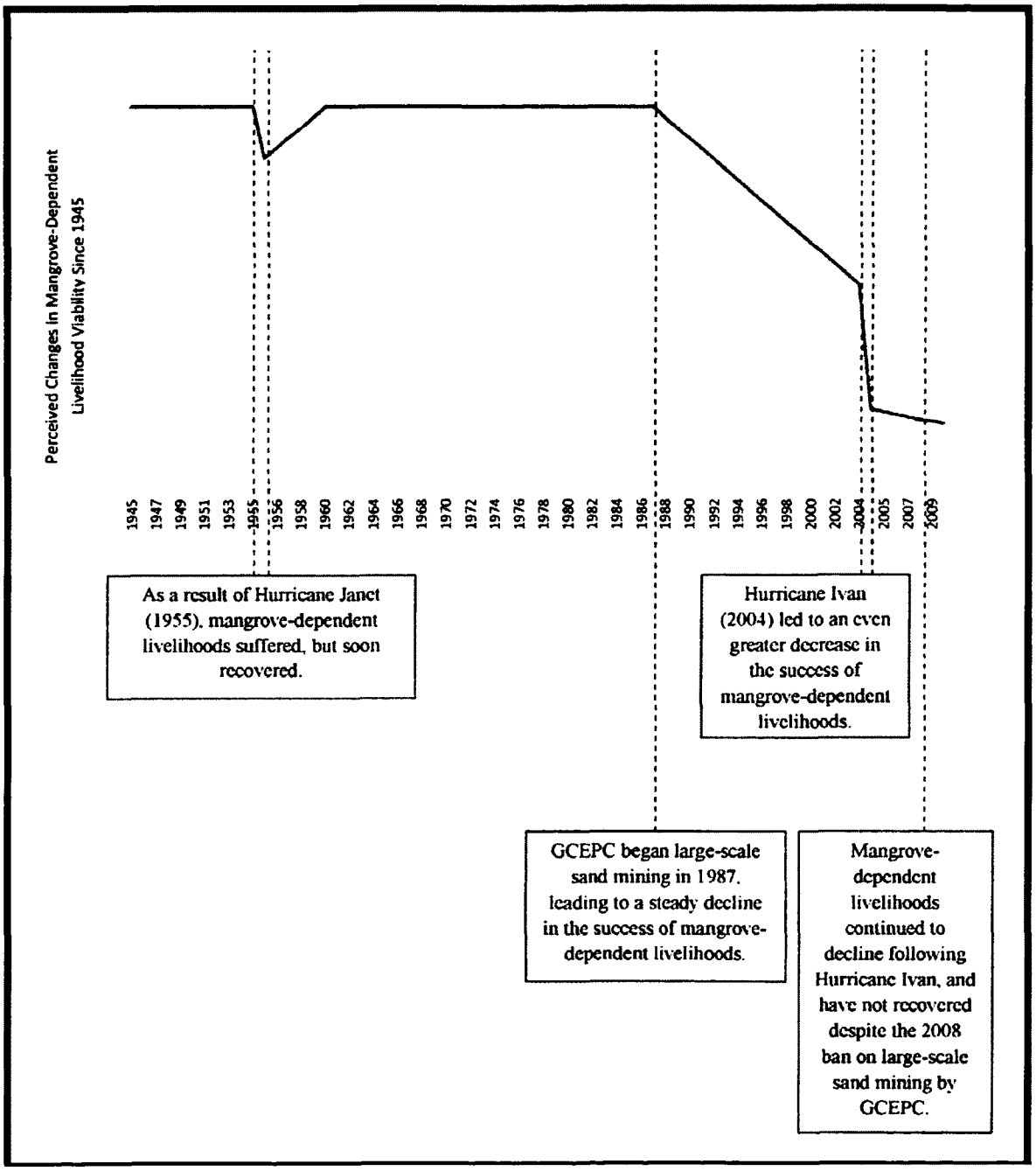
Consequently, the cattle is sold at a much lower price, and as revealed by Richard, a head of cattle is sold for approximately $EC500 - $EC800.

4.3.3 A Gradual Decline

From the pre-Hurricane Janet era to the present time, the viability of mangrove-dependent livelihoods has greatly diminished. Along these lines, Figure 4.33 draws upon informant's descriptions to illustrate the evolution of mangrove-dependent livelihoods since 1945. As Douglas (2003) notes, "Calypsonian Reggie Charles could not have sounded a truer note when he sung. 'yes we can see there are changes in our community, living today is not like it used to be.'" Neil identified that "the times are becoming harder." The consequences of the harder times resonate through the following comments

put forth by Douglas, who is speaking in general terms on behalf of all the community inhabitants in the location of study. "Right now people can't get food to eat...very few people have that. Since the time Ivan passed, we have fallen down...People are still planting the garden, and still trying to make money, but when you go to the market you don't have money to buy." Many interview respondents attempted to convey the desolate livelihood conditions by emphasizing that criminal activity has increased, as it has become more challenging to produce viable mangrove-dependent livelihoods. Therefore, some community inhabitants have resorted to illegal acts (beyond illegal sand mining) to support themselves. Consequently, there has been a significant increase in larceny and drug activity. As Emmanuel explained, "the criminal population has grown because there is nothing to do...everybody needs money."

Figure 4.33: Perceived Changes in Mangrove-Dependent Livelihood Viability Since 1945



Source: Author.

4.4 CONCLUSION

The conditions of the coastal environment, and more specifically the mangroves, in the location of study, have significantly changed from the pre-Hurricane Janet era to the present time. While the arrival of Hurricane Janet inflicted some damage upon the mangrove system, within a few short years it was able to recover to its pre-Hurricane Janet levels. Commencing in 1987, the same year that GCEPC began capital-intensive sand mining, the mangrove conditions began to change. The mangrove population decreased, mangrove species proportions were altered, and the overall mangrove quality was poorer than the pre-1987 levels. With the arrival of Hurricane Ivan in 2004, the already weakened mangrove system was greatly damaged, and has currently not seen signs of recovery.

Like the changing conditions of the coastal environment, the viability of mangrove-dependent livelihoods has also greatly shifted over time. While Hurricane Janet posed an impediment to mangrove-dependent livelihood viability, its impacts were short-lived. Within a few years following Hurricane Janet, livelihood viability had recovered. However, from 1987 to 2004, mangrove-dependent livelihoods increasingly suffered, and following the arrival of Hurricane Ivan, their viability experienced a substantial drop, without indications of recovery. Undoubtedly, a correlation exists between the declining mangrove conditions, and the decreasing viability of mangrove-dependent livelihoods.

CHAPTER 5: ANALYSIS AND RECOMMENDATIONS

5.1 INTRODUCTION

Scoones (2009) identifies a lack of rigorous attempts to deal with long-term change in environmental conditions as one of the failures of livelihood studies. This study aims to respond to the identified failure. In doing so, this study focuses on a specific component of "the long-term change in environmental conditions:" the increase in natural disasters, or more specifically, the increase in hurricane frequency and/or intensity. Fittingly, the following research question is asked: *how do environmental practices influence the vulnerability of rural livelihoods to natural disasters?* Through a consideration, and ultimately amalgamation, of the information presented in the preceding chapters, the research question can be answered.

In the following chapter I consider my research findings through a theoretical lens. In doing so, I compare the Hurricane Janet era to the Hurricane Ivan era, with the differentiating factor between the two being the form of sand extraction (i.e. small-scale in the Hurricane Janet era compared to large-scale, capital-intensive in the Hurricane Ivan era). I reveal the influential effects of environmental practices on the vulnerability of natural capital, which, in turn, impacts the livelihoods that are dependent upon it. The chapter then proceeds to explain the role of both micro-oriented actors and macro-oriented structures, with an acknowledgement of the role of external pressures, in influencing the natural asset transforming institutions in the location of study. The chapter concludes with the presentation of recommendations.

5.2 ANSWERING THE RESEARCH QUESTION

In order to effectively answer the research question, it is necessary to compare the events surrounding Hurricane Janet and Hurricane Ivan. As previously discussed, the area of Grenada's east coast between Telescope Point and Artiste Point was selected as the location of study because it possessed the following characteristics:

1. A significant number of community inhabitants pursuing a variety of mangrove-dependent livelihoods.

2. Both Hurricane Janet and Hurricane Ivan struck Grenada as a Category 3 hurricane.

3. With the exception of GCEPC-led sand mining in 1987, all environmental practices were administered by community inhabitants.

4. GCEPC-led sand mining was most intensely concentrated on the beach between Telescope Point and Artiste Point.

These factors are important in conducting a comparative analysis, given that one of the significant differences in the location of study, in the years prior to Hurricane Janet versus the years prior to Hurricane Ivan, was the presence of GCEPC-led sand mining.[63]

Before proceeding with the comparative analysis, it is important to highlight that this study focuses upon the environmental practice of sand mining. Initially, one may be inclined to question this focus given that the thesis concerns itself with the health of mangroves and the viability of mangrove-dependent livelihoods. As discussed in Chapter 2, "environmental practices" are defined as "human manipulation of a natural asset," and

[63] It is important to acknowledge that changing social, economic, and environmental factors in the 54 years between Hurricane Janet and Hurricane Ivan may have also had an influence upon the current conditions in the location of study.

manipulation refers to "the activities that are required to transform a natural asset, resulting in tangible human benefits." Although mangroves play an integral role in the success of the five indirect mangrove-dependent livelihoods discussed in Chapter 4, the beneficiaries of these trades tend to have few direct impacts upon the mangroves, rather they derive benefits from the various ecosystem services that the mangroves provide. Of course, charcoal producers, who have a direct mangrove-dependent livelihood, are an exception, as they themselves manipulate the mangroves. Therefore, beyond the actions of charcoal producers, environmental practices applied to mangroves, in the location of study, come in the form of beach manipulation in which the mangroves are situated. Thus, the environmental practices of the Small Man influenced mangrove health prior to 1987, after which it was the practices of GCEPC sand miners.

5.2.1 COMPARISON

In order to effectively answer the research question, this study looks at two contrasting methods of beach sand extraction, with all other things essentially remaining the same: small-scale sand removal (sand removal with a spade) prior to and following Hurricane Janet, and large-scale sand mining (sand extraction with heavy machinery) prior to and following Hurricane Ivan.

5.2.1.1 SMALL-SCALE SAND REMOVAL PRIOR TO AND FOLLOWING HURRICANE JANET

As alluded to throughout Chapter 4, the removal of sand with a spade, as witnessed both prior to, and following, Hurricane Janet, until 1987, is considered a SEP. This is justified by the Chapter 2 discussion of Bebbington (1999, p. 2029), as sand

removal with a spade allows the same sorts of transformations to be on-going. In the location of study, numerous interview respondents emphasized that due to the minimal amounts of sand that were removed, the beach would quickly recover, within a matter of hours, and there was always an abundance of sand. At the same time, the mangrove conditions remained intact, meaning that community inhabitants pursuing a mangrove-dependent livelihood were also able to engage in on-going transformations.

While the quality and quantity of natural capital was not "appreciating", it was not "depreciating" either, allowing for a relatively high and stable stock. Ultimately, this followed the notion of strong sustainability. Essentially, the natural capital (the sand), and human-produced capital (the spade) functioned as complements to one another, rather than substitutes. Therefore, human-produced capital was not employed to the extent that it would infringe upon the total amount of natural capital.

Moreover, numerous interview respondents expressed that they experienced a higher degree of capability and well-being, as their livelihoods were much easier to pursue, thus contributing to a heightened degree of meaning and happiness emanating from their work. This is further exemplified by the fact that the location of study had a meaningful place of recreation, which contributed to, as Armitage (2007, p. 65) phrases it, a "higher-level dynamic equilibria."

The mangrove system experienced a quick recovery following Hurricane Janet, which suggests that the degree of environmental vulnerability prior to Hurricane Janet was relatively low. This is attributable to the fact that environmental transformations were taking place with an adherence to SEPs, and as highlighted in Chapter 2, resilient

ecosystems are capable of accommodating and absorbing not only stresses, but also shocks, in ways that do not fundamentally alter the ecosystem structure. This being said, the mangrove system in the location of study was subsisting under the shock threshold (discussed in Chapter 2, see Figure 2.2), meaning that in the advent of a shock, such as Hurricane Janet, the mangrove system possessed a higher degree of resilience. Resultantly, the extent of damage incurred as a consequence of Hurricane Janet was minimized, as the mangrove system was capable of absorbing the shock of Hurricane Janet; ultimately, minimizing its impact upon the mangroves, and in turn the secondary natural assets that depend upon the mangrove system. By extension, the recovery of mangrove-dependent livelihoods paralleled that of the mangrove conditions; therefore, explaining the relatively quick recovery of mangrove-dependent livelihoods.

5.2.1.2 Large-Scale Sand Removal Prior to and Following Hurricane Ivan

With the commencement of sand mining by GCEPC in 1987, sand removal in the location of study took the form of UEPs, as described in Chapter 2. Most telling is the fact that similar sorts of transformations, pertaining to sand extraction, were no longer possible. As the sand mining progressed, the amount of sand on the beach decreased; thus, indicating that sand extraction was taking place in a way that did not allow it to maintain its current level. Consequently, this led to a decrease in the mangrove population, meaning that community inhabitants pursuing a mangrove-dependent livelihood were no longer able to produce similar sorts of transformations.

Ultimately, sand mining by GCEPC followed the concept of weak sustainability, as a decrease in natural capital (the sand) was met by an increase in human-produced

capital (large-scale sand mining machinery). This is evident through considering the fact that as sand became increasingly scarce on the beach, excavators and front end loaders progressively moved further into the sea in order to extract similar amounts of sand. Therefore, human-produced capital acted as a substitute for the decreasing stock of natural capital.

Consequently, in the lead-up to Hurricane Ivan many interview respondents expressed increased struggles in pursuing their livelihoods, diminished happiness with their way of making a living, and less involvement in recreational activities. This suggests that the level of capability and well-being among interview respondents had begun to decline, and is attributable to the diminishing natural asset base, given, as Bebbington (1999, p. 2029) acknowledges, the fact that assets give people their capability.

As a result of Hurricane Ivan, the mangrove system experienced a great deal of damage. This suggests that the mangroves possessed a high degree of environmental vulnerability prior to the arrival of Hurricane Ivan. Environmental transformations in advance of Hurricane Ivan were taking place through UEPs, and ultimately this weakened the natural capital base, thus limiting its ability to withstand a shock, such as Hurricane Ivan. Therefore, the mangroves were operating above the shock threshold, in the stress threshold. This explains why the mangrove system did not experience complete eradication prior to Hurricane Ivan, but rather why it underwent a decline in quality. However, the coupling of a vulnerable mangrove system, with a Category 3 hurricane, brought a great deal of damage to the mangroves, both during, and in the years

following Hurricane Ivan. Consequently, the mangrove-dependent livelihoods were compromised as well, seeing that the natural asset they were dependent upon had been greatly damaged.

5.2.1.3 Comparison Summary

A comparison of the events surrounding Hurricane Janet and Hurricane Ivan demonstrates that environmental practices are influential in sculpting the degree of environmental vulnerability, as witnessed through the differential effects of sustainable compared to unsustainable sand mining. The implication, of course, is that in the advent of a hurricane the damage to the natural capital base, and the following recovery, is greatly dependent upon the pre-hurricane degree of environmental vulnerability, which is influenced by the pre-hurricane environmental practices. Consequently, the vulnerability of livelihoods that are dependent upon natural capital is contingent upon the pre-hurricane levels of environmental vulnerability. As a result, in wake of a hurricane strike, there is a direct correlation between the degree of natural capital damage and recovery, and the degree of natural capital-dependent livelihood damage and recovery; thus, explaining the rapid mangrove-dependent livelihood recovery rate following Hurricane Janet, and the relatively desolate mangrove-dependent livelihood viability following Hurricane Ivan.

5.2.2 Why are Certain Environmental Practices Chosen?

Understanding the interconnection between sand extraction, and the vulnerability of mangrove-dependent livelihoods to hurricane damage in the location of study is

important, as establishing this relationship could prove to be extremely useful in implementing future policies and practices to reduce livelihood vulnerability. However, it is also necessary to understand *why* such practices take place. Utilization of the hybrid theoretical framework, presented in Chapter 2, will facilitate this understanding.

As discussed in Chapter 2, the hybrid theoretical framework incorporates a focus upon the agency of ground-level actors from the livelihoods framework, with a consideration of the overarching structures that are emphasized in political ecology. With this in mind, it is possible to analyze both the micro and macro dimensions of the events that contributed to the substantial differences in the degrees of environmental vulnerability at the time of both Hurricane Janet and Hurricane Ivan.

5.2.2.1 Understanding the Choice of Environmental Practices Surrounding Hurricane Janet

Prior to Hurricane Janet, we know that sand was removed with a spade, the mangroves were in good condition, and mangrove-dependent livelihoods were viable. Following Hurricane Janet, within a few years, these conditions resumed. Facilitating these conditions was the influence of a variety of both micro and macro orientated actors, and in turn, the institutions emanating from these actors.

In both the pre and post-Hurricane Janet era up to 1987, the agency exercised by a number of micro-oriented actors shaped the degree of environmental vulnerability possessed by the mangrove system. The overarching, most influential, actor was the community itself, with different "sub actors," operating under the community structure. Specifically, the network of individual community members and the Small Man, who

removed sand from the beach, did so in a way that adhered to institutional norms, and as discussed above, allowed similar transformations to take place in the future. By extension, these individual community members and the Small Man removing sand, dictated the mangrove quality, and in turn, the secondary natural assets that depend upon the mangrove system. Furthermore, the removal of beach sand in a sustainable fashion preserved the integrity of the beach, such that it continued to provide an ideal location of recreation; thus, maintaining the social fabric of the community. As well, the utilization of sustainable methods of beach sand extraction, and the resultant preservation of the mangrove quality, allowed the mangrove system to replenish itself, in spite of the stresses resulting from the unsustainable actions of a small percentage of community members (i.e. charcoal producers who may have over-extracted wood from the mangrove system). Ultimately, community access to the beach sand did not compromise the quality of the local environment.

As highlighted in Chapter 3, Grenadians were somewhat complacent regarding hurricane activity, as they have traditionally deemed themselves as being situated outside the hurricane belt. As well, NERO/NaDMA in their disaster preparedness efforts have not promoted sustainable institutions (i.e. SEPs) as a means of mitigating damage from natural disasters. Understanding this information is important, as it tells us that the Small Man, as well as community inhabitants pursuing a mangrove-dependent livelihood, utilized SEPs without the intention of doing so in order to reduce mangrove vulnerability, and in turn secondary natural asset vulnerability, to hurricane strikes. Nonetheless, the mangrove system was highly resilient to Hurricane Janet and experienced a rapid

recovery; further exemplifying the harmonious element of human-environmental interaction that existed in the years surrounding Hurricane Janet, as a result of the high level of environmental access possessed by community inhabitants in the location of study.[64]

As discussed in Chapter 2, the hybrid theoretical framework conceptualizes institutions as being dynamic in nature. Conducting field research through the lens of this theoretical tool allowed me to realize that external pressures, that is to say, factors beyond the realm of the agency of micro-oriented actors, and macro-oriented structures, play a role in influencing the institutional landscape. As a consequence, these external pressures, and their resultant institutional influences, become internalized, as actors are inevitably engaged with them. Essentially this becomes a situation of internalizing the externalities. The notion of external pressures diverges beyond the realm of the livelihoods framework and political ecology, and by association the hybrid theoretical framework. Therefore, it is not discussed in Chapter 2, as this realization was only made upon conducting field research. However, it is important to reaffirm that field research guided by the dynamic nature of the hybrid theoretical framework, allowed me to develop an appreciation for external contributory pressures. Failure to acknowledge such pressures, upon realizing their influence, would portray a significant degree of negligence on my behalf.

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[64] This being the case, inevitably a conscientious effort to institute SEPs, with the intention of reducing hurricane vulnerability, would prove to reduce future natural capital damage, and in turn, damage to livelihoods dependent upon the natural capital.

Along these lines, access to the beach not only allowed for the application of SEPs to the beach sand and, by extension, the mangroves, but it also created a niche for market influences. More specifically, consumer demands required that products of high quality be supplied to the market; be it the market in the nearby town of Grenville, or more informal market operations situated within the community (such as the selling of fish in the Junction, as described by Carlo in Chapter 4). Therefore, institutions (i.e. SEPs) capable of producing goods that met market demands were required, such as charcoal produced from the black mangrove tree, as well as larger fish, crabs, and cattle. This ensured the maintenance of a healthy coastal environment, and by extension a healthy mangrove system and secondary natural asset base, as community inhabitants pursuing a mangrove-dependent livelihood were, to some extent, bound by institutions that would yield similar transformations in the future, in order to meet future market demands. At the same time, given the fact that the livelihoods of many community inhabitants, generally of mangrove-dependent origin, were successful, their purchasing power remained relatively high; therefore, allowing market demands to be steady. Ultimately, the external pressure of the market, contributed to the internalization of SEPs capable of producing goods to meet market demands; thus, creating an expectation in which such practices are the norm.

Beyond the realm of micro institutional actors, macro-oriented forces also shaped access to assets (specifically the beach, and by extension the mangroves), and the following methods of natural asset transformation. These macro influences emanated from the Government of Grenada, a more powerful actor than the community

organizations within the location of study. Prior to the advent of capital-intensive sand mining in 1987, the government had been relatively absent from the beaches of St. Andrew's, taking somewhat of a "laissez-faire" approach. In turn, this allowed local institutions to take root. Thus, even though Grenada's beaches are deemed to be Crown Land, community inhabitants were permitted to remove sand, and channel the mangrove benefits. In fact, despite its promulgation in 1979, the Beach Protection Act was not regularly enforced until 1987.

Therefore, with the Government of Grenada permitting access to Crown Land (the beach and mangroves), the community inhabitants in the location of study formulated their institutions to effectively carry-out the necessary transformations to translate their assets into successful mangrove-dependent livelihoods. This being said, it is important to not lose sight of the fact that the enabling conditions created by the state alone (i.e. allowing community inhabitants to have access to Crown Land, through their laissez-faire approach), would not automatically produce viable livelihoods. Rather, it is what is done with this access by the community inhabitants that ultimately leads to livelihood success or failure. Therefore, both macro and micro actors have a collaborative role to play in explaining the choice of environmental practices in the location of study in the years surrounding Hurricane Janet, up to 1987.

5.2.2.2 Understanding the Choice of Environmental Practices Surrounding Hurricane Ivan

From 1987 up to the arrival of Hurricane Ivan in 2004, sand extraction was large-scale and capital-intensive, the mangrove conditions progressively deteriorated, and the

mangrove-dependent livelihoods suffered. Following Hurricane Ivan, the conditions continued to decline. In December 2008 large-scale sand mining ceased, and illegal sand mining activity increased. As was the case prior to 1987, in the years surrounding Hurricane Janet, following 1987 the conditions were also greatly influenced by the institutions derived from actors of both macro and micro-orientation, which are capable of explaining the application of UEPs.

In the pre and post-Hurricane Ivan era, from 1987 to the present time, the mangrove system's vulnerability can be conceptualized through a consideration of the extensive macro-oriented structural influences at play. Emanating from one of the most influential actors, the Government of Grenada, numerous sub actors shaped the way in which natural asset transformations took place. Through the implementation and RGPF enforcement of legislation, beach access, and consequently the mangroves situated on the beach, predominately rested in the hands of the Government of Grenada. Indeed, this was always the case, given that Grenada's beaches are considered Crown Land. However, after 1987 the state did away with its laissez-faire approach, and began to enforce its coastal land ownership; thus, actively engaging with the beach. Specifically, through the creation of GCEPC, and the following extraction of sand on a large-scale, sand was the only natural asset that was valued. Not only did GCEPC access to the beach dictate the beach quality, but it also bestowed the status of "gatekeeper" of the mangrove system, and its secondary natural assets, upon GCEPC. Moreover, the creation of GBS, further contributed to the monopolization of Grenada's beach sand industry, due to increased regulations on the quality of sand being sold. In essence, the top-down,

structural influences of the Government of Grenada resulted in the creation of new institutions (i.e. legislation pertaining to the beach), which in turn, necessitated the creation of sub actors (i.e. GCEPC, and GBS) who themselves implemented institutions (such as the practice of capital-intensive sand removal on behalf of GCEPC).

In part, the Government of Grenada's increased involvement in sand extraction can be viewed as a response to increasing demand for sand by Grenada's national construction industry, as a result of a greater emphasis placed upon construction undertakings by the government. According to *Grenada's 2005 Budget Speech*, prior to Hurricane Ivan, the country experienced sustained growth in the Construction, and Mining/Quarrying sectors, and following Hurricane Ivan, "the only sectors which experienced some level of buoyancy...were Construction (7.6% growth); Mining/Quarrying (10.2% growth)" (Boatswain, 2005, p. 6). Once again, external pressures, in the form of market influences, are factored into the equation. In order to meet this demand, the Government of Grenada implemented institutions which gave the government greater leverage in exercising its authority over access to the beach. Essentially, uninhibited beach access allowed the Government of Grenada to apply the transformations (large-scale and capital-intensive sand mining) it deemed necessary to meet market demands, and by extension its own agenda.

As a result of these macro-oriented structural influences, coupled with the internalization of external pressures in the form of market influences, the landscape of the institutions flowing from the aforementioned micro-oriented actors that governed access to natural capital in the location of study prior to 1987, began to change. With the

Government of Grenada exercising their control over Crown Land (the beach), no longer was the Small Man a steward of the coastal environment. Consequently, the SEPs formerly utilized by the Small Man to extract sand (i.e. the spade) proved to not be the sand extraction method of choice for GCEPC. This facilitated an inevitable decrease in the quantity and quality of natural assets (be it the sand, the mangroves, or the secondary natural assets dependent upon the mangroves). As a result, community inhabitants pursuing a mangrove-dependent livelihood became increasingly coerced into applying practices of a more unsustainable nature in transforming natural assets. This is consistent with the explanation provided by the paradigm of political ecology in Chapter 2, as an increase in UEPs amongst community inhabitants is not a result of their own ignorance, but is attributable to their diminished access to natural assets; thus, forcing natural asset users into more unsustainable practices. As exemplified in Chapter 4, this is the case with fishermen increasingly catching, and keeping, more juvenile fish, rather than returning them to the ocean, and crab hunters washing out the eggs from female crabs in order to ensure that their actions of catching an egg-carrying crab go unnoticed.

Moreover, prior to 1987 the environmental practices chosen to transform natural assets were in part dictated by external pressures in the form of local market influences; be it the market in Grenville, or smaller markets within the community. However, following 1987, these market influences changed. Specifically, consumers decreasingly demanded high quality goods, as community inhabitants became less concerned with the quality of goods, and more interested in simply being able to secure products from the market that they deemed vital to their subsistence. For example, community inhabitants

chose to purchase more juvenile fish and crabs, rather than not purchasing any at all. Therefore, the market no longer dictated sustainable asset transformations by community inhabitants pursuing a mangrove-dependent livelihood that were capable of maintaining similar sorts of transformations in the future. As a consequence, the institutional landscape changed, as transformations occurring through more unsustainable practices became more acceptable; such as catching juvenile fish, seeing that consumers were now willing to purchase smaller fish.

At the same time, given that most community inhabitants had a mangrove-dependent livelihood that was suffering, their purchasing power decreased, meaning their capacity to support the markets decreased. This is evident upon returning to the Chapter 4 claim by Douglas that, "people are still planting the garden, and still trying to make money, but when you go to the market you don't have money to buy." Further exemplifying the breakdown of local market influences, is the fact that some markets were lost completely, which is evident upon considering that fish were no longer sold in the Junction. Essentially, a downward spiral was unleashed in which lower consumer expectations were met by lower quality goods being provided to the market. Moreover, market expectations dropped, given that low quality goods were all that were available and became the new norm. Unlike prior to 1987, the option of providing higher quality goods no longer existed. Before 1987, consumers would not have accepted low quality goods, given that higher quality goods were readily available. However, following 1987, because top quality goods were no longer an option, they were decreasingly demanded.

Consideration of Grenada's increasing market demands for sand on a national level brings greater clarity to the current frontier of illegal sand mining (post December 2008). With the cessation of GCEPC-led sand mining, but the remaining presence of market demands for sand, the illegal sand mining niche expanded. In order to facilitate market demands for sand, especially sand at a much lower price than the imported or quarry sand options, the methods of transformation have become more large-scale and capital-intensive. Consequently, external pressures, in the form of market influences, have stipulated that transforming activities, despite their illegality, are unsustainable.

5.2.3 Bringing It All Together

A comparison of the environmental practices surrounding Hurricane Janet and Hurricane Ivan demonstrates that these practices greatly influence the vulnerability of rural livelihoods to hurricane strikes, as the said livelihoods are dependent upon the natural capital that the environmental practices are applied to. In advance of a hurricane strike, the degree of environmental vulnerability is contingent upon the type of environmental practices that are utilized in transforming natural assets into livelihood benefits. Whether they are SEPs or UEPs, environmental practices are shaped by actors at the micro and macro level, as well as external pressures. Application of the hybrid theoretical framework fosters a more in-depth understanding of the actors at play, as it allows for consideration of both macro and micro contributions, and ultimately institutional influences. Conceptualizing actor-oriented influences is indeed a large undertaking, especially through the hybrid theoretical framework, given the intricate network of both ground-level actors, and overarching structures as separate entities, but

also due to their interdependence upon one another in explaining the materialization of certain events. Nonetheless, as witnessed through the series of events in the location of study, both macro and micro contributions, along with the influence of external pressures, played a significant role in the rendition of various degrees of environmental vulnerability.

5.2.4 Current Conditions in The Location of Study and Future Implications

The current conditions in the location of study are detestable. The coastal environment, such as the beach, mangroves, and secondary natural assets, continue to suffer as a result of the pre-Hurricane Ivan UEPs, and the advent of Hurricane Ivan itself. Further exacerbating the undesirable environmental conditions is the fact that illegal sand miners continue to extract large quantities of sand from the beach. Due to these factors, community inhabitants pursuing a mangrove-dependent livelihood are suffering, as their output levels have greatly decreased, and they continue to face challenges in their livelihood pursuits. Furthermore, the social fabric of the community has degenerated. The beach no longer provides a desirable place of recreation, the illegal sand mining network continues to grow, criminal activity has increased, and there exists a great disconnect between community inhabitants and the RGPF.

The natural capital base, more specifically the mangroves, and in turn the secondary natural assets, given their rather desolate condition, are extremely vulnerable to a future hurricane strike. As a consequence, the mangrove-dependent livelihoods in the location of study are equally vulnerable. Undoubtedly, these conditions, along with

the increasing frequency and/or intensity of hurricanes, encourages one to ask: what does the future hold for community inhabitants pursuing a mangrove-dependent livelihood? Perhaps most accurately, when asked what would happen to his livelihood if another hurricane were to strike, Douglas bluntly replied, "we will lose it." Indeed, this seems like an inevitable outcome if another hurricane were to hit the already ravaged mangrove system. However, this does not have to be the case. Upon considering the events surrounding Hurricane Janet, it has become evident that environmental vulnerability can be greatly reduced through the institution of SEPs. Yes, there is hope for the future of mangrove-dependent livelihoods; albeit, such hope is contingent upon a multiplicity of rigorous efforts. Where should these efforts begin, and what conditions are required for them to be both relevant and effective? According to Scoones (1998, p. 14), the emphasis must first be placed on "getting the institutional and organizational setting right," thus improving "the effectiveness of conventional interventions."[65] Therefore, given the unquestionable influence of both micro-oriented actors and macro-oriented structures, and the resultant institutions emanating from these actors, in dictating the series of events from the pre-Hurricane Janet era to the present time, the following recommendations will first seek to create an organizational foundation, and will then follow with more "conventional," ground-level recommendations. Taking this approach is imperative to creating the necessary conditions upon which the following recommendations can flourish.

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[65] Conventional interventions such as skill development.

The following recommendations are oriented towards the establishment of a more positive relationship between the Government of Grenada and the Grenadian people. The Government of Grenada, and all its subdivisions (i.e. GCEPC, GBS, RGPF, NaDMA) must strive to develop greater bonds with the rural poor, such as the community inhabitants living on Grenada's east coast in the Parish of St. Andrew's, and more specifically in the location of study between Telescope Point and Artiste Point. As Paul claims, when the government talks, given their lack of credibility, he "just listens," but feels that they fail to take action on their words, thus prompting him to say, "it doesn't mean anything." Only through concrete action can this mentality towards the Government of Grenada subside.

5.3 RECOMMENDATIONS

5.3.1 ORGANIZATIONAL ORIENTED RECOMMENDATIONS

5.3.1.1 RECOMMENDATION 1

Reduce the price of domestic quarry sand and imported beach sand from Guyana.

5.3.1.1.1 COMMENTARY ON RECOMMENDATION 1

Reducing the price of sand distributed by GCEPC would be beneficial in many respects; thus, making it the most significant, foundational recommendation, as lowering the cost of sand will provide an opportunity for many of the following recommendations to come to fruition. Doing so would require a reduction in government royalties. By enhancing the affordability of sand, Grenadians will develop a greater degree of trust in

the government, as lower sand prices will indicate a tangible effort on behalf of the Government of Grenada to improve conditions. Moreover, a reduction in the price of sand will greatly reduce the market demands for sand extracted by illegal sand miners. This would be beneficial in that the extraction of beach sand will be greatly reduced; therefore, preventing further damage to the beach, and in turn the mangroves and secondary natural assets.

5.3.1.2 RECOMMENDATION 2

Increase the penalty for individuals caught illegally removing beach sand.

5.3.1.2.1 COMMENTARY ON RECOMMENDATION 2

The current penalty of an EC$500 fine and 6 month imprisonment does not significantly deter illegal sand miners. As Sgt. Nelson explained, "it (the penalty) should be more, so we have to appeal to the relevant authorities to look at the law and increase the penalty...If you really want to stop it, I think if the penalty increase, you will have less people doing that activity" (Government Information Service, 2010). Therefore, it is felt that a reduction in the cost of domestic quarry sand and imported sand from Guyana (Recommendation 1), along with increased penalties for those caught illegally removing beach sand, would greatly reduce the prevalence of illegal sand mining. With fewer people engaged in illegal sand mining, policing of the illegal activity would be more within the capacity of the RGPF.

5.3.1.3 RECOMMENDATION 3

Greater efforts must be made by the Government of Grenada to show the Grenadian people that domestic quarry sand, and imported sand from Guyana, is of good quality.

5.3.1.3.1 COMMENTARY ON RECOMMENDATION 3

An avenue upon which Recommendation 3 can be achieved is through creating public awareness of the quality control process of GBS, and the subsequent benefits of purchasing sand that has met GBS specifications. When discussed with Brenda, Standards Compliance Officer with GBS, she indicated that this is something that is not done. As revealed in Chapter 4, and highlighted by Figure 4.5, all sand must meet certain particle size specifications; therefore, given the particle size consistency, making it more reliable, the sand is ultimately easier for workers to use. Furthermore, domestic quarry sand and imported sand from Guyana does not possess high levels of salinity, as is the case with Grenada's beach sand. Consequently, the quarry sand and imported sand options would not lead to corrosion, while, given the high salt content of Grenada's beach sand, sand sold by illegal sand miners will inevitably result in structural corrosion. Greater efforts to disclose this information with contractors and workers will foster a more positive perception of domestic quarry sand and imported sand from Guyana.

Recommendation 3 is further achievable through conscious efforts on behalf of the Government of Grenada to continue government funded construction initiatives with domestic quarry sand and imported sand from Guyana. Creating public awareness of the construction materials used in such initiatives will reveal that the said materials are

equally as effective, if not more so, than Grenadian beach sand. According to Edward, the cricket stadium, bus station, and cruise ship terminal were all built using domestic quarry sand in an attempt to demonstrate its effectiveness. However, these construction initiatives took place prior to the cessation of GCEPC-led sand mining in December 2008. Therefore, I am not sure of the accuracy of this claim, as the utilization of beach sand at the time was pervasive throughout Grenada. If, indeed, the Government of Grenada did use domestic quarry sand in their pre-December 2008 construction initiatives, doing so for the purpose of revealing its effectiveness to Grenadian contractors and workers, would have undoubtedly been met with skepticism, as one would be inclined to question if the government actually used only domestic quarry sand, rather than beach sand, or perhaps a combination of both. Therefore, the Government of Grenada must continue to carry-out their construction initiatives with domestic quarry sand and imported sand from Guyana, and be sure to take advantage of the opportunity to reveal to the Grenadian public that such initiatives were carried out without Grenadian beach sand; ultimately, creating greater awareness of the effectiveness of the sand options that are now offered. Doing so would greatly reduce skepticism towards the materials used in such construction efforts, given that beach sand is no longer available at the Queen's Park or Telescope locations.

Along these lines, GCEPC must continue to promote the effectiveness of domestic quarry sand and imported beach sand from Guyana to contractors, as exemplified in Chapter 4 by Figures 4.6 and 4.7, as well as the pamphlet released by GCEPC entitled, *Inland Quarry Sand vs. Beach Sand.*

5.3.1.4 RECOMMENDATION 4

NaDMA must incorporate environmental vulnerability reduction through SEPs into their disaster reduction policy.

5.3.1.4.1 COMMENTARY ON RECOMMENDATION 4

As discussed in Chapter 3, the name NERO was changed to NaDMA in October 2004, with "the purpose being to more adequately reflect the mandate of the Agency as one of disaster management and not just response" (NaDMA, 2011). Given the unquestionable relationship between environmental vulnerability and natural disasters, NaDMA must seek to implement policy oriented towards reducing environmental vulnerability, which, admittedly, it is currently not doing, nor has done in the past. Chapter 4 reveals that the utilization of SEPs reduces environmental vulnerability; therefore, NaDMA must institute policies that necessitate the application of SEPs as a method of disaster preparedness and reduction. As highlighted in Chapter 2, a natural disaster is the effect of a natural hazard on society, and as revealed in Chapter 4, the societal impacts of Hurricane Janet were far less than the societal impact of Hurricane Ivan, given the significant discrepancies in pre-hurricane environmental vulnerability, and in turn, post-hurricane mangrove-dependent livelihood impacts, and ultimately, recovery. Therefore, efforts by NaDMA to reduce environmental vulnerability through SEPs will foster a greater degree of disaster preparedness, reduce their impact, and ultimately result in better disaster management, since the natural capital that livelihoods are contingent upon will be more resilient to future hurricane strikes.

5.3.1.5 RECOMMENDATION 5

The Government of Grenada/GCEPC must take responsibility for rehabilitating the damaged coastal environment in St. Andrew's.

5.3.1.5.1 COMMENTARY ON RECOMMENDATION 5

According to Monique, Manager Secretary with GCEPC, "a shortfall of the corporation (GCEPC) was that after the removal of sand, nothing was done to re-enhance the environment...It is something we can give back to the environment after taking so much." Given *(a)* that its actions instigated environmental degradation in the region and *(b)* that the coastal environment is a public good, the Government of Grenada/GCEPC must assume responsibility for rehabilitation initiatives.

5.3.1.6 RECOMMENDATION 6

The Grenadian youth must be educated on the following issues:

- The negative effects of sand mining.
- The relationship between a healthy coastal environment and successful natural-capital dependent livelihoods.
- The influence of environmental practices (both SEPs and UEPs) on environmental vulnerability.
- The correlation between pre-hurricane environmental vulnerability levels, and post-hurricane natural capital damage, and recovery.

5.3.1.6.1 COMMENTARY ON RECOMMENDATION 6

It is important to consider the events of Grenada's past, and to ensure that the youth are educated on the aforementioned issues. There are many valuable lessons to be learned from Grenada's past to the present time, and formal acknowledgement of these events through the education system will better prepare young Grenadians for a life in which increased hurricane activity is a reality they must face. An emphasis must be placed upon educating Grenadian youth, otherwise it is possible that important lessons from the past will be lost. Unlike the elder generations of Grenadian's who can draw upon lived experiences pertaining to the issues listed in Recommendation 6, today's youth, while some may have lived through an event such as Hurricane Ivan, were not actively engaged in pursuing natural-capital dependent livelihoods, while large-scale sand mining was occurring, and then attempting to resume these livelihoods following Hurricane Ivan. Therefore, it is vitally important for the youth to understand the environmental history of their community in order to ensure that these lessons from the past are incorporated into future decisions, as today's youth will likely live in a world in which hurricanes are more frequent and/or intense.

5.3.2 CONVENTIONAL, GROUND-LEVEL RECOMMENDATIONS

The implementation of Recommendations 1 to 6 will create the necessary institutional foundation upon which the following recommendations (7 and 8) can thrive. However, instituting them without sufficient "backing" will likely undermine the

initiatives and ultimately render them ineffective.[66] Therefore, collaborative efforts between the Government of Grenada and individual community inhabitants, are required for these recommendations to be successful. Such collaborative efforts will contribute to the re-invigoration of community inhabitants, and will ultimately re-create a sense of community ownership.

5.3.2.1 RECOMMENDATION 7

Coastal rehabilitation centered around mangrove replanting must take place in the location of study.

5.3.2.1.1 COMMENTARY ON RECOMMENDATION 7

As discussed in Chapter 2, Boyce (2003), amongst others, outlines that natural capital can undergo an enhancement in both quality and quantity. Given the current state of mangrove conditions in the location of study, and overall coastal environment, environmental enhancement from its current state is necessary. Doing so, as emphasized by numerous interview respondents, requires a reduction in sea encroachment upon the land and coastal vegetation that is currently taking place, and then the replanting of mangroves, which are considered the coastal "anchor." Sea encroachment reduction is achievable through the construction of a "sea wall."[67] According to Ronaldo, instructor in Marine Biology and Ecology at St. George's University, mangrove restoration is in its

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[66] As witnessed with the implementation of government policy allowing large-scale sand mining, ground-level efforts to preserve the coastal integrity, such as sand removal with a spade, were ultimately rendered ineffective without the necessary institutional support.

[67] A sea wall currently exists further north along Grenada's east coast in River Antoine, which is located in the Parish of St. Patrick's.

infancy in Grenada. Efforts must be made to rehabilitate the mangrove system in the location of study, given its present state, as it is currently vulnerable to future hurricane strikes, and so too are the livelihoods that are dependent upon the mangrove system.

5.3.2.2 RECOMMENDATION 8

A greater emphasis must be placed upon livelihood diversification in the location of study.

5.3.2.2.1 COMMENTARY ON RECOMMENDATION 8

As discussed in Chapter 2, livelihood diversification is an essential factor in ensuring the prolonged subsistence of rural inhabitants. In the location of study, livelihood diversification has been lacking. Many community inhabitants have traditionally placed their sole focus on the pursuit of their mangrove-dependent livelihoods. As a result, the advent of large-scale sand mining, followed by the arrival of Hurricane Ivan, has made it far more difficult for those individuals with a mangrove-dependent livelihood to support themselves and their families. While some interviewees pursued a diverse livelihood strategy, (i.e. complementing fishing with working as a small engine mechanic, or complementing crab hunting with building drainage systems for farmers), this type of diversity has generally been lacking.

With an expected increase in hurricane frequency and/or strength, and the fact that Grenada can no longer be considered outside the hurricane belt, diversifying livelihoods so that they are not as dependent upon mangroves will enhance the ability of community inhabitants to continue to support themselves and their families in the future.

Moreover, livelihoods that are less dependent upon natural capital would afford the coastal region a greater opportunity to recover. According to Emmanuel, "diversifying into other areas...can support us while the mangroves recover."

Livelihood diversification in the location of study must be the responsibility of both the community inhabitants themselves, as well as external contributors. Amongst community inhabitants there must be a willingness to diversify, and provide support for fellow community inhabitants in their diversification efforts. The following statement put forth by Emmanuel, exemplifies the mentality that is necessary if community inhabitants are going to effectively diversify their livelihoods:

> I have the concept, that whatever I have, I must pass it on to others. I don't want to waste it. We have a mentality among poorer classes of people, that if you lend someone what you have, they will become better than you are. I don't accept that concept. Whatsoever knowledge, information, skills I have, I share it around because at the end of the day, all of us have to live. And that is my concept in life. Whatsoever I can do to help you, to help anybody else, I will do that happily.

The Government of Grenada and civil society organizations should assist diversification efforts. External contributors would play an essential role in offering training, skills, and technology, that would facilitate livelihood diversification. To exemplify the important role of external contributors in facilitating the livelihood diversification process, Emmanuel spoke of the need and benefits of training in food processing, as outlined by the following statement:

> Even food processing this year. We've had loads of mangoes just waste away. Look at the amount of mangoes that spoil in our streets, below our mango trees. If we had people understanding how to process these things and package them, you can make some livelihoods there.

Ultimately, a genuine desire for livelihood diversification amongst community inhabitants, along with support from external contributors, would facilitate the successful transition to greater livelihood diversification in the location of study.

5.4 CONCLUSION

Through a consideration of the events surrounding Hurricane Janet and Hurricane Ivan, it has become evident that environmental practices (be it SEPs or UEPs) greatly influence environmental vulnerability. The degree of environmental vulnerability, in turn, is a key determinant of how much damage hurricanes and other environmental events impose upon the stock of natural capital. As revealed with Hurricane Janet, low degrees of environmental vulnerability prior to its arrival, allowed for a rapid post-hurricane mangrove recovery. Conversely, Hurricane Ivan demonstrated that high levels of environmental vulnerability in advance of its arrival led to severe mangrove destruction, without any significant indications of recovery. Through comparing the environmental differences in the Hurricane Janet era to that of the Hurricane Ivan era, and incorporating the viability of mangrove-dependent livelihoods into the equation, it becomes evident that the same environmental practices that dictate the degree of environmental vulnerability, also greatly influence the viability of mangrove-dependent livelihoods, as the said livelihoods are equally as vulnerable to hurricane strikes as the natural assets they depend upon.

Underlying the implementation of such environmental practices is a combination of numerous actors exercising their agency; be it actors of a ground-level micro-orientation, and/or more overarching macro-oriented structures. At the same time,

institutions are subject to alteration from external pressures, such as market influences. An understanding of the processes that shape environmental practices is necessary to properly formulate policies and recommendations. Fittingly, it is through holistic recommendations that positive action can take root.

CHAPTER 6: CONCLUSION

As revealed through the differential methods of sand extraction in the location of study, environmental practices influence the degree of environmental vulnerability and, thereby, the viability of natural resource-dependent livelihoods. This was the case with the healthy mangrove conditions that existed prior to Hurricane Janet, in which the sustainable removal of sand took place, and the undesirable state of the mangrove system prior to the arrival of Hurricane Ivan, in which unsustainable sand mining occurred. Pre-hurricane environmental vulnerability levels dictate the degree of damage that will be inflicted upon the environment, and by extension, the rate of environmental recovery, in the case of a hurricane strike. In turn, this thesis reveals that environmental practices, which render various degrees of environmental vulnerability, also greatly influence the degree of natural capital-dependent livelihood vulnerability to hurricane strikes. Essentially, the vulnerability of natural-capital dependent livelihoods parallels the vulnerability of the natural capital that they depend upon. This point is demonstrated by the substantially different impacts that Hurricane Janet and Hurricane Ivan had upon mangrove-dependent livelihoods.

This thesis addresses what Scoones (2009) has identified as a principal failure of development practices based upon the livelihoods perspective: a lack of rigorous attempts to deal with long-term change in environmental conditions. With the prevalence of natural disasters increasing, this thesis brings to the forefront an avenue upon which long-term change in environmental conditions can be addressed. This avenue, of course, is the maintenance and/or enhancement of natural capital through SEPs. The implementation

of such practices greatly reduces the vulnerability of rural livelihoods to, in the case of this study, hurricane damage. Along these lines, there are important lessons to be learned from Grenada about the effects of maintaining a natural capital base above the shock threshold. Given the unpredictable nature of natural disasters, natural capital must operate under the shock threshold in order to allow it to withstand the unexpected arrival of a shock, as was the case with Hurricane Janet. Conversely, the debilitating effects of a natural capital system operating above the shock threshold in advance of a hurricane strike were revealed through the damage inflicted by Hurricane Ivan.

As explained by Tierney (2006, p. 111), "the key to understanding disaster impacts and outcomes thus lies in the ability to recognize how long-term, macro-level trends and everyday life conditions set the stage for disaster events." This quotation is most fitting, as it attests to the importance of conceptualizing the events that have transpired in Grenada through the lens of the hybrid theoretical framework. Doing so provides understanding for why certain environmental practices are chosen. As witnessed in the location of study, numerous actors exercising their agency, be it micro-oriented ground-level actors, or larger macro-oriented top-down structures, play a role in both shaping and changing institutions over time.

Grenada must establish a sound organizational foundation upon which the viability of mangrove-dependent livelihoods can be restored. With this foundation, both the mangrove system and mangrove-dependent livelihoods will possess diminished degrees of vulnerability to future hurricane strikes. The lessons learned from Grenada, and the potential benefits of these lessons to other developing countries, must not be

squandered. Developing countries that currently possess damaged natural capital bases as a result of UEPs, and/or natural disasters, must also place an emphasis on strengthening their natural capital base, ultimately reducing natural disaster vulnerability, in anticipation of future natural disaster strikes. In locations in which the natural capital base is currently intact, it is vitally important that its quality is maintained or enhanced. In doing so, the natural capital, and by extension natural capital-dependent livelihoods, will recover far more quickly from a natural disaster. Natural disasters are increasing, and so too must our efforts to reduce vulnerability to such catastrophic events.

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