Recovery and Adaptation in Post-hurricane Maria Puerto Rico: Local and Government Perspectives

by

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ABSTRACT

Disasters represent disruptions to stability and offer lessons about how climate adaptation is negotiated and acted on. Viewing adaptation as a negotiation helps understand recovery not just as actions taken to minimize harm, but a reflection of values and motivations surrounding adaptation. This research elicits these perspectives and considers them as part of an ongoing agreement for disaster recovery and adaptation in Puerto Rico. Previous research has characterized recovery as an opportunity for rethinking societal arrangements for climate adaptation and highlights the importance of how adaptation is conceptualized across actors. This study builds on past research by using distinct perspectives to understand recovery as an adaptation process and a co-production of a new 'social contract' after Hurricane Maria. Community interviews and government documents are analyzed to understand who is involved, where change is happening, and what resources are necessary for success. The purpose of this is to consider distinct framings of recovery and adaptation, and what these contribute to long-term change. Community interviews give a perspective of local stability and show capacities for immediate and long-term recovery. Similarly, government documents discuss managing foundational vulnerabilities like infrastructure, while navigating recovery given geographical and economic obstacles.

Findings show that self-organization and harnessing social capital are crucial components of recovery in the Corcovada community after Maria. They rely on bonding and bridging social capital to mobilize resources and reducing vulnerabilities for future threats. This transformative approach was also present in official recovery documents,

though political and economic change were stressed as necessary for stability, along with modernizing infrastructure. While recovery documents suggest connecting physical and social resilience, community residents have cultivated this connection long before Maria. Unlike in Corcovada, the government of Puerto Rico is only starting to view disruptions as windows of opportunity and therefore mention plans for transformation but don't present actions taken. Further, the reality of vulnerable infrastructural, political and economic systems greatly affects recovery both in Corcovada and across the island. Both perspectives will likely affect actions taken in Puerto Rico and recognizing these unique framings of stability can help design transformative, adaptive social contracts for facing future threats.

DEDICATION

Para la Comunidad de Corcovada y todos los afectados por el huracán.

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CHAPTER 1

INTRODUCTION

Major disasters present opportunities to learn about how societies adapt to climate change. These events call into question how a population achieves stability, or at least survives, a massive destruction of critical services and infrastructure. Some research in disasters has begun to conceive such disruptions not just as opportunities to learn about bouncing back after recovery, but also a chance to learn about bouncing forward, or emerging stronger (Berkes & Campanella, 2006; Cretney, 2016; Brundiers, 2016). Taking disasters as lessons about climate adaptation means considering major vulnerabilities and capacities to understand how stability is achieved and how underlying conditions can be improved to spur fundamental change. That said, disasters are critical junctures where societies must evaluate and negotiate adaptation actions, which involves challenging and perhaps even changing agreements on how to prepare for disasters (Pelling & Dill, 2010). Hurricane Maria in Puerto Rico exemplifies a pivotal moment for the island as recovery continues to be negotiated and political agreements around climate adaptation come into question. This case represents an opportunity to learn not only about coordinating recovery in the face of disasters, but more generally about how long-term adaptation is conceptualized across governing institutions and citizens. Finally, recovery and long-term adaptation will be negotiated not only between citizens and the government, but also in coordination with the federal government as it is an unincorporated territory of the United States.

Impacts of a disaster are known to be produced by several factors, including unsafe conditions and root causes (Wisner et al., 2004). In Puerto Rico, vulnerabilities that pre-dated Maria will have to be considered in long-term recovery, such as economic instability and weak infrastructure (Vives, 2017). In addition, the island's capacity for recovery, both physical and organizational,

will have to be considered as well as which capacities should be enhanced to ensure stability or enable desirable transformations after Maria. Resilience is a commonly used lens with which disaster recovery is examined and is used here to understand recovery by exploring connections between built and social systems and how populations organize to achieve successful adaptation (Vale & Campanella, 2005). Both adaptation literature as well as disaster research have pointed to resilience to understand how to improve both human and non-human systems to face uncertainties (Tierney & Bruneau, 2007; Pelling, 2011). While resilience is used here to understand the connections between built and social systems, this research reaches beyond the concept to understand recovery and adaptation outcomes after Hurricane Maria not just as a 'resilient' but as a process of transformation and fundamental change. Further, viewing climate adaptation as process of increasing resilience or enabling transformation requires taking stock of perspectives that influence arrangements on maintaining well-being in the face of major ecological change (O'Brien et al., 2009). In recognizing the diverse perspectives at play in adaptation, this research uses the concept of negotiation to frame the ongoing discussions on recovery, long-term stability, and climate adaptation in Puerto Rico. To do this, perspectives of a local community and the overarching perspective of the government of Puerto Rico are elicited through qualitative interviews and key recovery documents on recovery. Both perspectives will be considered for their role in the co-production of an agreement on adaptation, including which actors and resources should be involved and what actions will produce change on the island. The next sections outline key discussions in disasters, adaptation, and resilience before presenting research questions and how they will be explored using the case of Hurricane Maria in Puerto Rico.

CHAPTER 2

LITERATURE REVIEW

Natural disasters have long been the subject of studies on climate change and adaptation (Blaikie et al., 1994). The term "natural disaster" has itself been the subject of discussion on which conditions actually produce damages and losses associated with extreme events, and if these are in fact natural or the result of broader institutional arrangements (Wisner, 2004). Further, disaster scholars have been concerned with how vulnerable populations cope with and overcome such disasters, especially at a local level (Lopez-Marrero & Wisner, 2012). In recognizing that the conditions which contribute to losses and damages from disasters varies widely across political and geographical contexts, researchers have concluded that strategies to address underlying conditions are equally as diverse and can be shaped by political, social, cultural, and economic landscapes (Neef & Shaw, 2013). Studies on vulnerability to disasters, capacities for recovery, and resilience of populations are common throughout disaster research and are discussed here to show the different ways disasters are experienced and overcome in a particular context. In this discussion, disasters are considered not only as the build-up of hazardous conditions triggered by extreme events, but as lessons on how people will adapt to the continued exposure of climate threats by examining both physical and non-physical vulnerabilities.

Recent research has looked beyond the direct impacts of disaster events and immediate response to consider the period of recovery as a pivotal juncture for adaptation (Birkmann & Teichman, 2010). Some scholars, for example, suggest that disasters present opportunities for rethinking socio-political regimes and the effects these might have on adaptation (Pelling & Dill, 2010). Even more, others have begun to consider disasters as actual opportunities to consider

new social contracts surrounding climate adaptation (Blackburn & Pelling, 2018). Pelling and Dill (2010) suggest that change after a disaster can happen in a way that "accelerates the status quo" or contests it (pg. 22). While a variety of institutional arrangements exist to take on the challenges of disaster risk reduction (IPCC, 2012), most disaster adaptation strategies do not involve examining and altering socio-political and economic regimes that may have exacerbated risk to begin with. However, using disasters to understand the broader processes of adaptation can foster a re-evaluation of these dominant regimes as well as the values and beliefs regarding adaptation that are held across individual and institutional actors. Further, this re-evaluation has been considered a window of opportunity to challenge existing institutional structures and dominant ways of thinking about adaptation (Birkmann et al., 2009). In addition to examining the conditions that produce vulnerabilities to disasters and capacities necessary for successful adaptation, understanding the processes of change after disasters can provide insights into the values that drive adaptation--and, perhaps, transformation--after disasters.

2.1 Key concepts in disaster and adaptation: vulnerabilities, capacities, and resilience

Seminal research provides frameworks for understanding the underlying conditions and pressures that can produce a disaster. Specifically, Blaikie et al. (1994) define a disaster as a function of hazards interacting with root causes, dynamic pressures, and unsafe conditions. The event itself exacerbates pre-existing conditions like lack of resources, dangerous locations, and macro-forces like climate change. The Pressure and Release (PAR) model suggests that economic instability, lack of shared power, and lack of social protections are common foundational vulnerabilities that can exacerbate impacts of natural forces (Blaikie et al., 1994). According to the authors, pressure from a hazard is placed on vulnerable people and places, and these same

populations are on the other hand made more vulnerable by dynamic pressures and root causes. In turn, these vulnerabilities affect capacities to cope and adapt to extreme events. Lecheinko and O'Brien (2008) also suggest that vulnerabilities are affected by global climatic and political processes. In summary, both physical and social vulnerabilities can present challenges for disaster recovery and climate adaptation more broadly. As major disruptors of social and ecological stability, disasters present opportunities to reflect on vulnerabilities in the face of extreme events and consider them for future adaptation.

Much like different root causes of vulnerability, adaptive capacities represent many sets of conditions that determine successful adaptation (Adger et al., 2011). These capacities involve how material and organizational resources are mobilized in the face of a disturbance or a chronic issue. Eakin & Lemos (2014) differentiate between "generic" and "specific" capacities in the face of climate adaptation. Generic capacities are foundational development needs and specific capacities refer to planning for and anticipating threats. For example, generic capacities at individual and system levels include material assets, health status, transparency in governance, and participation in social organizations. The authors suggest that when populations lack these generic capacities, "individuals and communities face chronic, intense stress that undermines human welfare and erodes the social fabric that is necessary to manage risk effectively" (pg 4). Specific capacities, on the other hand, are focused on reducing the impact of climate stresses and shocks. They can include adopting technologies, early warning systems, and disaster planning (Eakin & Lemos, 2014). While high specific adaptive capacity can decrease loss associated with climate threats, considering both types of capacities can best inform adaptation action after a sudden shock in a way that addresses both immediate impacts and long-term development.

Adger and Vincent (2005) write that "Adaptive capacity has diverse elements encompassing the capacity to modify exposure to risks associated with climate change, absorb and recover from losses stemming from climate impacts, and exploit new opportunities that arise in the process of adaptation" (pg. 400). As seen in research on vulnerability and resilience, however, exposure to risk associated with climate change varies widely as do the resources available to recover from loss. Therefore, adaptive capacity as it is exhibited at particular level, such as a community-scale, may look different than efforts to increase capacity at broader scales. For example, bridging organizations and horizontal networks are steps taken at a national and international level to increase adaptive capacity (Adger et al., 2005). At a local level, these actions might take the form of an inclusive governance structure for decision-making, such as a committee of residents who act as community leaders. Community action to increase adaptive capacity have been of particular interest to studies in resilience to disasters (Cutter et al., 2008). In communities, improvising, learning and acting collectively represent social learning, a key capacity in adaptation (Adger, 2003). Research in disaster resilience has further stressed the importance of social capital and social networks in reconstruction and recovery. Aldrich (2012) writes, "higher levels of social capital--more than such factors as greater economic resources, assistance from the government, and low levels of damage-- facilitate recovery and help survivors coordinate for more effective reconstruction" (pg. 2). Strong social networks and organization have also been cited as factors that contribute to overall resilience, another concept used to conceptualize adaptation after a disaster (Carpenter, 2013). Since resilience has been used to examine how groups overcome vulnerability and increase adaptive capacity in the face of disaster events, it is useful to also discuss the concept within the broader processes of adaptation.

Throughout resilience literature, the term has been used to describe how systems, populations, and institutions maintain stability given major uncertainties associated with climate shifts (Holling, 2001; Pelling, 2003; Walker et al., 2004). While some view this characteristic as an actual measure of vulnerability--in other words the more resilient, the less vulnerable--(Holling, 2001), others have begun to examine resilience as a component of change in adaptation, especially with regard to disasters. The United Nations defines resilience in the context of natural disasters as "the capacity of a system, community, or society to resist or to change in order that it may obtain an acceptable level in functioning and structure" (UN/ISDR, 2001). Disaster research has further defined resilience to better explain local actions to reduce impacts of a disaster, especially by outlining actions taken by groups or organizations to overcome loss. Considering the concept of resilience has been central to understanding large- and small-scale adaptation, it is not surprising that the term has made its way into the language of disaster recovery both in government communications and in citizen-led initiatives after disasters (Manyena, 2006). However, some have noted that defining resilience as simply returning to a normal function after a disturbance can be problematic and, more specifically, this definition does not "measure all of the ways in which a system may fail" (Walker et al, 2004, pg. 1). Other processes of adaptation, such as transformability, may be better positioned to unpack the root causes of exposure and help to develop plans for long-term adaptation.

Conceptualizing resilience as resisting change, as does the UN definition, runs contrary to the view of climate adaptation as an opportunity for a major shift in social and ecological systems. Some scholars suggest that "transformability" best describes the type of change that is fundamental, and some suggest that transformation at a small scale can enable resilience at larger scales (Folke et al., 2010). Resilience and transformation often diverge when considering

interactions between social-ecological systems and climate adaptation. This is because resilience is not typically characterized as forward-looking (Redman, 2014), while transformation is. In addition, transformation involves issues of ethics and process, and opening new possibilities for adaptation (Pelling et al., 2015). Despite these differences, both resilience and transformation involve learning and adapting as important processes of change. However, the forward-looking nature of transformative change allows for consideration of fundamental vulnerabilities and how these might affect long-term adaptation or increase exposure to harm or risk (Wisner et al., 2004). Adaptation research has recently called for more analysis of transformational change in climate adaptation through the lens of social contracts (O'Brien et al., 2009; Adger et al., 2013). Social contracts can shed light on the arrangements in place for securing the rights of citizens, and can be especially helpful in understanding how governments will secure these rights given the uncertainties of climate change. This framing allows transformational change in adaptation to be thought of not just as a general shift in systems, but a more complex process of re-negotiating rights and responsibilities among different actors.

2.2 Disasters: opportunities for negotiation and transformation

While much disaster research has focused on resilience, others have highlighted a transformational approach to recovery. Unlike resilience, which is known to be a conservative example of adaptation in that it focuses on returning to normalcy, transformational change involves examining vulnerabilities so deep that they are almost imperceptible, especially during normal times (Pelling, 2011). Since these vulnerabilities are ingrained across social, economic

and political domains, challenging them requires also intentionally challenging the status quo regarding decision-making across all areas of the social structure. This purposeful type of adaptation should also be reflected in the processes of participation and decision-making if adaptation is to be considered just and transformational (Schlosberg et al., 2017). In other words, the end-goal of transformational change is as important as the deliberation and decision-making processes occurring along the way. This understanding of transformation as a purposeful examination of the status quo has led to more questions about how societies interpret change and adaptation. O'Brien and Selboe (2015) call for a "*deeper* interpretation of adaptation, recognizing that individual and shared beliefs, values, worldviews, and knowledge systems influence how people or institutions approach change itself" (p. 312). These values are often the baseline of how individuals understand their own capacity for adaptation and can affect actions taken.

Recent research has pointed to disasters as potential 'windows of opportunity' for this purposeful fundamental change (Manyena, 2013). Some of the factors that contribute to the idea of disasters as opportunities for change are that they bring to light political attention and intervention that may not have existed before (Lakoff, 2010), and that the instability brought on by the disaster event opens an opportunity for citizen rights to be renegotiated (Pelling & Dill, 2010). To further consider transformational change after disaster as a negotiation of rights, responsibilities, and collectively held values, it is important to identify who is involved in this negotiation, as well as their level of involvement. For example, research in 'transformative disaster risk management' has found that not only do transformations typically happen at a local level, but also the 'burden of transformation' is also placed on 'individuals, populations, and civil society' (Gibson et al., 2016, p. 1). In other words, negotiating a new contract for climate adaptation can be viewed as a discussion between multiple actors all contributing to change from

diverse perspectives and capacities. In this process, what is being negotiated is equally as important as who has access to negotiation and what their interests are. Those involved in negotiation of a new contract can advocate for their own best interest and work to achieve stability, but those who are not participating in the negotiation are not able to do so. Climate change, specifically, presents a challenge in identifying and examining who should participate in negotiating change for adaptation because of its effects on voiceless and vulnerable populations like those in developing countries, future generations and even non-humans (O'Brien et al., 2009; O'Donnell & Talbot-Jones, 2018). Research on how adaptation is negotiated, however, has focused mostly on national and international agreements that dictate the rights of citizens and the responsibilities of governments in facing climate uncertainty. Nonetheless, climate adaptation offers an opportunity to rethink the existing 'social contract' in order to establish rights and obligations given uncertain futures (Adger et al, 2012). Some scholars have pointed out that new agreements around climate adaptation must be more than just old agreements with a new environmental component. Instead, it is suggested that an entire new "environmental contract" is needed in order to face "threats such as climate change that require collaboration between individuals, businesses and governments" (Miliband, 2006). Further unpacking the roles of individuals as well as the government in negotiating this new contract means factoring in not only rights and responsibilities, but also the core perspectives held around what actually constitutes adaptation and long-term recovery.

Disaster and adaptation research have effectively outlined the complexity of actors, dominant beliefs, and processes that constitute change after a disaster event. In describing the diverse actions taken to achieve stability in the face of increased risk brought on by climate change, there is not one but multiple perspectives of recovery, resilience, adaptation, and

transformation that exist in a given context. The value of eliciting diverse perspectives comes from an intentional examination of the beliefs associated with immediate recovery and long-term adaptation. In the next section, the concepts used to elicit these diverse perspectives are outlined as well as key research questions that will guide the process of elicitation and contribute to ongoing discussions on the negotiation of recovery and adaptation after disasters.

CHAPTER 3

FRAMING CONCEPTS AND RESEARCH QUESTIONS

Evaluating multiple perspectives is central in framing disaster recovery as a process of negotiation. Adger et al. (2003) found that "adaptation will inevitably be characterized both by processes of negotiated adjustments involving individuals, civil society, and state, and by renegotiation of risk-bearing and sharing between them" (pg. 14). This research illustrates how to elicit different perspectives of disaster recovery and how joining them under a common lens generates a conversation that is beneficial for recovery, adaptation, and resilience. When considering the multitude of actors involved in recovery, it is useful to recognize that not all of these perspectives are "equal" in that they illustrate both institutional and landscape perspectives as well as individual and local perspectives. Each of these might hold conflicting views of what constitutes adaptation, and actions taken based on those views might have negative consequences for some while benefiting others (Kates, 2000). Therefore, this research uses both community and government perspectives of stability, vulnerability, and adaptive capacity to explore which aspects of disaster recovery and adaptation are being negotiated across these two actors.

The concept of resilience has been used in framing disaster recovery, and involves evaluating vulnerabilities and capacities (Wisner, 2004). However, this evaluation process varies across scales, and is often reflective of specific knowledge systems (Vogel et al., 2007). In other words, "resilient" outcomes at one scale--within a local community in Puerto Rico, for example-- might not reflect the goals that the government has for a "resilient" island as a whole. Further, resilience is not the only framing that can be used to understand adaptation to disasters. As discussed before, transformation can also help us understand a more intentional approach to adaptation that involves challenging not only values and beliefs, but also institutional processes and power

dynamics of adaptation. While resilience can be useful in observing how populations "bounce back" after a disaster, the concept of transformation is also used here as a means of exploring long-term fundamental change and adaptation.

As previously mentioned, exploring the multiple framings of adaptation held by all of those who might influence change will allow for a deeper understanding of the root causes of risk and vulnerability affecting adaptation as well as which values are driving adaptation actions. O'Brien et al. (2010) write that framing matters because "dominant perspectives do not confront fundamental aspects of the problem and may lead to regretful (and deadly) actions or inaction" (p. 4). Exploring these perspectives will help to address the following research questions:

- What can be learned from exploring both community-based and official perspectives of adaptation to disasters?
- How are perspectives of adaptation (including stability, vulnerabilities and capacities, and fundamental change) articulated across both community interviews and official documents?
- What can these perspectives tell us about the ongoing negotiation of recovery and adaptation in Puerto Rico after Hurricane Maria?

By addressing these questions, this research aims to present an initial discussion of recovery and adaptation in Puerto Rico after Hurricane Maria. While Maria is not the first disaster to be considered for its lessons on disaster recovery and adaptation, it adds to our understanding of these by exploring a context where power and decision-making are complex given the island's historical context and relationship with the United States (Rodriguez-Diaz, 2018). It also adds to current discussions about how to integrate diverse knowledge systems into planning for future threats in Puerto Rico by juxtaposing the perspective of government entities, those primarily

responsible for recovery, with that of a local community (Ramsey et al., 2019). After Hurricane Maria, long-term recovery has been considered mostly by examining the roles of the governments of Puerto Rico and the United States (U.S. Congress, 2017). A third perspective is included in this research and represents that of a rural community in western Puerto Rico. Community case studies have previously been the focus of both academic and policy efforts to understand resilience and disaster recovery (Aldrich, 2012). Here, the Corcovada community in Añasco was chosen as a case study because of their success in leveraging capacities to negotiate adaptation, such as restoring water services to hundreds of people just two days after Hurricane Maria, despite existing challenges that predated the storm (FCPR, 2018). While not all communities represent cases of quick recovery, these perspectives can offer insights into long-term stability and adaptation. Further, analyzing both community and government perspectives can be a first step in identifying values and motivations for adaptation among those guiding recovery as well as citizens. The following sections introduce the case of Puerto Rico as a unique example of climate adaptation, given social, political, and ecological challenges.

CHAPTER 4

THE CASE OF HURRICANE MARIA IN PUERTO RICO

Puerto Rico is an archipelago in the Caribbean 1,030 miles from the coast of Florida. It is an unincorporated territory of the United States which holds commonwealth status[1]. As a territory of the United States since the Treaty of Paris in 1898, residents of Puerto Rico were granted U.S. citizenship as a part of the Jones Act in 1917[2] with unique and discretionary policy structures and agreements set up for the island's economic and social development. Although Puerto Ricans have been able to elect their own Governor since 1947, all legislative affairs on the island are subject to federal rule, a key component in the structuring of economic and political institutions on the island. The decades following the incorporation of Puerto Rico into the United States was marked by the creation of massive institutions on the island and the injection of investment into industries such as manufacturing, pharmaceuticals, telecommunications, and energy (COR3, 2018). PREPA, the Puerto Rico Electric Power Authority is one of these institutions and was created in 1941 with a mandate of total electrification of the island (Energy Commission of Puerto Rico). Since then, PREPA has created, operated, and managed most energy production and consumption on the island. This grid that connected regional production to mass distribution and transmission has not seen much improvement in infrastructure since it's construction, which contributed to its complete devastation across the island after Hurricane Maria (Vives, 2017). Not only was the power grid's infrastructure brought to its knees after the storm, institutional mismanagement of PREPA came into question when considering reconstruction (U.S. Congress, 2018). As a government institution, PREPA is subject to oversight by the United States

[1] According to a 1997 GAO report, an unincorporated territory is an area controlled by the United States, but where "fundamental rights apply as a matter of law, but other constitutional rights are not available" (GAO, 1997)
[2] This legislation had several components, of which some are related to importing goods to Puerto Rico.

government and was highly criticized by members of Congress when considering how the grid would be re-imagined after the storm. As the government of Puerto Rico coordinated response and recovery with federal entities, questions were brought not only about the island's failing critical infrastructure but also about how reconstruction would be affected by the ongoing bankruptcy process that jeopardized the survival of public entities, PREPA included (Garcia-Lopez, 2018). While the process of reconstructing the energy, grid continues to be deliberated among both state and federal actors, other aspects of recovery as well as the role of the United States in that process have also been scrutinized.

Quickly after Hurricane Maria made landfall in Puerto Rico, discourse surrounding the event in mass media presented diverse perspectives of disaster recovery. Headlines about the condition of the electric grid, about the state and national government response, the President's response, and the island's looming fiscal crisis filled newsfeeds (Vick, 2017; DePillis, 2017; Campo-Flores, 2018). Maria, the strongest hurricane to make landfall in Puerto Rico since 1928, struck the island in September 2017 with sustained winds of 155 miles per hour. Residents of the island experienced what is now recognized as the largest blackout in United States history, and the second in world history with over 75% of electricity clients without power even after one month of the storm's passing (Houser & Marsters, 2018). Along with damage to nearly all of the transmission and distribution lines, Hurricane Maria brought to the forefront questions about energy infrastructure on the island and the capacity of PREPA and other government entities to address emergencies involving both critical infrastructure and essential services. In emergency response phases, recovery was almost exclusively dictated by the state government of Puerto Rico and federal entities like FEMA and the United States Army Corps of Engineers (USACE). Much like any other State, Puerto Rico received help from FEMA as well as personnel from other states

through an Emergency Management Assistance Compact. However, unlike responses to hurricanes in other regions of the U.S., FEMA was not able to quickly deploy resources and help to Puerto Rico after Maria due to its geographic location, effectively exacerbating damages and delaying aid (Willison et al., 2019).

The damage to the built infrastructure was felt across the entire island, since foundational systems like the electric grid were vulnerable and therefore took down other integrated systems such as communication and medical services (COR3, 2018). Failures in these essential services were not something that could be addressed quickly by either federal or local responders because of the island's isolated geography. In addition, landslides, overflowing rivers, and obstructed roads prohibited access to vulnerable communities once emergency personnel were able to reach the island. Finally, recovery aid and essential resources arriving from surrounding countries and territories was not able to be sent to Puerto Rico due to maritime laws that require all shipments arriving to ports be on U.S. vessels. This lagging recovery process was seen at just about every phase and was at the forefront of news coverage. This process was not uniform across the different regions of Puerto Rico and while some areas received resources and restored essential services like electricity and water relatively quickly, others still lacked these even after one year (AP, 2018). As emergency relief was being coordinated across state and federal departments, the island's infrastructure collapsed resulting in the death of at least 2,975 U.S. citizens (George Washington University, 2018). The island's residents organized to minimize damages and loss of life despite inconsistent aid from federal, state, and local resources. While challenges associated with location and the arrival of emergency aid proved to be detrimental across the island, there were some communities that overcame these vulnerabilities. One of these is the focus of this research, a community in the western mountainous region of Puerto Rico.

CHAPTER 5

RESEARCH DESIGN

This research aims to answer the previous questions by exploring narratives of recovery and stability in Puerto Rico after Hurricane Maria. Adaptation research has cemented the importance of examining the processes, relevant discourses, and those involved in planning for climate change (O'Brien & Selboe, 2015). Typically, government discourse has been recognized as having the most impact on policy making, especially for climate change. Community discourse has also been explored by some scholars as a way to understand local vulnerabilities and capacities for climate adaptation (Schlosberg et al., 2017). Lastly, not considering the value of both of these perspectives could lead to exclusion of those with less power, as well as exacerbated climate risks (Barnett & Palutikoff, 2015). Therefore, to effectively examine disaster recovery as a process of negotiation and adaptation, both the perspective of the government of Puerto Rico will be considered, as well as perspectives from the Corcovada community in Añasco.

Access to the Corcovada community allowed for this study to be designed around a local case of recovery after Hurricane Maria. Therefore, participation in this study was not random, but purposefully chosen to include the Corcovada community's story as well as the perspective of recovery and adaptation as told by two central government documents. Given the history of the community in its organization around their community aqueduct and their ability to restore water to those in the area after such devastation helps to answer the question of how recovery actions are negotiated and executed despite some notable vulnerabilities associated with living in Corcovada. On the other hand, government documents provide a distinct perspective that focuses on coordinating recovery and negotiating adaptation at the island level. Both of these sources give

insight into vulnerabilities and capacities at a community level as well as the government's perspective on recovery, both perspectives that are recognized as crucial in exploring new arrangements for climate adaptation (Pelling & Dill, 2010). The following sections describe these sources and why they were chosen for this research.

5.1 Community interviews and recovery documents

While resilience was a word used across reports and releases by federal entities and news media outlets to describe recovery (Donalds, 2018; Ortega, 2018; FEMA 2017, 2018; FCC, 2018; DOE, 2017; Rockefeller Foundation, 2018), these sources didn't necessarily offer one cohesive perspective. The government of Puerto Rico ultimately surpasses any other entity as being central to recovery both directly and through collaboration with the U.S. government and other non-government entities. Specifically, COR3, the agency created after Hurricane Maria tasked with coordinating resilient recovery, housed documents on emergency management by FEMA as well other reports from the Governor's office and COR3 itself. At the time, there were two major documents that stood out because they documented the critical first steps towards recovery and an outline for long-term transitions. First of these is "Build Back Better Puerto Rico", the official request for federal assistance where the Puerto Rican government explains the damage caused by Hurricane Maria across the island and the resources necessary to survive the first steps of emergency management. The second is "Transformation and Innovation in the Wake of Devastation", which despite being generally aimed at outlining an economic recovery plan for the island provides the government's most comprehensive assessment of recovery to date. A primary motivation for reviewing official recovery documents was to learn more about how the government has come to understand recovery after Hurricane Maria, and what motivations are

guiding the process of adaptation across the island. Since the government of Puerto Rico will be a central figure in dictating new arrangements for adapting to Maria and future threats, their perspective will be key in conceptualizing resilience in recovery.

The second set of data consists of semi-structured community interviews. Since the aim of this research was not to present established frameworks of recovery to participants, or evaluate and promote a particular perspective of adaptation, a mostly qualitative methodology was appropriate. Denzin and Lincoln (2011) write, "Interviews record what the interviewer draws out, what the interviewer remembers, what he or she chooses to tell, and how he or she understands what happened" (pg. 452). The goal of using this method was to capture what this community understands their own recovery and long-term stability to be. Corcovada residents have a unique perspective to offer since their recovery was notably different than that of other communities across the island. For this reason, community interviews were focused on questions about recovery after Hurricane Maria but also expanded to include what individuals perceive daily stability in Corcovada to be and how they restored that stability after the storm. Therefore, much like the government recovery documents, the interviews were able to not only present a timeline of facts about post-Maria recovery, but the deeply held values that are associated with adaptation actions both in Corcovada and across Puerto Rico.

The goal of joining perspectives of recovery across these two groups is to generate an understanding of how stability will be achieved on the island after Hurricane Maria and, more generally, in the face of climate uncertainty. Neither one of these two perspectives of recovery are meant to be taken as the correct conceptualization of stability or successful adaptation. Rather, they are explored here to show that any action towards both short-term recovery and long-term stability must be considered within a unique context. In other words, the government of Puerto

Rico's coordination of post-disaster recovery reflects a larger context influenced by a particular sociopolitical, economic and ecological landscape. Community interviews also give context to the government's account of recovery, since the perception of individual citizens allows a deeper understanding of barriers to implementing institutional adaptation actions and root causes of vulnerability (Azhoni & Goyal, 2018). Finally, bringing both perspectives together provides not just a description of recovery, but a reflection of power, capacity, vulnerabilities and challenges across scales. Considering both accounts of recovery could reveal disjunctions on what constitutes stability on the island, therefore influencing actions towards adaptation or even prohibiting adaptation.

5.2 "What do you mean by resilience?": interview questions and other challenges

Translating concepts which in themselves are varied and contested into guiding interview questions comes with inherent challenges. For this study, one challenge came in documenting perspectives and conceptualizations of resilience while recognizing that participants will not likely use this word, or any concept found in the literature, to help guide observations. Instead, interviews depended on questions about capacity and resources in the community, the experience of the hurricane, and recovery efforts both local and across the island. [A full interview protocol is shown in Appendix C].

Since Corcovada has previously been the subject of case studies, community leaders took much of the direction in recruiting participants who would be willing to be interviewed. During visits to the community, leaders would act as guides throughout the neighborhood, recommending households to interview. This sampling strategy represents another challenge in getting a wide range of perspectives within the community, since participation would be mostly out of my

control. However, this saved time in recruitment and proved to be helpful in navigating around the community and surrounding areas[3].

5.3 Analyzing interviews and documents

The mostly open and unstructured interview process used in this study was conducive to a similar "open" form of data analysis that consisted of open coding using key concepts to identify common themes from the interviews and documents. No demographic or other statistical analysis was conducted, since the Corcovada community was chosen purposefully for their history of community organization and the sample of participants themselves were nearly all older residents of the community who lived along the main road. Qualitative interviews produced narrative-like data, and not easily identifiable or closed answers. Therefore, line-by-line coding was used to produce a list of codes which were then grouped into larger themes[4]. A similar open coding was used for the recovery documents, and new themes found in the documents were added to the list from the interviews. Making a list of themes across both documents and interviews allowed a better understanding of key research concepts-- stability, vulnerabilities, capacities, transformation--and how they appear in both sets of data. The next sections present key findings from official documents and community interviews discuss these themes within the context of the research questions.

[3] A map of the location of the Corcovada community is in Appendix B
[4] A full list of codes is in Appendix D

CHAPTER 6

FINDINGS

Narratives from interviews centered around the community members' conceptualization of bouncing back after the hurricane by organizing community-led recovery. In addition, community members described how they maintain stability in Corovada during normal times, especially given the isolated location of the community and the challenges associated with access to basic services like water infrastructure as well as lack of access to a hospital emergency room in the immediate area. Residents are eliminating their vulnerabilities by strengthening the reliability of their community aqueduct, mainly by establishing new solar energy infrastructures. By describing how social organization in the community helped to address damages after the hurricane and mentioning which community values are carried into actions to better Corcovada, interviews showed how residents perceive their capacity and motivations for adaptation after Hurricane Maria.

Across government documents, the vulnerabilities that exacerbated destruction on the island after Hurricane Maria are mostly associated with the failing energy grid, aging critical infrastructure, and the lack of coordinated help due to inconsistent emergency management and a challenging geographic location. To counteract these adverse conditions, both the Official Request for Federal Funds and the island's Long-Term Economic Recovery Plan stress the role of financial capital in reconstructing the island's infrastructure. Looking beyond the rebuilding of physical infrastructure, the recovery documents frame long-term adaptation as "innovative" and "transformative". Similar to the perspective of recovery as told by the residents of Corcovada, the government of Puerto Rico suggests reimagining major systems on the island. However, these include political and financial systems, and do not consider changing the vulnerable energy grid.

The following sections will further elaborate on the themes of stability, vulnerability, and capacities for adaptation that were observed within both interview data as well as in the government's plans for disaster recovery and provide examples from the analyzed text throughout.

6.1 "La gente empezaba a luchar para las cosas y de repente las cosas llegaban" ["People started to fight for things, and suddenly those things were provided"]: adaptation in Corcovada

The first residents to be interviewed in the community showed an eagerness to talk about work done by Corcovada residents after the hurricane to address damages. However, after continuing to speak with more neighbors, the community's work proved to be a common theme in nearly all aspects of community life, not just after Hurricane Maria. After the storm, residents of Corcovada came together to address critical infrastructure damage, mainly by restoring electricity and clearing roads for emergency personnel to be able to enter the community. During "normal times" the community organization is manifested in the form of a committee which coordinates to maintain the aqueduct system, organize activities and educational resources for residents. While the concerns of the community shifted to focus on the hurricane for some time, their organization is a capacity that residents of Corcovada say is a part of their culture. In the following sections, this idea will be explored through a description given by the residents themselves.

Corcovada residents spoke of a future-oriented approach as central to recovery. The goal of restoring essential services after Hurricane Maria might be to return the community to a normal functioning state, but the actions taken by the Corcovada community involve envisioning and transforming their system to where vulnerabilities associated with the failing grid were reduced or

even eliminated. One example of this is the community aqueduct, managed by leadership within the community who have formed a central committee called the "Comité Comunal de Corcovada". Creating and managing the community aqueduct has been a critical practice in organization. Another example of this organization was how residents reimagined their energy infrastructure after Maria to consider a photovoltaic system that would make their aqueduct independent of PREPA's energy infrastructure.

Separating the community's potable water system from the public water and sewage authority, PRASA, happened more than 50 years ago and has proved to be central in reducing vulnerabilities associated with water infrastructure. One leader said,

> "And that's where the organization comes in. If we weren't organized here, we would be like the neighborhood just over there, they depended on [PRASA] when the hurricane came. You can't trust [PRASA] so that's why we have the [aqueduct] system" [I3]

Managing a separate water system for the community stems from a mistrust in the public sewage authority, whose infrastructure failed after Maria. In COR3's assessment of Puerto Rico's water system, the government noted that,

> "There are great deficiencies in water production, management, and distribution. A concise and sustainable plan for dredging and maintaining water reservoirs is needed; currently, close to 50 percent of the water produced is lost through leaks in the water distribution lines." [RD1]

After Hurricane Maria, this resulted in mass water outages for the island's residents. In November 2017, one month after the storm, the government of Puerto Rico reported that "until recently 70% of the potable water is either unavailable or has yet to be certified as safe to drink" (Government of P.R., 2017). Meanwhile, Corcovada residents were able to restore water services through the use of their community aqueduct. They did this by securing a backup generator to connect and power water pumps, which was given to the community after one resident attended a FEMA meeting. This very much differentiated Corcovada from surrounding communities that remained without running water after the storm. One resident looks back on the impact that having a community aqueduct has had:

> "[Over the past] 50 years, the community has always had water and has had everything at home. Then you go to other places and you see the all need that there is.."[I1]

Unlike water, residents still lacked electricity for months after the hurricane. Most participants mentioned electricity as a cascading damage brought on by the Hurricane, since power outages affect almost everything in the community including the aqueduct's water pumps and support systems for residents with medical conditions. Some comments on the effects of not having electricity were:

> "The highest concern is that we didn't have electricity…the electricity came back…when did it come back? It came back in February. 127 days without electricity" [I3]

> "They have a little boy who has some dystrophy...they have him hooked up to a bunch of machines and a respirator, goodness you wouldn't believe it. Then they're over there in that isolated house." [I6]

Geographic location was also a challenge that affected the community's ability to restore energy, since the Corcovada area is in a mountain region with only one road leading to and from the center of town. Despite damages related to lack of electricity, the community organized to brainstorm about moving their aqueduct to a separate power system to eliminate the vulnerabilities associated with being connected to the public energy authority, PREPA. By tapping into resources from a solar energy company and foundation, they planned to have panels and batteries installed to the aqueduct system to prevent any water disruptions. Some community leaders said,

> "Well now we're thinking about a solar energy system for the families here. And that way, if the cement post falls, well we wouldn't have to bring in another one because the energy would be solar." [I5]

> "We got a quote from a [solar company and foundation] and they said it would be forty-five thousand, but the foundation would cover 60% or something like that. So, then all we had to do was find 18 thousand or so." [I2]

> "If we could put solar [panel] units on our houses and for our aqueduct system, we wouldn't have to worry." [I5]

The energy grid was by far the most cited damage associated with the Hurricane. In addressing damage to their energy supply, community members seized an opportunity to implement a photovoltaic system that would further separate them from the aging electrical infrastructure. This future-oriented approach is largely made possible by the use of social capital through a community work ethic and mobilizing external resources. This self-organization was key in hurricane recovery but has roots in the Corcovada community culture.

6.2 Self organization and social capital

One central tool allowing the Corcovada community to harness external resources, coordinate relief efforts, and maintain community stability is a self-organization they have developed over many decades. This organization was key in coping with geographic and financial vulnerabilities after the hurricane. During interviews, residents identified church groups, NGO's, foundations, and friends from the mainland U.S. as sources of support after the hurricane. All these entities contributed in one way, or multiple, in the community's organization in recovery efforts. As a foundational resource, support from neighbors within the community and extended family members were also mentioned as key in cleanup efforts, finding a backup generator, and even food delivery after the hurricane. The only road that goes up to and through the community was damaged and covered in debris after Hurricane Maria. Residents recalled the days after the storm when community members took to the streets to handle cleanup. After clearing pathways of debris, residents were able to make their way down the road to get the aqueduct up and running. Some residents described the days after Maria:

> "Here, there were 45 people out on the roads cleaning debris so that the posts could be put back up, picking up electric cables, clearing the way." [I4]

> "People took to the streets. They cut trees and cleaned up. We had this place looking like new after two days." [I6]

Help from neighbors was present after the storm, but also when participants spoke about daily life in Corcovada. Within the community, the internal culture of reciprocity towards fellow residents was present after the hurricane as seen in road cleanup, but also during normal times. One participant said,

> "If I have to move a tree at my house, it's not just me doing it. Five more people show up. It's mutual help, and that's important to have." [I10]

Another participant mentioned that despite the geographic landscape of the area, community members feel connected to one another. They say,

> "If you look at our community, even though we each have our own land and our own houses, we're more united than those neighborhoods where all the houses are lined up" [I13]"

Corcovada has historical ties to the church community, particularly Christian organizations which were among the first to arrive in the mountain area of Añasco to build the

first schools and communities where Corcovada is now. This connection was felt strongly through all the interviews with residents. “God has blessed us and look at all that we have”, said one resident [I3]. Although church groups were among the most cited resources for help post-hurricane, residents also mentioned a network including non-profits and extended family of Corcovada residents. One resident said

> “The Presbyterian church helped a lot and some university students came to help too. And now I hear they are setting up a solar unit with another group.” [I5]

Another resident said that the community was thankful to have had the help of people across the island coming to help friends or family in the community and bringing equipment and machinery with them.

> “The best we had was that we had two people come with machinery whose [family] was from Corcovada. When the hurricane came, one of them came down from over there and the other from Ponce and cleaned all up and down. They used the machines and with them and people helping, everything looked clean in no time.” [I2]

Similar external resources were activated when the community’s backup generator for the aqueduct system stopped working. One community leader was invited to a FEMA visit meeting in the city center of Añasco and recalled,

> "When I arrived at the meeting, there was someone I knew there. I told him our generator stopped working and he said, 'FEMA has one that you can use'." [I11]

Based on insight from participants, networks within the community helped problems like road cleanup after Hurricane Maria, despite neighbors being quite far from each other geographically. External networks including church groups, extended family members of residents, and friends positioned within FEMA helped bring food, supplies and most importantly a diesel generator that the community used to power their aqueduct. While Corcovada residents self-organized to recover from the Hurricane and better their community, official documents provided a perspective of recovery that included evaluating institutional, social, and economic vulnerabilities while navigating stability across the island.

6.3 Vulnerabilities: energy grid, emergency management, and fiscal crisis

After Hurricane Maria, emergency personnel and recovery officials were tasked with both assessing the acute damage of the hurricane as well as considering efforts for long-term recovery. The first document chosen for this analysis, titled" Build Back Better Puerto Rico", was focused on outlining damages reported by FEMA and the U.S. Army Corps of Engineers, then made requests for federal funding to address those. In describing the impacts of the hurricane, the documents outlined threats produced by the storm as well as vulnerabilities that predated the hurricane. The second document analyzed, titled "Transformation and Innovation in the Wake of Devastation" moves beyond assessing damage to include plans for long-time recovery. The document highlights the values guiding Puerto Rico's transition out of emergency management into planning for the island's future. Among the island's biggest challenges for adaptation cited in

the official documents was the weak energy infrastructure which took down other critical systems like water and communications, obstacles in planning and executing emergency response, and insecurity stemming from the existing fiscal crisis. Initial assessments of the damage to energy infrastructure done by the U.S. Army Corps of Engineers (USACE) reported,

> "The transmission and distribution system consists of 2,478 miles of transmission lines, 31,485 miles of distribution lines, and 344 substations. The storms decimated both transmission and distribution lines across the island, with 847 poles and transmission towers destroyed, and nearly 900 conductor and insulator failures system-wide. 74% of substations, both primary and secondary control centers and all power generation plants incurred moderate to severe flooding and varying levels of wind damage."[RD1]

Damage to the grid had a cascading effect, since water, communications, and health services were also paralyzed due to lack of electricity. One document describes the compiling damage due to loss of energy:

> "..many hospitals and primary care facilities were forced to close, nursing homes were left without power or resources, the social service "safety net" fell apart, and basic resources such as clean and potable water, food and medicine became scarce and turned the emergency on the island into a humanitarian crisis." [RD1]

Re-imagining the grid may not have been as pressing of an issue as was major cleanup of debris—mainly electric poles and transmission lines -- and distributing generators for temporary use. These tasks were made even more challenging because of Puerto Rico's geographic location and the restriction of foreign aid. Recovery dragged on for long periods due to the distance between Puerto Rico and the closest state that could provide assistance. Looking back on the days after Hurricane Maria, one report said,

> "…aid from other states was not readily available due to a lack of mutual assistance compacts and the geographical separation of more than 1,000 miles between Puerto Rico and the continental United States." [RD1]

While the acute damage to the grid was most visible post-hurricane, the recovery process was severely setback by delays in the delivery of aid. Although an Emergency Management Assistance Compact (EMAC) allowed other states to send aid, the journey to Puerto Rico was still far, and paralyzed airports and seaports stalled aid from getting to the places it was needed the most. Aid from other states arrived often too late and help from surrounding countries was prohibited by existing maritime laws. One document noted that this policy "requires that all goods transported by water between U.S. ports be carried on U.S.-flag ships that are constructed in the United States, owned by U.S. citizens, and crewed by U.S. citizens and U.S. permanent residents" [RD2]. Even though this law was waived for ten days on September 28, 2017, COR3's long-term recovery plan notes the effects that this law has on the island not just during a disaster, but in normal times. It states,

> "The Jones Act may constrain Puerto Rico's ability to import a variety of goods and services at more-competitive prices (including, but not limited to, liquefied natural gas, food, and other commodities). Although data limitations obscure the exact magnitude of the effect, it is likely that the prices of imports in Puerto Rico, and of the goods and services produced from these imports, may be artificially inflated, which disadvantages both producers and consumers." [RD2]

Another vulnerability mentioned in the long-term recovery plan was the effect that the island's existing debt crisis would play in securing funds for recovery. Specifically, the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) is mentioned, as is the Fiscal Oversight and Management Board which monitors all government spending on the island. The crisis was described the following way:

> "Economic contraction in the years prior to the hurricanes contributed to a severe fiscal crisis, in which lower revenues and high rates of spending were financed through heavy borrowing. This resulted in high and unsustainable levels of debt, including more than $70 billion in bond debt and a substantial unfunded pension liability. Despite stabilization efforts by the government of Puerto Rico, Puerto Rico's credit rating dropped below investment grade in early 2014, followed by a series of defaults on debt payments. The fiscal crisis ultimately resulted in the passage of the Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) in 2016, which established the Financial Oversight and Management Board (FOMB) and provided the framework for restructuring Puerto Rico's debt. FOMB's purpose is "to provide a

> method for [Puerto Rico] to achieve fiscal responsibility and access to the capital markets" by certifying financial plans, approving and monitoring budgets and activities related to the budgets and fiscal plans, providing advice on issues of financial stability and management, and certifying restructuring and approving actions related to debt issuance. Recovery activities will be undertaken in a way that is consistent with FOMB's authorities."

Further, official documents mention economic stability as an integral part of recovery. Along with new infrastructure, new economic strategies are key in the government plans for recovery. One document says,

> "we can implement innovative solutions that can make Puerto Rico a showcase for the world with a modern and more resilient infrastructure, a newer and stronger housing stock, and a more vibrant and competitive economy" [RD2]

In recognizing PROMESA and its effect on the island's economic capacity in the face of Maria, official documents say that the disaster also presents an opportunity to build on this law in a way that benefits Puerto Rico. The language in the document reads,

> "The plan presents an opportunity to build on the policies of fiscal stabilization and debt restructuring laid out in the Puerto Rico Oversight, Management, and Economic Stability Act and to invest in a way that revitalizes our island and people as an asset for America's national and global economic success."

Major vulnerabilities outlined in recovery documents--the energy grid, lack of comprehensive and effective emergency management, and the island's fiscal crisis--are cited as root causes of risk associated with Hurricane Maria. Government documents recognize that overcoming these obstacles in the short term represents a challenge for recovery, and also point to pathways for transforming these vulnerable systems for long-term stability.

6.4 Transformation through investment, innovation, and statehood

In recovery documents, Hurricane Maria is suggested to be a window of opportunity to reimagine the island's physical and economic systems. The long-term economic recovery plan says,

> "The complete and widespread devastation gives us an opportunity to view our island as a blank canvas, upon which we can implement innovative solutions that can make Puerto Rico a showcase for the world with a modern and more resilient infrastructure, a newer and stronger housing stock, and a more vibrant and competitive economy" [RD2]

Energy infrastructure is prioritized both in immediate reconstruction and some government reports prioritize reconstructing the old grid. For example, one comment suggested that the grid's failure presents a

> "unique opportunity to rebuild the power infrastructure and rethink how power is generated and distributed across the island to make the system more efficient, resilient, and sustainable." [RD1]

However, in the island's requests for federal funds the budget indicates that the majority of funds would be spent on

> " ..substation reconstructions and flood protection; transmission and distribution lines hardening, control center rebuilding, with upgrades to the operation and IT; power generation, and fuel supply hardening". [RD1]

In its initial assessment of hurricane damages and requests for federal funding to address these, one government document frames the destruction as a chance to re-design the island's economic and built infrastructure. The document says,

> "Due to the unparalleled and widespread devastation, the disaster recovery period in Puerto Rico represents a chance to "begin again" and rethink the design of major components of the Island's critical infrastructure, invest in the quality and survivability of its housing stock and public buildings, and restructure, modernize and reform how it delivers basic services to its residents. Puerto Rico can also improve its resiliency and sustainability to protect the federal and state investment in the recovery and produce benefits for the island's residents for generations to come." [RD1]

Outside of federal aid, the other most cited source of funding were partnerships with private-sector entities. Public-private partnerships, or "P3" as the documents call them, form part of the aid network outlined by recovery plans. They are mentioned as key in economic investment for long-term recovery. In official documents, they are mentioned as both sources of aid for recovery and for long-term economic reform:

> "It is clear that multiple federal agencies, as well as private insurance proceeds and the private sector—including public-private partnerships, charitable foundations, corporate foundations, and institutional investors—will play a part in funding the recovery" [RD2]

> "We will need to pull together both resources and expertise from countless public and private-sector partners" [RD2]

Further, the government's economic recovery plan includes policy reform to make way for such investments in public-private partnership on the island.

> "While regulations can be effective at promoting and protecting public interests, outdated and obsolete regulations may unnecessarily curtail economic growth and impede private sector investment" [RD2]

Not only do recovery documents signal change in infrastructure and the economy, they also mention shifts in political arrangements as a way to secure stability in the long-term. In the long-term recovery plan, Governor Roselló writes,

> "to be confident both now and in the future that the inequities experienced in our past will fade forever, we will need to put Puerto Rico on a path to full equality through statehood. From that point forward, we will be fully empowered as citizens of the United States, with equal rights and responsibilities, to contribute to the success not only of Puerto Rico but of the United States as a while." [RD2]

The plan for transformation is evident in both documents, which mention changes in housing, energy, and the economy will be a part of Puerto Rico's vision for stability. One document summarizes these changes by stating,

> "Puerto Rico is ripe for transformative innovation; the Island will not only address recovery needs but also address the chronic issues and ongoing concerns that have been a drag on Puerto Rico's ability to prosper. Recovery dollars will be invested with the intent to propel Puerto Rico toward the visions and goals set forth in the foundational plans. It is essential that capital investments be used in a strategic manner to affect the recovery by improving the physical infrastructure beyond its pre-hurricane condition, by improving the human capital environment, and by improving the natural capacity of the Island." [RD2]

Recovery documents stress the importance of innovation--both physical and political--in maintaining stability on the island. Although they describe the island as a "blank canvas" with which new economic and social systems can be created, they also recognize that there are major barriers, such as the island's current political arrangement with the United States, which will present challenges along the way. "Innovation" is also mentioned as an underlying theme for actions taken in long-term recovery, but documents mainly cite economic investment in the energy grid and partnerships with non-government entities as innovative solutions to major issues.

CHAPTER 7

DISCUSSION

For Puerto Rico, Hurricane Maria represented a significant shift as the local and federal government as well as all of the island's citizens endured the most fatal disaster to hit the United States in recent history. The storm itself posed a great physical threat, however, further examination shows that economic and social conditions present on the island before Maria are inextricably tied to the hurricane damage and must therefore be considered as part of recovery and adaptation post-Maria. Both disaster and adaptation research have each explored the notion of recovery as a social-ecological process that involves addressing both physical and non-physical vulnerabilities. Further, studies have used concepts such as resilience and adaptive capacity to explain how various factors influence adaptation outcomes. The following discussion shows how conceptualizations of vulnerability, capacities, and long-term stability are manifested in recovery actions of a local community as well as in major plans outlined by the government of Puerto Rico.

7.1 Vulnerability pre-Maria: physical and social instability

Carpenter (2013) writes, "Geographic space is the stage to which we assign meaning and in which social interactions are set" (pg. 13). Geographic factors did greatly affect both the amount of damage caused by Hurricane Maria as well as recovery processes. Prior to Hurricane Maria, the island's location and geography was significant in that it represented the physical and political separation between the local government and the oversight of the United States. This separation is not only a metaphor for the dual-governing system that exists on the island and that has produced instability in managing the island's economic and infrastructure systems. It also represented a physical challenge in that key recovery entities such as FEMA were not able to

quickly get to the island to deliver necessary resources and services. Official recovery documents point to a mixture of infrastructural and institutional disjointedness that multiplied the destructive effects of Hurricane Maria. Not only do the documents outline the failures of the energy grid and the cascading effects on medical assistance, communications, and water supply, but they also describe the lack of systems in place to coordinate across recovery entities like FEMA. The island's dangerous location was a major challenge in immediate recovery, proving to be a contributing factor to damage associated with the storm (Blaikie et al. 1994). This vulnerability exacerbated challenges not only for recovery entities, but also made it difficult for communities such as Corcovada to receive aid and restore power once FEMA and local officials were able to mobilize.

In addition to physical constraints, political processes can also add to instability and vulnerability when confronting climate adaptation (Lecheinko & O'Brien, 2008). In Puerto Rico, the lack of access to federal aid was cited by the government as a main setback in recovery actions, and statehood is presented as an option for overcoming the political vulnerability that stems from the island's status of 'unincorporated territory of the United States'. For Corcovada residents, there is a recognition that physical and social systems across the island are ineffective in providing communities with essential services such as water and energy, which proved to be especially true after Hurricane Maria. The community's internal social structure, their central committee, is a testament to their overcoming broader instability across the island to address issues faced by residents.

7.2 Key adaptation capacities: self-organization and social capital

A rapid assessment of Corcovada after Hurricane Maria might describe the community as "resilient" in that they were able to return to stability quickly after the storm through community organization and work. A closer look, however, may point to a more specific type of resilience, social resilience, which goes beyond system stability to consider things such as livelihood, institutional organization, and stakeholder input (Adger, 2000). Social resilience, often associated with community resilience, has not been shown to reduce overall vulnerability of a community on its own (Wilson, 2013). Yet, in the case of Corcovada, the social action approach proved to be successful in recovery after Hurricane Maria, especially in restoring energy and water services. The ability of the community to adapt to stressful conditions after the hurricane by drawing on social capital is the most prominent of the capacities demonstrated after the storm and is largely due to their ability to overcome lack of internal resources by mobilizing networks of aid. Actions taken by local institutions, such as community groups, and their ability to learn and organize after a disaster have been described as organizational resilience (Tierney & Bruneau, 2007).

Speranza (2014) mentions self-organization as a major attribute of resilience. They make the distinction of general self-organization, or spontaneous emergence of a whole new societal structure, and autonomous self-organization as a group defining their own rules and processes under conditions of crises or instability. Some indicators for self-organization, according to the authors, are the presence of "institutions, cooperation and networks, and reliance on own resources" (Speranza, 2014). In the face of a crisis and unstable environment such as the period after Hurricane Maria, these characteristics of community organization in Corcovada proved to be crucial adaptation capacities that contributed to ensuring basic needs were met within the community. The community aqueduct is by far the most prominent example of this organization

and was key in securing access to running water after the hurricane. Planning around failing water infrastructure led to formation of the aqueduct and is an example of reorganization and learning for adaptation (Cutter et al., 2008). While disaster research would refer to this organization as hazard mitigation since it relates to restoring water after a disaster, this attribute of the Corcovada community is also present during normal times and therefore more closely resembles community resilience (Goldschalk, 2002; Adger, 2005).

In Corcovada, community stability is held together by a web of internal and external resources. Internally, they demonstrate a responsibility towards one another after the hurricane through road cleanup and during normal times through managing the aqueduct. This sense of connectedness is associated with bonding social capital and has been linked with overcoming vulnerabilities in isolated communities (Adger, 2003). Bonding social capital is a characteristic of communities with high social cohesion (Adger, 2003). Other forms of social capital were shown in the community's ability to find resources outside of their internal network. This bridging social capital was the reason for securing a diesel generator after attending a visit from FEMA officials. The community also received help from church groups who brought food after the storm and friends and family of community members who came to help clear roads with machinery. Going beyond immediate recovery, the community received funding from an environmental foundation to install a photovoltaic system to connect to their aqueduct. For residents of Corcovada, the high value placed on connections both in and outside of the community represents their perceived stability before and after Hurricane Maria. While emergency assistance from recovery entities and financial assistance to bolster their water and energy infrastructure played an important role, these were discussed as peripheral to the social structure that exists in the community. Meanwhile, official recovery documents illustrated institutional arrangements and financial resources as

central to stability in Puerto Rico not just after Maria, but as a baseline for solving other issues identified by the government.

7.3 Transformative adaptation

Forward-thinking in Corcovada is an approach that is used for reducing their overall vulnerability as an isolated community. Adger (2000) defines adaptive capacity as the ability to cope with external stressors, yet actions taken by the Corcovada community reflect something beyond coping. Their ability to reduce vulnerabilities associated with the failing energy grid and further strengthen their water infrastructure represents planning for long-term stability. This forward-thinking approach is not commonly used in conceptualizations of resilience, especially when there is a focus on system stability or equilibrium (Redman, 2014). Sustainability research, on the other hand, emphasizes adaptability and change, especially when planning for the future. In Corcovada, the actions taken to connect their community aqueduct to solar panels in case of more grid failures is an example of this future oriented action and could potentially reduce vulnerability in the community even more. This future-oriented approach is a characteristic of transformative adaptation, which the Corcovada residents have adopted to reduce their vulnerability even prior to Hurricane Maria. This transformational approach is manifested in their challenging of institutional arrangements such as the disaster recovery process conducted by local and federal entities. By using internal networks, they were able to circumvent the ineffective recovery actions by the government of Puerto Rico and FEMA to create their own system of aid.

For the Corcovada community, the ‘window of opportunity’ which triggered fundamental system change did not happen after Hurricane Maria, but decades before (Manyena, 2013). For the government of Puerto Rico, however, the notion of transformative change is just starting to

take root and is present in major recovery and economic plans. The approach taken by Corcovada is more in line with common conceptualizations of transformation, since it represents a more intentional way of re-imagining systems to benefit community members. The presence of a central committee also reflects an integration of diverse perspectives and robust decision-making that is associated with transformative change (Schlosberg et al 2017). The approach taken by the government of Puerto Rico, on the other hand, seems to be reactionary, and the result of a lack of access to immediate recovery aid. This is similar to definitions of resilience that stress the importance of bouncing back, and not necessarily addressing vulnerabilities (Pelling, 2003).

7.4 Negotiating recovery and adaptation

Generally, social contracts are used to establish obligations and responsibilities of government to its citizens, as well as the rights and responsibilities of citizens (O'Brien 2012). In some cases, social contracts are formalized via 'on-paper' commitments that establish what actions should and will be taken by whom, and what happens when these commitments are not met. In other cases, there is a constant co-production of agreements between people and government, or other responsible entities, on what should be expected from each under certain circumstances. After Maria, those responsible for recovery included municipal, state, and federal entities. This informal agreement is essential when thinking about post-disaster recovery, as this period is often one of confusion about responsibility for restoring normalcy at different levels. Both community interviews and government documents point to Hurricane Maria as a window of opportunity to reimagine physical and social systems and potentially create a new 'social contract' to ensure stability given the risks associated with climate change. Reflections on Hurricane Maria also recognize it as a pivotal point for Puerto Rico in reconstructing both built

systems as well as social and economic ones (Rodriguez-Diaz, 2017). Although the island's long-term plan emphasizes new and innovative infrastructure along with new economic strategies, these plans must account for underlying challenges. One major challenge is funding, which the island has solicited from the United States government to pay for reconstruction. In recognizing that relying on federal funding limits the island in how aid can be spent, official documents point to non-governmental organizations and private sector partners as potential partners for recovery. However, some scholars argue that privatizing as a form of integrating environmental efforts with economy is detrimental to cultural autonomy and local well-being (Escobar, 2001).

While the resulting "agreement" of recovery is important, the ways in which it comes about also merit attention (Hajer,1995). Specifically, there are several entities shaping the scope of responsibility and authority in recovery. The government of Puerto Rico as well as the federal government can be considered the main actors in coordinating recovery efforts at the island level since these were and still are the entities coordinating relief and reconstruction. However, from community interviews and recovery documents, it is clear that non-governmental organizations and communities are also shaping recovery during a time when it is unclear if obligations will be met by the government. There is no doubt that Hurricane Maria marked a significant upset in stability for everyone in Puerto Rico. Some researchers suggest that this event will play a central role in defining responsibilities that the U.S. has to Puerto Rico and vice versa, given the island's existing fiscal challenges (Draitser, 2016). Although some research suggests disasters create a "blank slate", Puerto Rico's unique history with the United States and vulnerabilities present before Hurricane Maria might affect just how much the island can start fresh (Agrawal, 2011). Despite this, recovery documents show an eagerness to re-negotiate the current political arrangement currently in place between the United States and Puerto Rico.

CHAPTER 8

LIMITATIONS

This research was conducted with the purpose of uncovering perspectives of recovery as ways of conceptualizing a new social contract around climate adaptation using the case of Hurricane Maria in Puerto Rico. However, in doing so it recognizes that these perspectives of vulnerability and adaptive capacity are greatly shaped by a particular context (Grothmann & Patt, 2005). Hurricane Maria played a significant role in shifting conversation around climate adaptation in Puerto Rico and even exposed potential new arrangements for stability in the island's relationship with the United States. However, these new arrangements should be considered within the entire scope of Puerto Rico's sociopolitical and ecological history. Although this study represents a snapshot in time, further research could expand upon this major shift by considering formal agreements such as the laws and policies which makeup Puerto Rico's current political arrangement with the United State and the uncertainties associated with future climate impacts on the island. The scope of this study was based on the relevance of Hurricane Maria as a major disaster and a clear source of instability on the island for years to come. That said, widening that scope to include more analysis of the island's capacity for adaptation considering its unique political structure and unique vulnerability to climate risks could provide more enriching examination of climate adaptation in Puerto Rico.

CHAPTER 9

CONCLUSIONS

The period after a major disaster involves identifying and neutralizing specific threats like complete loss of electricity and water services. Addressing these types of threats and others after a disaster does require some technological and managerial resources like investing in robust emergency aid and better infrastructure. However, these approaches are not enough when considering the underlying vulnerabilities that produce hazards and risks for populations affected by a disaster event. Digging deeper into how disasters are survived and managed by individuals as well as governments speaks to wider processes of adaptation and how social, political, and economic systems can be challenged to reduce vulnerability and promote transformative change. In Puerto Rico, both the government as well as local perspectives show an intent to transform the island's broken social and physical systems, however there is a disconnect in deciding who should be taking transformative actions. This may stem from an underlying mistrust of political systems which is shown both by the Corcovada resident's reluctance to rely on state and federal aid, as well as the government of Puerto Rico's reluctance to accept the current political arrangement with the United States. While this study focused on broad perspectives of adaptation, a narrower emphasis on who is involved in recovery and adaptation could provide more context for decision-making after Maria and in the long-term. This could be done by exploring the governance of disaster recovery in Puerto Rico to understand the policy structures that will affect adaptation.

The emerging "agreement" surrounding recovery post-Maria can be considered a co-production of a contract between the government and citizens of Puerto Rico to establish a plan that produces successful outcomes both locally and for the island as a whole. However, to extend the current understanding of a new agreement beyond recovery after Hurricane Maria, more

research should be extended to study views regarding what responsibilities each have, where to prioritize action, and what an ideal long-term recovery should look like. This could be done by focusing on imagining future climate scenarios given Puerto Rico's unique geographical and social context.

Narratives from the Corcovada community demonstrate a structured network of aid and support that has been established over decades. This network has allowed them to address vulnerabilities related to water and energy. In addition, economic, political, and infrastructural instability across the island has become something that the community can account for in their decision-making and has made them more adaptable to face threats such as Maria. Their ability to adopt a transformative approach to reducing vulnerabilities is not mirrored in the government's approach to recovery and adaptation, however. Long-term plans are described as transformative in recovery documents, but only address the island's biggest physical and economic risks by investing more into the existing energy grid structures and expanding funding sources to include entities outside of local and federal government. Recovery plans recommend statehood as a possible solution to issues faced by the island in receiving aid, which could signal a major governance and policy-making shift on the island.

Perspectives of adaptation outlined both in the Corcovada community as well as in government documents show that the island will have to confront major vulnerabilities at many scales to better prepare for future disasters and other instability caused by climate change. Understanding these separate-but-linked narratives on recovery is a first step in mapping out which actions are necessary to maintain stability, and how these will affect the island and its residents.

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APPENDIX A

[IRB EXEMPTION]

EXEMPTION GRANTED

David Manuel-Navarrete
Sustainability, School of
Dear David Manuel-Navarrete:

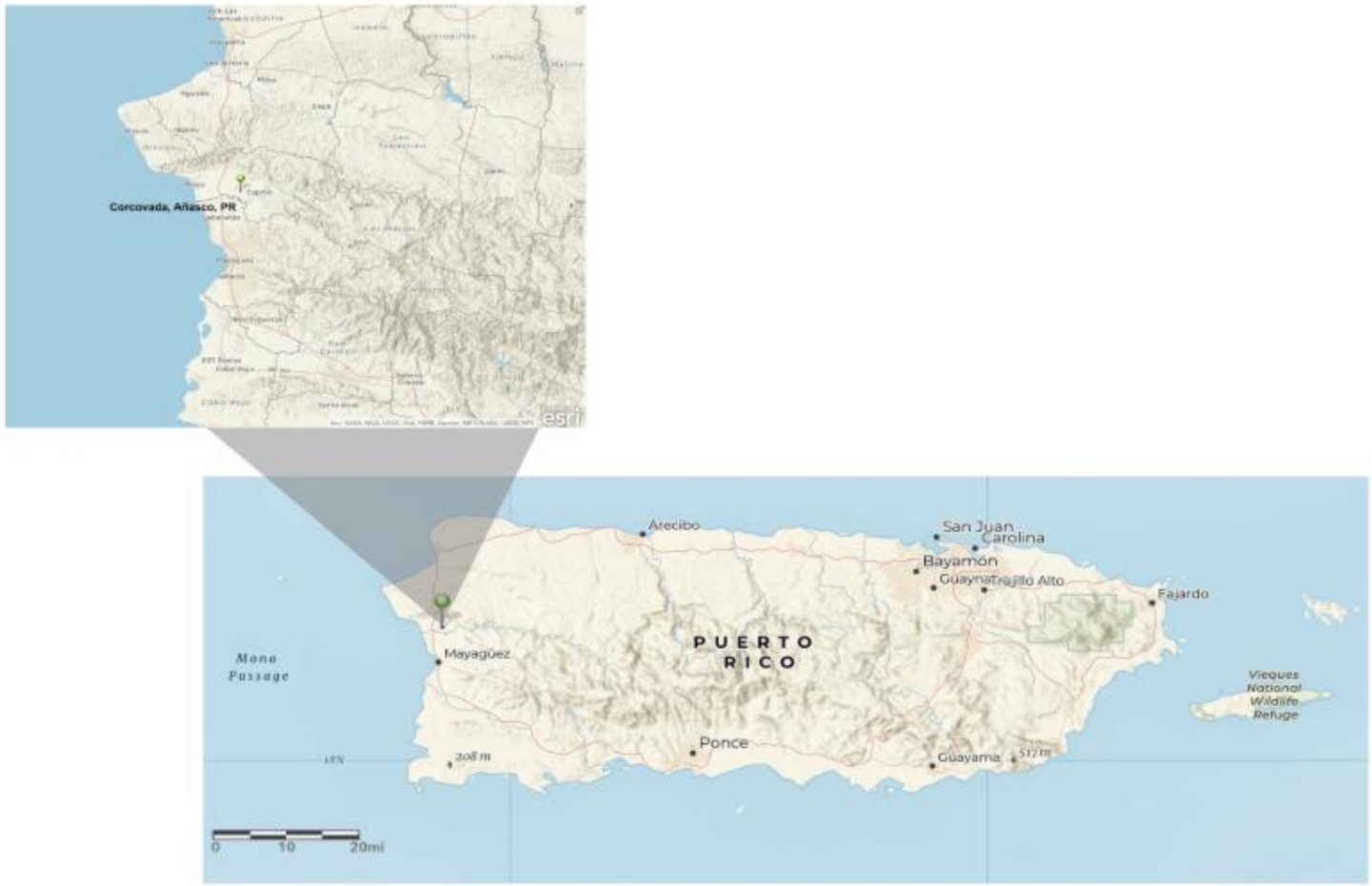
On 7/12/2018 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Assessing the Role of Perception for Adaptive Capacity in Post-Hurricane Maria Puerto Rico
Investigator:	David Manuel-Navarrete
IRB ID:	STUDY00008371
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Social Behavioral Protocol_OrtizJessica.docx, Category: IRB Protocol; • Ortiz_Consent_letterhead.pdf, Category: Consent Form; • Interview Questions.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • citiCompletionReport5204526 (1).pdf, Category: Non-ASU human subjects training (if taken within last 3 years to grandfather in); • Verbal Consent Script.pdf, Category: Consent Form;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 7/12/2018.

APPENDIX B

[MAP OF CORCOVADA LOCATION]



(Source: ArcGIS)

APPENDIX C

[INTERVIEW PROTOCOL]

Interview Questions: "Assessing Perception of Adaptive Capacity in Post-Hurricane Maria Puerto Rico"

Jessica Ortiz, MA Sustainability

1. Background Information
a. Please introduce yourself, describing your family, home, and work.
b. How long have you been living in this community?
c. Describe the everyday experience of yourself and your family in this community

2. Experience of Hurricane Maria
a. Describe your experience in the days leading up to the hurricane and during the storm both at your house with your family and things you experienced in the community.

3. Perceived capacity of recovery entities
a. What were there government actions you observed leading up to/during/after the hurricane?
b. What were these actions focused on, in your opinion?
c. Were these actions consistent with previous issues of national concern?

4. Material and social resources
a. What did you do to prepare for the hurricane, if anything? What resources did you have at home, in your community, or from the government?
b. Did members of your community do things differently than you? Did they have different resources
available to them?

5. Perception of successful recovery
a. Do you think you had enough resources, time, and information to prepare for the storm?
b. Do you think you were well-prepared? Why or why not?
c. How would you describe your ability to recover from the storm?
**Do you have anything else to add that you think is important?

APPENDIX D

[ABBREVIATED CODEBOOK]

Code	Description	Examples
Forward-thinking **Sub codes:** Improving energy and water systems, creating external networks, creating educational opportunities, innovation	This is a capacity to plan for future vulnerable situations and reduce chronic vulnerabilities. In the community, this is shown in both post-hurricane recovery through physical infrastructure, as well as during normal times by making sure the baseline material and social needs of the community are met.	**"**If we could put solar [panel] units on our houses and for our aqueduct system, we wouldn't have to worry."[Interview] "The community did things other than the aqueduct, too. We created the computer center, we started offering English classes." [Interview]
Self-organization **Sub codes:** Community input, care for neighbors, community work, FEMA meetings, external networks, sharing resources, flexibility	This is a capacity of the community to bring together social and material resources from inside and outside of Corcovada. The cornerstone of this organization is the Committee who hold weekly meetings, identify resources and networks to help the community, and manage the community's local aqueduct system.	**"**It's just organization. It's putting aside the "I" and all of us getting to work. If I have to move a tree at my house, it's not just me doing it. 5 more people show up. It's mutual help, and that's important to have." [Interview] "We're preparing with gas, diesel, everything except for water, we have that already. We have a new generator to power the aqueduct just in case."
Recovery entities **Sub codes:** Corcovada, municipal government, Governor Roselló, NGO's, COR3, FEMA, diaspora, church, god, federal government, U.S. Congress, Trump Administration	These are people and other entities that are involved with recovery.	"She handles the people from FEMA, and well it's been a year and they are still giving us a hand with some things, with technical services and all of that." "The task is ahead is as daunting as it is urgent, and recovery cannot be accomplished unless Puerto Rico receives substantial federal assistance."[Build Back Better PR]
Vulnerabilities	These are conditions identified by the community and in official	**"**The main problem that we have is if the energy goes out, if

Sub codes: energy grid, laws and policies, PROMESA, geographic location, infrastructure damage, older residents, lack of financial resources	documents as exacerbating hurricane damage. They are physical vulnerabilities such as geographic location, social vulnerabilities such as Puerto Rico's commonwealth status, and economic such as having access to emergency funding.	the water pumps aren't powered then we don't have water." "...aid from other states was not readily available due to lack of mutual assistance compacts and the geographical separation of more than 1,000 miles between Puerto Rico and the continental United States"[Transformation and Innovation]
<u>Hurricane damage</u> **Sub codes:** fleeing Puerto Rico, housing, agriculture, water infrastructure, energy infrastructure, economy, roads, communication networks, livelihoods lost, death, pharmaceutical industry	These are physical and non-physical damages of the hurricane mentioned in interviews and documents. Physical include damage to housing, built infrastructure, and ecological mainly in the form of agriculture. An example of a non-physical damage is having to abandon Puerto Rico.	**"**...tens of thousands of Puerto Ricans left the island to escape their post-hurricane hardships" "All of that there was our corn field. It didn't leave a single branch or tree, nothing, nothing, nothing. That *quenepa* tree, that was the prettiest thing."