

Summer 8-10-2016

## Coastal Louisiana: Adaptive Capacity in the Face of Climate Change

Tara Lambeth  
tlambeth@uno.edu

Follow this and additional works at: <https://scholarworks.uno.edu/td>



Part of the [Community-Based Research Commons](#), [Environmental Studies Commons](#), [Human Geography Commons](#), [Indigenous Studies Commons](#), [Policy Design, Analysis, and Evaluation Commons](#), [Social and Cultural Anthropology Commons](#), [Social Policy Commons](#), [United States History Commons](#), [Urban Studies Commons](#), and the [Urban Studies and Planning Commons](#)

---

### Recommended Citation

Lambeth, Tara, "Coastal Louisiana: Adaptive Capacity in the Face of Climate Change" (2016). *University of New Orleans Theses and Dissertations*. 2228.  
<https://scholarworks.uno.edu/td/2228>

This Dissertation is protected by copyright and/or related rights. It has been brought to you by ScholarWorks@UNO with permission from the rights-holder(s). You are free to use this Dissertation in any way that is permitted by the copyright and related rights legislation that applies to your use. For other uses you need to obtain permission from the rights-holder(s) directly, unless additional rights are indicated by a Creative Commons license in the record and/or on the work itself.

This Dissertation has been accepted for inclusion in University of New Orleans Theses and Dissertations by an authorized administrator of ScholarWorks@UNO. For more information, please contact [scholarworks@uno.edu](mailto:scholarworks@uno.edu).

Coastal Louisiana: Adaptive Capacity in the Face of Climate Change

A Dissertation

Submitted to the Graduate Faculty of the  
University of New Orleans  
in partial fulfillment of the  
requirements for the degree of

Doctor of Philosophy  
in  
Urban Studies

by

Tara Lambeth

B.F.A. New York University, 2005  
M.S. Pratt Institute, 2012

August, 2016

## **Acknowledgements**

Above all, I would like to thank the Pointe-au-Chien Indian Tribe for their participation in the study, their contribution to the collaborative effort, and their vast knowledge about the environmental changes in their ancestral home.

I would also like to thank Dr. Matthew Bethel of Louisiana Sea Grant, for both introducing me to the tribe and designing the original study and methodology that inspired this case study.

This study would not have been possible without my work at the University of New Orleans' Center for Hazards Assessment, Response and Technology (UNO-CHART), where, under the leadership of Dr. Monica Farris and Dr. Pamela Jenkins, I was able to progress from Research Assistant to Assistant Director throughout the course of my doctoral studies.

I would like to extend my deepest appreciation to my dissertation chair and mentor Dr. Pamela Jenkins, as well as the members of my dissertation committee: Dr. Matthew Bethel (Louisiana Sea Grant), Dr. Monica Farris (UNO-CHART), Dr. Bethany Stich (UNO) and Dr. Marla Nelson (UNO).

Finally, I would like to thank my parents, Dan and Susan Lambeth, for always encouraging me to work hard and never stop learning, and my husband Sam and all of the kids for putting up with four years of hard work.

Support provided by: Louisiana Sea Grant College Program

## Table of Contents

Acknowledgements.....	ii
List of Figures.....	iv
List of Tables.....	vi
Abstract.....	vii
Chapter 1: Introduction.....	1
Chapter 2: Theory and Literature Review.....	18
Chapter 3: Research Design.....	63
Chapter 4: Findings and Discussion.....	75
Chapter 5: Links to Literature and Theory and Analysis.....	145
Chapter 6: Conclusions.....	168
References Cited.....	183
Appendix A: Questions for Interviews and Focus Groups.....	189
Vita.....	190

## List of Figures

Figure 1: Pointe-au-Chien Indian Tribe Community Sign.....	5
Figure 2: Map of Pointe aux Chenes.....	6
Figure 3: Map of Atchafalaya Basin and Areas South of Houma.....	8
Figure 4: Code Cloud.....	79
Figure 5: Elevated Home in Pointe aux Chenes.....	83
Figure 6: Bayou Pointe-au-Chien.....	85
Figure 7: Map of PAC, Houma and I-10.....	86
Figure 8: Deteriorating Land in the Bayou.....	89
Figure 9: French Map of Louisiana, 1755.....	91
Figure 10: French Map of Louisiana, 1763.....	92
Figure 11: Bayou Faleau.....	93
Figure 12: Land Loss after Hurricanes Katrina and Rita.....	94
Figure 13: Palmetto House, Pointe aux Chenes, 1930-1940.....	100
Figure 14: Proposed Levees and Local Levees in Pointe aux Chenes.....	105
Figure 15: Dead Oak Trees on Eroding Ridge.....	111
Figure 16: Dredged Pipeline in the Bayou.....	124
Figure 17: 2012 Coastal Master Plan.....	129
Figure 18: Coastal Restoration Project Outside of Pointe aux Chenes.....	132
Figure 19: Levee Alignment – Sustainability.....	137
Figure 20: Levee Alignment – Vulnerability.....	139
Figure 21: Land Loss in Pointe aux Chenes, 1932-2010.....	140

Figure 22: Spoil Bank Elevation.....141

Figure 23: Vulnerability of Canals to Land Loss and Erosion.....142

## List of Tables

Table 1: Distribution by Deductive Code.....	76
Table 2: Code Application by Interviewee.....	80
Table 3: Response Diversity Codes.....	82
Table 4: Connectivity Codes.....	99
Table 5: Abundance/Reserves Codes.....	107
Table 6: Learning Capacity Codes.....	114
Table 7: Collaborative Capacity Codes.....	121
Table 8: Inductive and Deductive Mapping Codes.....	136
Table 9: Response Diversity Code Count.....	160
Table 10: Collaborative Capacity Code Count.....	161
Table 11: Connectivity Code Count.....	162
Table 12: Abundance/Reserves Code Count.....	163
Table 13: Learning Capacity Code Count.....	164
Table 14: Adaptive Capacity and the Pointe-au-Chien Indian Tribe.....	165

## **Abstract**

Extreme weather events can result in natural disasters, and climate change can cause these weather events to occur more often and with more intensity. Because of social and physical vulnerabilities, climate change and extreme weather often affect coastal communities. As climate change continues to be a factor for many coastal communities, and environmental hazards and vulnerability continue to increase, the need for adaptation may become a reality for many communities. However, very few studies have been done on the effect climate change and mitigation measures implemented in response to climate change have on a community's adaptive capacity.

This single instrumental case study will examine the effects of climate change and policy responses to climate change on the Pointe-au-Chien Indian Tribe located in Pointe aux Chenes, Louisiana, in order to discover how climate change affects the adaptive capacity of an indigenous population intricately tied to the surrounding ecosystem. This study will provide information on how the community plans to adapt to climate change, and the urban planning and hazard mitigation methods that can be used to facilitate the process. It also posits how government agencies can empower local communities to participate in mitigation planning, and provide local knowledge in order to make those plans more effective. As climate change continues to affect our coastal environments, it will continue to have an effect on our coastal communities. Understanding the strength and longevity of community adaptation in Pointe aux Chenes will help the community respond to the changes and increasing hazards in the environment. This understanding can be applied to all coastal communities facing similar challenges the world over.

Keywords: adaptive capacity, climate change, coastal Louisiana, community resilience, Native American communities, climate adaptation, adaptation planning



## **Chapter 1: Introduction**

Climate change and the resulting sea level rise affect many coastal communities throughout the world. In coastal Louisiana, subsidence and sea level rise combine to create one of the highest rates of relative sea level rise in the world. This relative sea level rise has an acute affect on coastal communities in southeast Louisiana, particularly those made up of indigenous inhabitants who rely on the ecosystem for their livelihood. The relative sea level rise changes the environment, and in turn, alters the land, resources, and livelihoods in the communities that make the coast their home. Policymakers implement mitigation measures to combat environmental change from the top down, while coastal community members devise adaptation strategies to live with these same environmental changes. One of these communities, the Pointe-au-Chien Indian Tribe, deals with this environmental change in their ancestral home on a daily basis, and continues to adapt to these changes in order to continue to thrive in their coastal home. The changes are becoming increasingly severe so that adaptation becomes more and more challenging. The policy responses to these severe changes make adaptation more challenging as well. This case study explores how human activities and natural disasters, coupled with mitigation policy, compromise the effectiveness of mitigation measures, and how local knowledge of adaptation can more effectively contribute to mitigation policy. This study analyzes the complex set of interactions that will determine whether or not the Pointe-au-Chien Indian Tribe survives into this century.

## ***History of Environmental Change in Southeast Louisiana***

Residents of Louisiana have dealt with environmental change in Southeast Louisiana throughout history, as Southeast Louisiana's deltaic environment makes human settlement difficult. The river deposits natural sediment throughout time, and slowly changes location as the sediment is deposited. In fact, "if it were possible to view the last 10,000 years from a satellite with a time-lapse camera, the Mississippi River would be seen to snake back and forth from east to west across the northern Gulf of Mexico, switching deltas every 1000 to 2000 years" (Keddy, Campbell, McFalls, Shaffer, Moreau, Dranguet, & Heleniak, 2007, p. 46). Like many populated areas across the world, people altered the deltaic environment in Southeast Louisiana to make it most suitable for human settlement. Prior to the arrival of Europeans, Native American tribes lived along the coast of Louisiana for thousands of years, farming, hunting and fishing (Keddy et al., 2007). The land most used for farming was along the Mississippi River, as it had the most fertile soil (Keddy et al., 2007). The tribes altered the land to make it more conducive to farming, but also migrated with changes in the environment, such as flooding, hurricanes, and resource availability.

European settlers had a more permanent affect on the environment. Between 1718 and 1844, European settlers cleared vegetation from the land and settled on the high ground, which was composed of the natural levees and river ridges of the Mississippi River (Lopez, 2009). While the initial settlement occurred on the naturally elevated portions of the land, the deltaic environment proved vulnerable to flooding. From 1844 to 1900, a series of floods caused by the fluctuation of the levels of water in the river resulted in the construction of artificial levees and ridges, which "prevent the river's natural overbank flow" (Lopez, 2009, p. 2). Throughout time, flood protection projects were primarily implemented at the state and federal level. To this day,

the Army Corps of Engineers provides the scientific studies, funding and construction of the various flood protection systems throughout Southeast Louisiana.

The environment was not only altered for flood protection; in the late 1800s, the logging industry in southeast Louisiana boomed. From 1890 to 1938, the industry leveled many forested areas in the region. Another large flood in 1927 pushed the residents of Louisiana to once again alter the land to protect the settled areas from river flooding. After the flood, the construction of the Bonnet Carre and Morganza Spillways “allowed successful management of the Mississippi River for flood protection through the combined use of levees and spillway outlets to relieve river-stage levels” (Lopez, 2009, p. 5). From 1930 to 1974, estuaries in the area were dredged and shielded to help further protect the region from floodwaters (Lopez, 2009). At the same time, the shipping and oil and gas industries continued to grow, resulting in the pollution of the water in the region from 1950 to 2002 (Lopez, 2009). The oil and gas industry in particular drastically altered the wetlands environment, due to the dredging of oil canals throughout the region (Lopez, 2009, p. 6). All of these environmental changes throughout time “are multigenerational events which have latent, cumulative impacts” (Lopez, 2009, p. 10). Similarly, climate change is a long-term event that will have severe impacts on the region. The subsidence caused by the dredging and starving of the delta will continue, which will exacerbate the effects of sea level rise in the area. Ironically, the projects used to protect the region from flooding are also making the region more susceptible to flooding.

All of the flood protection projects and industrial growth in the region resulted in the loss of natural habitat, the loss of wetlands, and the loss of sediment, which builds land naturally in a deltaic environment. Rather than collecting along the delta, the sediment flows out to the Gulf, where it cannot be utilized to rebuild lost land and habitat (Lopez, 2009, p. 5). Over the last 50

years, the loss of the wetlands has become drastic, while “the cycle needed to grow a delta is considered to be approximately 1000 years” (Lopez, 2009, p. 10). The man-made changes to the environment alter the environment faster and more intensely than the delta can naturally rebuild. Additionally, the land was altered well before scientists began studying and documenting environmental changes (Lopez, 2009, p. 2). Therefore, the knowledge about how to restore these changed environments is missing: “lack of understanding about the non–anthropogenically altered landscape challenges the understanding or restoration of the environments that existed prior to major human impacts” Lopez, 2009, p. 10). As residents of coastal Louisiana for thousands of years with close knit communities and oral history traditions, Native American tribes have local knowledge about how the land has changed over time, how they have responded to these changes in the past, and what could be an effective response in the future.

The following quotes describe the environmental changes experienced by various tribal members in the Pointe aux Chenes area. The quotes underline the vast extent of change in the area over time, and how the representatives of the tribe have experienced these changes.

“I could remember...my grandfather, my mom lived down here...my grandfather’s boat was not as wide as this, and we used to be able to pull on the marsh grass as we were travelling down the bayou...yeah, it was narrow, very narrow.” – Tribal Member 1

“In another few years this will all be open...we’ll have a couple of storms...it will all be gone.” – Tribal Member 2

“This right here was all land, land all the way to the Gulf, now it’s open water.” –  
Tribal Member 3

“That there, a few years ago, they had land all the way from that light all the way  
to the end of that point, and now you don’t have nothing, it’s just water.” – Tribal  
Member 4

“Well for high tide, we never had to worry before, but now, we gotta worry.” –  
Tribal Member 4



Figure 1 - Pointe-au-Chien Indian Tribe Community Sign, Source: SLWDC

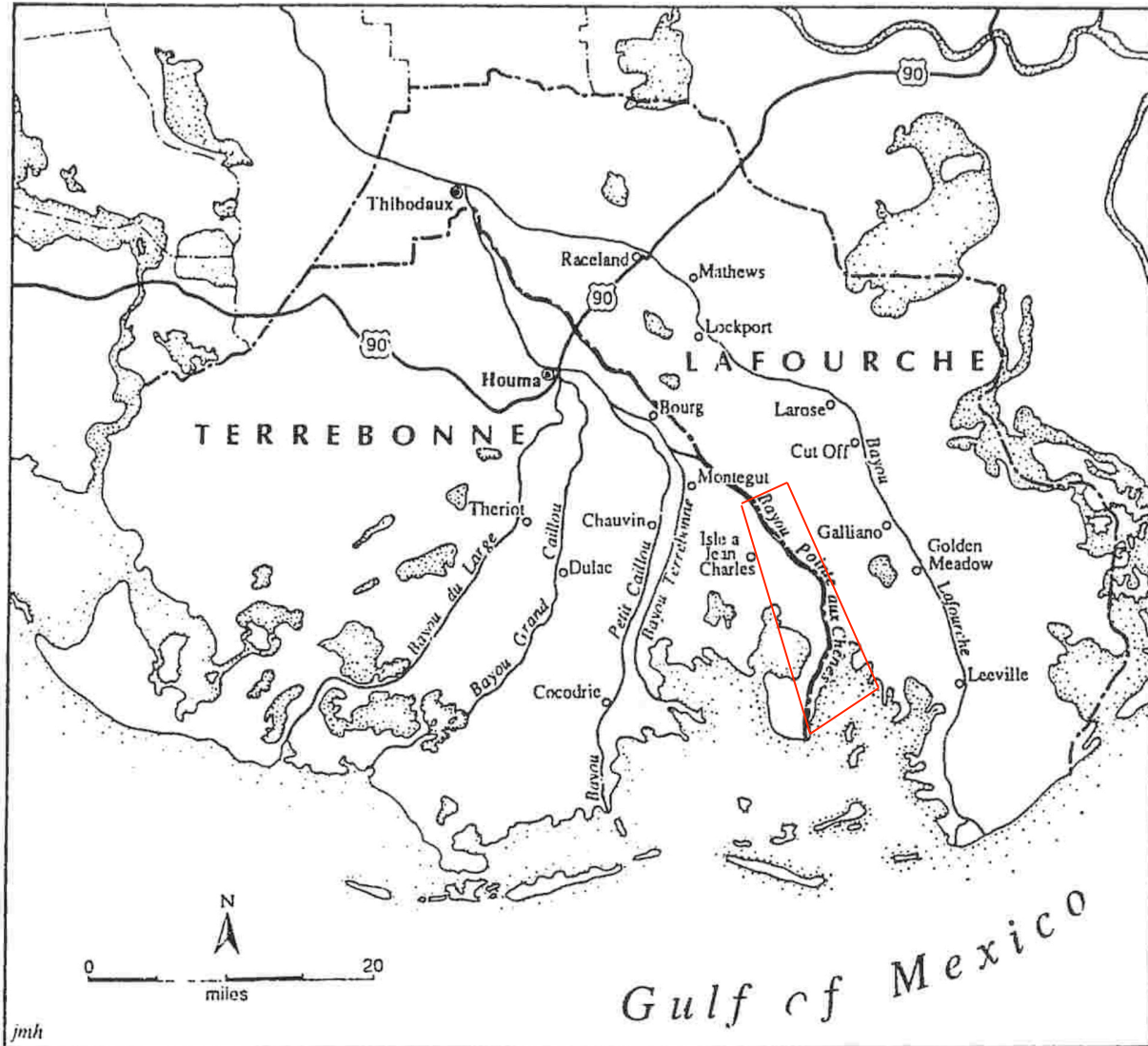


Figure 2 - Map of Pointe aux Chenes, Source: Rottet, 1995, p. 365

Pointe aux Chenes is a predominantly Native American community located in coastal Southeast Louisiana, on the border of Lafourche and Terrebonne parishes. The only land connection to these parishes is a one-way highway (Carmichael, 2008). The community borders Bayou Pointe-au-Chien, and runs along eight miles of the bayou (Carmichael, 2008). The community is located on the ancestral lands of the Chitimacha tribe. Elevated homes line the bayou, which is filled with shrimping boats. In addition to the homes, the community has a church, school, bait shop, and community building (Carmichael, 2008). The community lies just

north of the Gulf of Mexico, in an area of marsh, wetlands, lakes and bayous. The estimated total population of the census tract that encompasses Pointe aux Chenes is 3,657 people, made up of 1,159 households and 859 families (US Census Bureau, 2014). Of the 1,159 households, 73.9% live in detached housing, while 25.9% live in mobile homes. Approximately 13.8% of that population in the census tract is American Indian, and 20.1% of the population speaks Indian French (US Census Bureau, 2014). In addition, 84.1% of the residents of the census tract work in Terrebonne Parish, but only 10.9% of the residents in the census tract work in agriculture, forestry, fishing and hunting (US Census Bureau, 2014). The area is rural, and borders a 35,000-acre Wildlife Management Area owned by the Louisiana Department of Wildlife and Fisheries. The Wildlife Management Area provides a marshy environment available for recreational fishing and hunting (see Figure 3). While the community is now called Pointe aux Chenes, due to a local teacher's campaign to change the spelling from what translates as dog point to what translates as oak point, the Native American tribe uses the original spelling, Pointe-au-Chien, as does the bayou that runs through the community (Carmichael, 2008, p. 28).

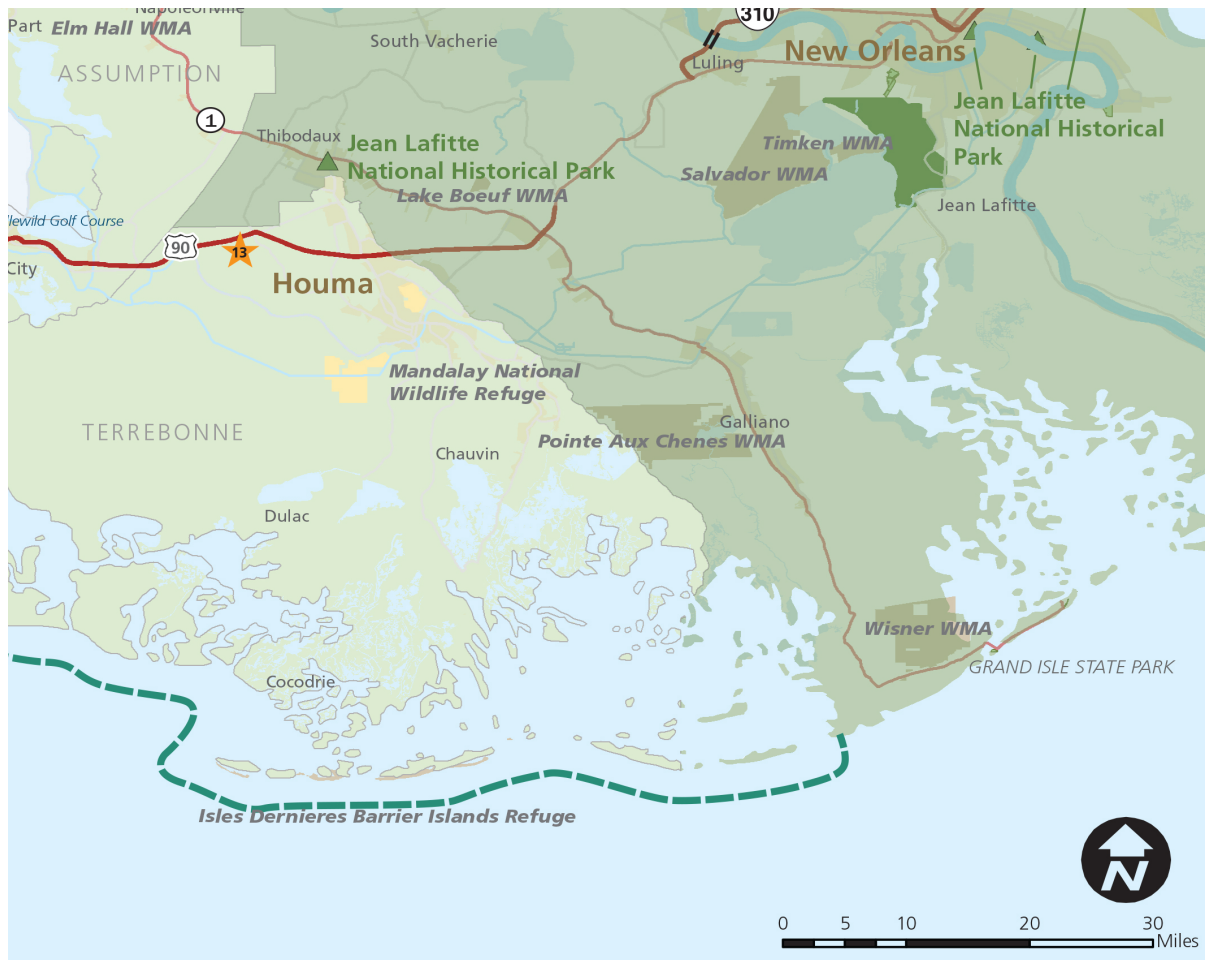


Figure 3 - Map of Atchafalaya Basin and Areas South of Houma, Source: [atchafalaya.org](http://atchafalaya.org)

Currently, the Pointe-au-Chien Indian Tribe has 680 members. The tribe speaks Cajun French, and descends from the Acolapissa, Atakapas, Biloxi and Chitimacha Indians. The Acolapissa tribe originally resided along the lower Pearl River, moving to the north shore of Lake Pontchartrain in the early 1700s, then closer to New Orleans in 1718. The tribe subsisted mainly on farming, supplemented with hunting and fishing. A number of epidemics brought by European settlers diminished the tribe’s population, and they eventually joined with the Houmas in Ascension Parish (Sultzman, 2016). The Atakapa Indians resided in Southeast Texas and Southwest Louisiana (Atakapa-ishak.org, 2016). The Biloxi Indians originally lived around the



Pascagoula River region of Mississippi. The tribe joined the Tunica tribe after a smallpox epidemic drastically reduced their population. Most of the members of the joined tribes then settled in Marksville, Louisiana in the 1700s, while others settled in the Terrebonne/Lafourche region. Like the Acolapissa, the tribes subsisted on farming, hunting and fishing (tunicabiloxi.org, 2016). The Chitimachas are natives of southern Louisiana, making the coast their home for the past 6,000 years. At one time, their land consisted of all of the Atchafalaya Basin. The Chitimachas subsisted on farming, hunting and fishing, and excelled in ceramics and basketry. A war with European explorers in the early 1700s pushed the Chitimacha to the edges of the Mississippi River delta (Chitimacha.gov, 2016).

The Pointe-au-Chien Indian Tribe, descended from all four tribes, resides between the Mississippi River delta and the Atchafalaya Basin. Over the years, these two watersheds created an area rich in soil and wetland habitat. The community is intricately tied to the local ecosystem, living off of the land by fishing, trapping, and shrimping. The tribe faces the effects of subsidence and sea level rise; combined to result in one of the highest rates of relative sea level rise in the world (NOAA, 2012). This relative sea level rise pushes the community further and further north up Bayou Pointe-au-Chien; it alters the salinity of their waters and causes species traditionally used for fishing and trapping to move elsewhere. Members of the community continue to fish but can no longer trap because of the loss of critical marsh habitat, and recall days when bayous that are now over a hundred feet wide were just a few feet across (pactribe.tripod.com).

They also remember their ancestors living miles down the bayou, on barrier islands that have disappeared or are in the process of disappearing. The tribe owned large farms and raised cattle, but the loss of land has made this impossible. Now tribal members keep small gardens in

their yards. In the past twenty-five years, tropical storms and hurricanes have inundated the community with floodwaters. These storms include Hurricane Andrew, Hurricane Lili, Hurricane Katrina, Hurricane Rita, Hurricane Gustav and Hurricane Ike. Additionally, federal and state hazard mitigation planning projects that help to protect other nearby communities from flooding and storm surge do not protect the community. For example, the planned Morganza to the Gulf project, which will result in a levee that protects Lafourche and Terrebonne parishes, will run directly adjacent to the community, including the current village, but excluding the village sites, fishing areas and sacred sites south of the Cut Off Canal from future hurricane protection and further increasing the likelihood of storm surge. Although it is recognized by the parish and state, the tribe is not recognized by the federal government ([pactribe.tripod.com](http://pactribe.tripod.com)).

At the 2015 Paris Climate Conference, Chief Thomas Dardar of the United Houma Nation, another coastal Louisiana tribe, emphasized the importance of federal recognition when responding to climate conditions along the coast. Like the Pointe-au-Chien Indian Tribe, the United Houma Nation is not recognized by the federal government, and so does not have access to the resources it needs to prepare for climate change. According to Dardar, “it’s always indigenous people that live along the coastlines – and they’re always having to meet what nature has to give us first” (Wendland, 2015). Additionally, when asked about the commonalities among indigenous communities, Dardar pointed out, “we’re on the edge of society where we live and exist” (Wendland, 2015). Being on the edge of society both physically and socially makes these indigenous communities even more vulnerable. Dardar states that federal recognition would help indigenous communities in Louisiana to be more resilient (Wendland, 2015). Federal recognition would increase resilience because it provides the opportunity to protect cultural heritage sites and resources through land trusts. In addition, it allows tribes to be independently

self-governing, and act as their own autonomous nation within the United States. It also requires government agencies to interact directly with the tribe, and allows access to federal programs and funds. Further, recognition as an independent nation allows tribes to have more power, and apply for funding to protect and increase their resources. For example, the Navajo Nation holds a trust for 16 million acres of land in Arizona, New Mexico and Utah. Without this resilience, the tribes may be forced to relocate, and the fabric of their communities will unravel.

Some members of another coastal Louisiana tribe of Biloxi-Chitimacha-Choctaw descent, the Isle de Jean Charles tribe, want to relocate to a safer location. The tribe currently resides on Isle de Jean Charles, located a few miles from the Pointe-au-Chien Indian Tribe. The island that the tribe calls home lost 98% of its land because of relative sea level rise. Scientists predict that the island will completely disappear within the next 50 years. Because of this extreme land loss, the tribe worked for the last 13 years to try to obtain funding to relocate to a less vulnerable location. The state of Louisiana received this funding in January 2016 for the Isle de Jean Charles community. The community is being called “the first community of official climate refugees” (D’Angelo, 2016).

The Pointe-au-Chien Indian Tribe, like four other coastal Louisiana tribes, is seeking federal recognition from the United States. Unlike their neighbors on Isle de Jean Charles, the consensus of the tribe is that they do not want to leave their ancestral home, as they are tied to the cultural and social aspects of the area. Climate change forces the community to adapt as the water rises and the land disappears, but the participants in the study are determined to stay where they made their homes for centuries. If the tribe had to relocate, it would have to do so as a community, in order to maintain their social and traditional bonds. Many tribal members elevated their homes to prevent flooding, an example of a local adaptation, but the storm surge

can reach such heights in the community that houses reach as high as thirteen feet (pactribe.tripod.com). Increased storm surge may push the tribe to have to relocate to a safer location in the future as well.

While the tribe has strong social networks and connection to the land and water, its members do not always have access to the resources needed to adapt, or manage the hazards and risks associated with their environment. Furthermore, the community is located outside of the more populated areas of the parish, and is therefore not always included in hazard mitigation planning decisions, which help to reduce the risks the parish faces. There are many factors to explore in order to understand how the Pointe-au-Chien Indian Tribe can adapt to climate change. Disaster, hazard mitigation and planning policy play a role in the adaptation of the community. These policies determine the funding for mitigation measures, such as coastal restoration and house elevation, that can help the community adapt to rising waters and increased storms. The vulnerability of both the landscape and the community also play a role. If the landscape cannot withstand a storm, then the community will be inundated with water. If the community does not have the resources to evacuate, elevate, and/or implement other nonstructural adaptation measures, they will be left in harm's way (Reckdahl, 2016).

Combatting the community's vulnerability is its resilience and ability to adapt. This adaptive capacity can come from both the environment and the people. For example, many communities in the bayou plant food instead of relying on grocery stores. In addition, community members often take it upon themselves to repair the landscape through placement of rocks or small levees. Further, the tribe has close social networks stemming from familial connections and ancestral ties. The members of the tribe look after one another, providing help and resources to other members of the community when needed. All of these factors contribute to the tribe's

ability to adapt to the environmental hazards that make their existence more and more tenuous (Kerner and Thomas, 2014).

The adaptive capacity of the tribe determines the overall resilience of their community. Resilience and adaptive capacity emerge from local knowledge. In this case study, members of the tribe were interviewed in order to understand their relationship to the environment, the environmental hazards they face, and their ideas for adapting to these hazards. As a part of a separate study, a team of physical scientists mapped the themes that emerged from the interviews, so that the tribe could visualize their vulnerabilities, as well as their ability to adapt to those vulnerabilities. Conducting interviews with the community, as well as mapping the community's hazards based on identified issues in the interviews, helped to explain how the community adapted in the past, what they need to adapt to in the future, and how they would like to plan for this adaptation. In this way, adaptation planning was placed in the community's hands, so that locals can lead and implement the adaptation strategy. Further, understanding the adaptive capacity and resilience of this coastal community helps to explain the capacity and resilience of other coastal communities facing sea level rise, land loss, and other environmental hazards due to climate change.

The research question addressed in this study is how will climate change, and the mitigation and policy measures implemented to combat climate change, affect the adaptive capacity of the Pointe-au-Chien Indian Tribe over time? The sub-questions of the research question include how do climate change and subsequent policy responses affect the tribe's ability to respond, connectivity, resources, capacity to learn, and ability to collaborate?

This case study contributes to the knowledge of community resilience theory and adaptive capacity. It also helps to reveal how climate change and sea level rise will affect coastal

communities in the future. It helps to identify the characteristics of the Pointe-au-Chien Indian Tribe that make them inherently adaptive, and whether changes in climate, as well as policy responses to changes in climate, harm that adaptivity in any way. In addition, this study posits ways to maintain that adaptive capacity, and therefore protect the tribe's traditions and culture, even though the Pointe aux Chenes area faces climate change and sea level rise. Furthermore, this study explores the community processes and urban planning hazard mitigation methods needed to facilitate adaptive capacity for the Pointe-au-Chien Indian Tribe in the face of relative sea level rise.

The following chapters expound on the theory, literature, research design, discussion, analysis and recommendations of the study. The second chapter details hazard mitigation theory, including the origins of the study of hazard mitigation and the main concepts to date, studying disaster and the underlying social and physical vulnerabilities, and the different scales of urban planning that contribute to hazard mitigation and resilience planning, as well as the theoretical lens used for the case study. Chapter two also includes the literature review, and delves into the studies needed to understand disaster, vulnerability, resilience and adaptation. Chapter three explains the design of the research, and the variables available to test adaptive capacity in the face of climate change and mitigation measures implemented to combat this climate change. The fourth chapter discusses the codes and themes evident in the adaptive capacity of the Pointe-au-Chien Indian Tribe. These codes and themes stem from the interviews, observations and focus groups conducted with members of the tribe. Chapter five relates the themes revealed in the preceding chapter back to the literature and theory, discusses the mitigation plans that affect the tribe and their participation in those plans, and explores the effects of climate change, and mitigation measures and policies implemented to combat climate change, on adaptive capacity.

Finally, the last chapter analyzes and makes broader conclusions and recommendations about adaptive capacity, climate change, mitigation policy, and coastal communities.

Coastal communities throughout Louisiana, the United States, and the world will benefit from the results of the project, through learning more about the adaptation process, and how it affects community resilience in a coastal community facing one of the highest rates of relative sea level rise in the world. Although this case study details the experiences of an indigenous tribe of ecosystem users, the relationship between adaptation and the effects of mitigation policy on coastal communities can be applied to all communities implementing mitigation to prepare for climate change. This community's adaptation process helps to reveal how relative sea level rise will affect similar coastal communities. This study particularly applies to indigenous communities tied to their local ecosystem. Other community members in similar situations, community organizers, local, state and federal officials, urban planners, and academics interested in climate change and adaptation benefit as well, by having access to the information. The results have regional, national, and global applicability, as climate change affects coastal communities the world over. In addition, the transcripts and information in the dissertation will aid the community in gaining further understanding about their adaptation process, and aid them in preserving their tradition and culture as severe environmental change threatens their way of life.

### ***Summary***

As climate change continues to affect our coastal environments, it will continue to have an effect on our coastal communities. Understanding the strength and longevity of community adaptive capacity will help communities adapt and respond to the changes and increasing hazards in our environment. In addition to understanding the adaptation process, disaster

mitigation policy should enable the adaptation of local communities so they can influence policy and participation in the direction and implementation of policy. This understanding of adaptation and processes and participation in policy can apply to other communities experiencing climate change in Louisiana and in the rest of the United States, and perhaps throughout the world as well. In the next chapter, there is a review of hazard mitigation, disaster and urban planning theory, the theoretical lens for the case study, and the studies needed to understand disaster, vulnerability, resilience and adaptation in order to explore the facets of adaptive capacity, how social scientists measure this capacity, and the most effective ways to study this capacity in a changing environment.



## ***Terms***

The terms listed provide context for the main points detailed in the study.

***Adaptation***: “the process of making appropriate changes to better cope with climate uncertainties or to reduce its negative effects” (Shaw & Sharma, 2011, p. 18).

***Adaptive capacity***: “the ability of a system to reorganize and reconfigure as needed to cope with disturbances without losing functional capacity and system identity” (Kern & Thomas, 2014, p. 682)

***Community resilience***: “A process linking a set of networked adaptive capacities to a positive trajectory of functioning and adaptation in constituent populations after a disturbance” (Norris et al., 2008, p. 131).

***Natural hazards***: “extreme events that originate in the biosphere, lithosphere, hydrosphere or atmosphere” (Alexander, 2000, p. 9).

***Natural disaster***: “the product of hazard...and vulnerability” (Alexander, 1997, p. 291).

***Hazard mitigation***: “advanced action taken to reduce or eliminate the long-term risk to human life and property from natural hazards” (Godschalk et al., 1999, p. 5).

***Vulnerability***: “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard” (Blaikie et al., 2003, p. 9).

## **Chapter 2: Hazard Mitigation, Disaster and Urban Planning Theory and Understanding Disaster, Vulnerability, Resilience and Adaptation**

This chapter describes hazard mitigation theory, the current case study and the research questions for the study, and a literature review of disaster planning, community resilience, and adaptation. In order to understand the breadth of knowledge, the review includes applicable literature that describes the interaction of policy and local knowledge. This chapter also examines the theory behind hazard mitigation, as well as studies measuring effective hazard mitigation planning, community resilience, and adaptive capacity. These studies contribute to the ultimate design of the study, as well as the research questions utilized in the study. Additionally, the studies describe various ways localities use mitigation planning, what makes a community resilient, and what allows a community to adapt to changes in the environment. The ability to adapt and local knowledge about adaptation, coupled with mitigation planning policy, is of particular importance to this study. The fifth chapter reviews the theory and literature in conjunction with the gathered data in order to better understand the results of the study.

### **Hazard Mitigation, Disaster and Urban Planning Theory**

Hazard mitigation theory would not exist without disaster. Hazard mitigation theory emerged from the study of disastrous events and how society responds to these events (White, 1974). The theory states that response to disaster could also include mitigating for the next disaster as a part of the disaster cycle (Mileti 1999; Tierney, 1989; White, 1974). Hazard mitigation theory is not just about preparing for the next disaster; it is also about

repairing the social and physical vulnerabilities that contributed to that disaster (Comfort, Wisner, Cutter, Pulwarty, Hewitt, Oliver-Smith, Wiener, Fordham, Peacock & Krimgold, 1999; Mileti, 1999). These social and physical vulnerabilities are often ambiguous, and dichotomous (Bogard, 1988; Soja, 1989). This dichotomy stems from the fact that society's influence on nature contributes to its vulnerability, while nature puts communities in vulnerable situations (Soja, 1989). Additionally, some efforts at mitigation can increase vulnerability (Bogard, 1988; Mileti, 1999).

There are ways communities can combat this vulnerability. Communities that successfully mitigate hazards without becoming more vulnerable are often referred to as resilient (Godschalk, 2003). Since resilience is frequently a function of a community's local knowledge, it is hard to plan for or create (Scott, 1998). This makes hazard mitigation planning difficult to accomplish successfully. Harnessing local knowledge to plan and adapt for the future may be the key to successful hazard mitigation (Scott, 1998).

The in-depth study of hazard mitigation theory began with Gilbert White (1974), who uses a questionnaire targeting 22 case studies, a global overview of disaster, and a comparison of field data to research the process. He finds that social response, rather than physical infrastructure, was significant in responding to disaster. It was this response, at the community and individual level, which helps people recover from disaster more effectively. White postulates that if risks were mapped at a geographical level, and plans were made prior to disaster, this response could be even more effective. Assessing risks and making plans before disaster occurs is the basis of hazard mitigation theory (White, 1974).

This risk assessment does not have to be developed with disaster in mind. Bogard extends hazard mitigation beyond the disaster response cycle and deeper into the social

realm, calling it “a set of strategic actions that actively reshape and redistribute the social parameters of hazards” (1988, p. 153). Additionally, he points out the ambiguous nature of disaster, in that it is difficult to determine the effects disasters will have at both the physical and social levels. According to Bogard, this ambiguity is embedded in all hazards research, through physical, social and other dimensions (1988, p. 151). Adding to the ambiguity of hazards research is the limited information individuals have about these hazards (1988, p. 157). Limited information about hazards and the ways to mitigate those hazards lead to inadequate preparedness for disaster. Therefore, even when mitigation measures are taken, they may be ineffective, or have unintended effects on other physical or social structures in the community (Bogard, 1988; Mileti, 1999). Furthermore, society produces and/or alters the physical environment, in addition to influencing the social relationships and networks in that locality, while at the same time, the environment’s inherent vulnerabilities alter human settlements (Soja, 1989).

Thus, hazard mitigation theory spans from in-depth research studies following disastrous events, to theoretical examinations of the relationship between the social and physical environment. According to Tierney (1989), hazard mitigation theory ranges from the exploration of social systems and the analysis of policy, to research studies on specific disaster events. On the other hand, even though there are many different types of studies, Tierney claims that hazard mitigation research “lacks a theoretical focus” (1989, p. 370). Tierney attributes this lack of focus to the fact that most studies only examine the individual or the community, rather than the population at large, like White’s case studies, and that most of the studies stem from a disastrous event. This wide breadth of research draws the focus away from the production of risks at the physical and social level – the root of what

communities or individuals need to mitigate (Tierney, 1989, p. 376). Furthermore, most of these theories and research ignore the community organizations and social networks that help individuals and communities to mitigate (Tierney, 1989, p. 383). Tierney calls for a more holistic study of hazards, spanning across disciplines, geographical areas, and time (1989, p. 386). Finally, Tierney asks theorists to study the ways hazard mitigation has been effective, even when obstacles were present, in order to enhance the knowledge of the field, rather than focusing only on disastrous events (1989, p. 386). This holistic study of effective hazard mitigation would lead to a more focused hazard mitigation theory.

Hazards and disasters cannot be studied in a vacuum, as they are a result of physical and social developments (Mileti, 1999, p. 35). These physical and social developments often result in vulnerability (Comfort et al., 1999, p. 39). Furthermore, many mitigation measures can contribute to further risk, such as the installation of levees that increase storm surge for communities located outside of those levees (Bogard, 1988; Mileti, 1999, p. 3). This could be because many issues with effective hazard mitigation come from the inability to understand long-term effects. Often, disaster recovery increases risks to a community, as the desire to quickly rebuild outweighs the need to examine what caused the hazard or disaster in the first place (Comfort et al., 1999).

Communities have underlying issues that cause hazardous and disastrous events, such as environmental hazards and social inequality (Mileti, 1999; Tierney, 1989). Effective mitigation addresses these issues before an event occurs. Mileti observes that recent changes in our society, such as changes in climate, increased inequalities throughout society, and the construction of more and more imperfect infrastructure, all make hazard mitigation more necessary than before (1999, p. 3). To Mileti, the key to effective hazard mitigation is at the

local level. Repairing physical and social infrastructure locally, while reinforcing infrastructure and increasing social networks, will lead to more resilient communities (1999, p. 5-6). Unfortunately, changes to physical infrastructure are often funded and completed at the state and federal levels. According to Comfort et al., enabling communities to reduce risk locally through “training, capacity building and resource transfers” would help to reduce vulnerabilities (1999, p. 43). They suggest mapping risks at the local level in order to share information and enable localities to reduce risk.

Localities that are able to reduce risk and vulnerability are often referred to as resilient communities (Godschalk, 2003). These communities have strong social networks, and adapt by learning from hazardous and disastrous events (Godschalk, 2003). According to Godschalk, “resilience requires combinations of apparent opposites, including redundancy and efficiency, diversity and interdependence, strength and flexibility, autonomy and collaboration, and planning and adaptability” (2003, p. 139). Therefore, resilient communities are able to plan and adapt physically and socially to risks (Godschalk, 2003). According to Scott, the ability to adapt and be flexible is called “metis” or “the kind of knowledge that can be acquired only by long practice at similar but rarely identical tasks, which requires constant adaptation to changing circumstances” (Scott, 1998, Loc 2414). This ability includes the expertise to respond and adapt to social and environmental factors (Scott, 1998, Loc 4183). Communities that have this expertise are often on the margins of society, relying on their own adaptation measures, rather than those passed down by local, state or federal governments (Scott, 1998). Therefore, Scott asserts that top down state based planning is not effective for these communities, as it subverts their innate adaptive knowledge.

Repairing social and physical vulnerabilities is most effective at the community level, where the innate knowledge of that community can contribute to reducing risk (Comfort et al., 1999; Scott, 1998). Although the hazard mitigation process can be ambiguous (Bogard, 1988; Soja, 1989), communities can reduce risk through adaptation, local knowledge, mapping, enhancing social networks, and planning at the local level (Tierney, 1999; Comfort et al., 1999; Scott, 1998). Studies of effective local hazard mitigation, particularly when a community is combatting social and physical vulnerabilities, are rare (Tierney, 1999). Extracting hazard mitigation from the disaster cycle and top down planning efforts and placing it in the community may be a more effective way to study how localities can reduce risk, adapt to environmental circumstances, and bounce back from disastrous events (Scott, 1998; Tierney, 1999). Therefore, effective hazard mitigation includes reducing risks by addressing physical and social vulnerabilities, and planning for hazards locally by accessing local knowledge and adaptive capabilities.

There are many ways to mitigate social and physical vulnerabilities in a community, and the reduction of these vulnerabilities often requires the ability to adapt. Defining the characteristics contained in the adaptation process could help communities increase their ability to adapt, and therefore their ability to reduce their vulnerability.

### **Theoretical Lens**

Communities can adapt to hazards by harnessing local knowledge and making use of the ability to adapt to those hazards. The adaptive capability of a community or group of people can be measured by the adaptive capacity metric. Therefore, this study analyzes adaptive capacity using the metric designed by Kerner and Thomas (2014). Kerner and

Thomas define adaptive capacity as “the ability of a system to reorganize and reconfigure as needed to cope with disturbances without losing functional capacity and system identity” (2014, p. 682). Adaptive capacity includes response diversity, collaborative capacity, connectivity, abundance/reserves, and learning capacity (Kerner & Thomas, 2014, p. 682). Each characteristic of adaptive capacity has traits within it that also contribute to a community’s ability to bounce back. The characteristics in this study are the characteristics of adaptive capacity defined by Kerner and Thomas: diversity of response, connectivity, resources, the ability to learn, and the ability to collaborate. The diversity of response includes the different ways the community can respond to an event, connectivity includes relationships to the area and the population in the area, resources include the assets available in the community to keep the community thriving, the ability to learn includes the community’s continued intellectual understanding of their situation, and the ability to collaborate involves the ability of the community to work internally and externally towards a common goal.

In order to understand the adaptive capacity of the Pointe-au-Chien Indian Tribe in the face of climate change, this study uses Kerner and Thomas’s metric to design research questions for the study. The main question explores the tribe’s general adaptive capacity, and the sub-questions explore each characteristic Kerner and Thomas identify as a part of adaptive capacity.



## **Research Questions**

The research question addressed in this study is how will climate change, and the mitigation and policy measures implemented to combat climate change, affect the adaptive capacity of the Pointe-au-Chien Indian Tribe? The sub-questions of the research question include how do climate change and policy responses to climate change affect the tribe's ability to respond, how do climate change and policy responses to climate change affect the tribe's connectivity, how do climate change and policy responses to climate change affect the tribe's resources, how do climate change and policy responses to climate change affect the tribe's capacity to learn, and how do climate change and policy responses to climate change affect the tribe's ability to collaborate? These research questions contribute to a case study that explores the adaptive capacity of the Pointe-au-Chien Indian Tribe both now and in the future, as climate change, and planning and policy responses to this change, continue to alter their ancestral home.

## **The Study**

Planning policy and hazard mitigation efforts help to reduce environmental hazards and social and physical vulnerabilities. Resilience and adaptation measures also help to combat hazards and vulnerabilities. But, mitigation is not always effective, and resilience and adaptation are not always enough, particularly as the climate continues to change. The ability to be resilient is often synonymous with the ability to adapt. Mitigation often refers to top down strategies, such as state and local plans and structural improvements, while adaptation applies to bottom up strategies and communities responding to hazards at a more local level (Kleim, 2008). Climate change, and policy responses to climate change, will have a

significant effect on coastal communities, both environmentally and socially. According to Erisman et al. (2015), “natural and social systems – from climate to energy, food, water and economies – are tightly coupled” (p. 151). Sea level rise will change natural environments, forcing communities to adapt by elevating homes, relocating elsewhere in the community, and generally altering their way of life.

Mitigation and adaptation measures could also have an affect on a community’s resilience, as they change jobs, invest in retrofitting measures, react to flood protection projects, or move to new locations. Kerner and Thomas categorize resilience into three types: stability, readiness and adaptive capacity (2014, p. 682). Stability refers to “the degree to which a system can continue to function if inputs, controls, or conditions are disrupted,” readiness is “how quickly a system can respond to changing conditions” and adaptive capacity is “the ability of a system to reorganize and reconfigure as needed” (Kerner & Thomas, 2014, p. 682). This study only focuses on adaptive capacity, as it is the most directly related to environmental changes.

Climate change and sea level rise, as well as the planning and policy responses to those hazards, will have an effect on the adaptive capacity of coastal communities. The Pointe-au-Chien Indian Tribe, an indigenous community in coastal Louisiana, lives in an area with one of the highest rates of relative sea level rise in the world. According to NOAA’s tidal gauge records, relative sea level rise in southeast Louisiana is increasing at a rate of three feet per every one hundred years (NOAA, 2012). This is due to land subsidence from an altered delta combined with sea level rise resulting from climate change. In fact, land in southeast Louisiana is subsiding at a rate of 11.2 millimeters per year (Marshall, 2013). Further, by 2100, 60.6% of land in Lafourche Parish is projected to be below sea level, and

60.9% of land in Terrebonne Parish is projected to be below sea level (Marshall, 2013). Currently, the land in southeast Louisiana averages around three feet above sea level (Marshall, 2013). In the tribal village site in Pointe aux Chenes, the land elevation ranges from 2.8 to 3.1 feet (LSU AgCenter, 2016). Therefore, this study explores how climate change, and the mitigation and policy measures implemented to combat climate change, affects the adaptive capacity of the Pointe-au-Chien Indian Tribe. It also posits how local knowledge can more effectively contribute to mitigation policy, and how planners can empower local communities to participate in mitigation planning and implementation. This discovery can apply to any community that has to adapt to hazards stemming from climate change, in any area of the world.

### **Literature Review: Disaster Studies, Urban Planning, Vulnerability, Resilience and Adaptation**

Climate change causes sea level rise in coastal communities, in many cases resulting in hazardous environmental changes. Climate change also causes more extreme weather, such as hurricanes, and causes these events to occur more often and with more intensity (UNISDR, 2015). Understanding how communities manage risks can help mitigate the results of these extreme events. Hazard mitigation planning happens at the local, regional, state and federal level. But, not all mitigation plans are successful, or reach every vulnerable population. Underlying social and physical vulnerabilities of populations often contribute to the devastation of natural disaster, and the ineffectiveness of hazard mitigation. Physical vulnerabilities originate from hazardous environmental conditions, while social vulnerabilities stem from social processes (Blaikie, Cannon, Davis, & Wisner, 2003). As

populations continue to urbanize, inequalities in social systems grow, and as the environment continues to change, mankind becomes more and more vulnerable. Yet, some populations that have vulnerable traits can be more resilient than other populations, and therefore able to recover from disasters more effectively (Cutter, Mitchell, & Scott, 2000). The resilience of vulnerable populations often emerges from the ability to adapt. Adger calls the “understanding of adaptation and coping mechanisms, and hence the state of vulnerability, one of the most important research issues within the area of global environmental change” (1999, p. 250). Adaptation can take many forms, such as structural and nonstructural adaptation measures, changes in settlement patterns, and even relocation. Thus, this literature review will explore disaster studies, disaster planning, social and physical vulnerability, resilience, and finally, adaptation.

### ***Disaster Studies***

Adapting to climate change is similar to responding to disaster, as climate change is a slow moving, long-term disaster. Natural disaster can have negative effects on human environments, and defining these effects is the first step to understanding the causes of, and ways to circumvent, natural disaster. This understanding can help communities mitigate disasters more effectively, so that hazards do not necessarily become disasters in the future.

Natural disasters are a byproduct of natural hazards. Mileti, through studying the history of natural hazards and mitigation, and exploring how research influences hazard mitigation policy, claims that natural hazard is “the product of risk, vulnerability, exposure, and the capacity of humans to respond to extreme events” (1999, p. 106). A natural hazard becomes a natural disaster when a community does not adapt fully to risks. Natural events

move beyond nature to negatively affect human environments, and therefore become disasters. Olshansky and Chang, after reviewing the planning literature on disasters, assert that disasters reveal underlying issues in the environment, the economy, and society (2009, p. 208).

The study of disaster is the study of many environmental and societal processes. In order to fully understand the effects of natural disaster, researchers study how they affect human settlements and social systems. The National Research Council, in a report that explores the history of and current literature on disaster, finds that “disaster research, which has focused historically on emergency response and recovery, is incomplete without the simultaneous study of the societal hazards and risks associated with disasters” (2006, p. 2). Similarly, Alexander, after studying natural disasters and the response to those disasters from 1977-1997, claims that the best way to research disaster is to examine hazards, risks and disasters holistically, as different parts of an entire process (Alexander, 1997, p. 298). Much of the disaster literature focuses on the best way to study disaster, and the most recent consensus is that it is the result of a systemic process, not a single event or community.

The disaster process involves mitigation, preparedness, response and recovery. This process is cyclical, with response and recovery following immediately after a disastrous event. Disaster researchers differ on the most effective ways to respond to an event, and if this response should come from the community, state, regional or national level. Barton (1969) studies the effect of disaster on the population immediately after an event, during the aforementioned response and recovery period. Using the literature on disaster, he analyzes findings from disasters throughout history, such as the Irish famine and Hiroshima, comparing the various community responses to these disasters. He examines the physical and

social damages from the event, the timing of the event, such as whether it occurred quickly or over a long period of time, how long the damage lasted, and how prepared the community was before the disaster occurred. He also studies the behavior of the individuals involved in the disaster before, during and after the event. He applies these measurements to conclusions drawn by disaster studies in the past, in order to better understand the effects of various types of disaster on social behavior. Barton places particular importance on the therapeutic community, wherein community members bond together to help one another after a disaster, noting that low probability high consequence events, such as hurricanes and tornadoes, garner more philanthropy than slow moving disasters, such as income inequality and drought. Picou and Marshall also call for the identification of therapeutic processes after disaster, including active volunteerism and effective government action (2004, p. 769). In addition, Barton (1969) finds that the creation of a federal educated disaster authority that works with community organizations to respond to disaster would be helpful. As White (1974) notes, this research largely focused on disaster response rather than disaster mitigation.

Scholars also examine disasters from a holistic point of view, rather than focusing solely on response or mitigation. Alexander (2000) analyzes disasters and disaster policy in order to discover useful disaster response methods. He examines past disasters and studies of those disasters from a geographer's perspective, detailing the causes and effects of those disasters holistically. Alexander criticizes the idea of a federal disaster authority, pointing out that it removes the emic responses and knowledge that individual communities may have to an event. Quarantelli (1997) analyzes the findings of forty years of research on disaster in the social sciences in order to pinpoint what is needed to sufficiently respond to and recover from those events. He states that a centralized control authority can be ineffective, as it often

relies on leadership from outside sources that are unfamiliar with the locality. He explains that effective leadership often comes from local organizations, and finds that disaster management is more effective when those managing the disaster work with local leaders that are already working as a part of the community (Quarantelli, 1997, p. 15). Quarantelli further cautions that even a localized emergency management authority and structure may not be enough, because if a community is socially vulnerable, an emergency center is not going to compensate for those inherent inequalities (1997, p. 17). He finds that effective response and recovery stems from effective management of disaster, which involves cooperation with community leaders (Quarantelli, 1997).

Disaster literature often focuses on social inequalities. These inequalities can include income inequalities, limited access to resources, and overpopulation. Addressing these inequalities can help mitigate or alleviate the effects of disaster. Davis (2006) reviews the historic effects of overpopulation and overurbanization on populations at the global level, and calls the increase of urban third world slums the “reproduction of poverty.” Davis points out that informal urban settlements are the most hazardous and vulnerable environments in third world cities (2006, p. 16, 124). Hamza and Zetter (1998) also explore the effects of globalization on communities by reviewing disaster studies, and the structural processes that lead to disaster in urban areas. They find that increased inequalities cause increased vulnerabilities in communities throughout the world (Hamza & Zetter, 1998). Hamza and Zetter further explain that proper hazard mitigation takes societal factors into account, not just factors of hazard and risk (p. 291). They find that understanding the way social systems affect a community’s susceptibility to disaster, as social systems often put different communities in more vulnerable situations, would aid in effective hazard mitigation (Hamza

& Zetter, 1998, p. 292). Thus, alleviating societal inequalities can reduce the effects of disaster, or eliminate them all together. In other words, repairing inequalities at the social level, or at the very least understanding the existence of those equalities, can reduce risk to environmental hazards.

Hazard mitigation planning emerged from the idea of alleviating risk before disaster occurs. Godschalk, Beatley, Berke, Brower, and Kaiser, after studying federal hazard mitigation planning policy and the ways communities implement that policy across the country, find that hazard mitigation is “advance action taken to reduce or eliminate the long-term risk to human life and property from natural hazards” (1999, p. 5). Alexander uses the geographic perspective to illuminate the structural issues that impede proper mitigation. Alexander agrees that communities can reduce their vulnerability through mitigation of the social and physical vulnerabilities that cause hazards, but cautions that the cultural and infrastructural structures of our society make it difficult to mitigate effectively (2000, p. 23). He points out that mitigation cost benefit analyses may encourage societies to mitigate more effectively. Therefore, communities are encouraged to mitigate if they understand that the mitigation strategies will result in financial savings. In other words, while hazard mitigation is a worthwhile endeavor, it is difficult to get communities to support mitigation efforts, which are often only effective in the long term, without understanding the financial advantages of those strategies.

Hazardous and disastrous events impact society and the environment in disproportionate ways. Studying disaster can help to understand how to prevent this disproportionality. Results from these studies reveal that vulnerable populations experience hazards and disasters more harshly, and have more difficulty recovering from these events



(Davis, 2006; Hamza & Zetter, 1998; Mileti, 1999). In addition, localities can better recover from events by mitigating the hazards that caused the event so the next event is not as harmful. Hazard mitigation strategies can alleviate hazardous conditions in vulnerable environments, as well as make up for social inequalities that result in disaster. But, educating communities about the advantages of hazard mitigation strategies can be a challenge, as communities need to understand their risk in order to support hazard mitigation measures. Because they involve making plans and devising strategies for improvement, hazard mitigation solutions are often left to planners.

### ***Urban Planning Studies: Reducing Vulnerability and Mitigating Hazards***

Urban planners have numerous policy findings for reducing vulnerability and mitigating hazards, including structural and nonstructural processes. According to Godschalk et al., “hazard mitigation is advance action taken to reduce or eliminate the long-term risk to human life and property from natural hazards” (1999, p. 5). Structural mitigation measures can include building floodwalls, or restoring wetlands (Broome, Dubinin & Jenkins, 2015). Nonstructural mitigation measures can include elevating homes, or acquiring land for floodplain use (Broome, Dubinin & Jenkins, 2015).

One nonstructural measure is planning, and hazard mitigation is often addressed by a hazard mitigation plan. A hazard mitigation plan is, “the plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in society” (Godschalk et al., 1999, p. 13). Hazard mitigation plans include assessing the hazards that affect the locality, and then developing structural or nonstructural measures to protect from those hazards. Many mitigation measures fall under the umbrella of

environmental planning. Brody and Highfield (2005) compare land use plans in Florida with development to see if environmental planning is actually effective. They find that many areas ignored the land use plans that were put in place. These land use plans tried to curb development in vulnerable areas, but did not actually stop development, which resulted in greater harm to ecosystems. Brody and Highfield claim that a local, adaptive method of planning over time can be more effective in protecting the environment, and therefore mitigating hazards. Brody, Zahran, Maghelal, Grover, and Highfield (2007) also assert that urban planners are responsible for protecting vulnerable environments from overdevelopment and promoting community resilience (p. 343). By studying 383 flood events in counties in Florida over a four year period, in order to discover how planning policy affects damage to property from flooding, they find that changes in wetlands by overdevelopment results in more flooding and damage to property. They also find that nonstructural measures are more effective than structural measures such as levees (2007, p, 343). Conversely, they discover that even when nonstructural mitigation measures are put in place, more development occurs in vulnerable places. In addition to the incongruous effect hazard mitigation has on development, there is also difficulty implementing mitigation measures based on scale.

Planners can implement hazard mitigation measures at different geological scales, but differ on what level hazard mitigation is most effective, whether it is from the community, regional, state or federal level. Burby, Beatley, Berke, Deyle, French, Godschalk, Kaiser, Kartez, May, Olshansky, Paterson and Platt (1999) through a three year study on how local government can facilitate hazard mitigation, find that federal policy often undermines these measures. They further examine the federal role in hazard mitigation, and find that the federal government can do more to support mitigation at the state and local level. Other

planners, such as Burby, call for the integration of federal, state and local plans. Burby (2006) explores the damage done by Hurricane Katrina, and delved into the role of federal, state and local hazard mitigation planning programs during that event. He examines policy decisions implemented at all levels of government in the New Orleans area, as well as planning requirements and building code enforcement at the local level. He finds that more thorough planning before the event could have circumvented some of the damage, particularly at the federal level, as local decision makers may not have the resources or political power to adequately mitigate hazards and disasters.

On the other hand, many planners state that hazard mitigation is best planned for at the regional, rather than the federal, level. Wheeler, Randolph and London (2000), examine the role of planners in responding to climate change by looking at ways planners worked to reduce greenhouse gas initiatives throughout the world. They explain that since hazards come from local, rather than federal practices, assessing vulnerabilities at the regional level may be a more effective way to mitigate for disaster (2000, p. 217). Godschalk et al. also suggest a more regional approach to hazard mitigation, wherein every area affected by the hazards addresses the environmental concerns, rather than each locality separately (1999, p. 13). Still other planners find that hazard mitigation may be most effective at the community level. Blaikie et al. explore causes and responses to geologic disasters such as earthquakes, landslides and volcanoes through their planning work in developing countries, and find that organization at the local level can reduce the vulnerability to these disasters, wherein the people experiencing the hazards locally explore the causes and solutions to their problems (2003, p. 285).

It is often difficult to garner support for hazard mitigation planning at the community level. Godschalk, Brody and Burby study five different planning processes that include community participation, and find that communities often do not participate in hazard mitigation planning (2003, p. 750). They postulate that perhaps the citizens were not aware of the level of risk in their community, that local officials did not adequately communicate the hazardous conditions in the area or the planning process being undertaken to mitigate these conditions (p. 750).

There are different practices applied in successful participatory planning. Innes (1996), using a study of planning processes in New Jersey, and eight case studies of planning processes in California, finds that consulting stakeholders while making a comprehensive plan is the best way to involve community members, as well as obtain support for the plan. She calls this process consensus building, which is a “collective search for common ground and the opportunities for mutual benefit” (p. 464). She further explains that because it works horizontally rather than vertically, consensus building “created social, intellectual, and political capital” (p. 470). This consensus building results in more comprehensive plans that address all of the needs of the community. Beierle and Konisky (2000) examine approximately thirty previous case studies on public participation on environmental planning in the Great Lakes region. They find that public participation can help localities attain social goals if the process consists of well communicated and deliberative participatory processes, and can be successful at both the bottom up and top down levels. Duram and Brown (1999) perform a quantitative survey of 64 federal watershed planning projects. They claim that public participation increased the ability to identify shared issues and made the final watershed plans more effective. Laukkonen, Blanco, Lenhart, Keiner, Cavric, and Kinuthia-

Njenga (2008) explore mitigation and adaptation strategies to climate change throughout the world, and point out that a new tool for community participation in climate adaptation strategies is needed, as “responses to climate change require not only local knowledge but also the translation of information into a learning process” (p. 291). Tang and Brody (2009) study 40 jurisdictions in California with mandated comprehensive plans, using the variables of planning capacity, environmental assessment capacity, public participation capacity, and contextual characteristics. They discover that having a larger number of planners, higher population, and constant plan updates makes comprehensive plans more effective, but that public participation does not have much of an effect. It could be that comprehensive plans take a more top down approach, while local plans require more public participation.

Some planners find that public participation is more about the understanding of risk, rather than immersion in the planning process (Holub & Fuchs, 2009). By interviewing 157 citizens in an area in Germany susceptible to flooding, Grothmann & Russweig (2006) find that the understanding of flood risks by members of a vulnerable community, as well as the communication of the costs and benefits of mitigating those risks result in effective mitigation. In the California study mentioned previously, Tang and Brody (2009) also discover that more information management and sharing resulted in an effectively implemented comprehensive plan. By studying legislative measures and hazard mitigation plans related to natural hazards in Austria, Holub & Fuchs (2009) determine that more information on hazards and risk should be communicated to local communities, and that those communities should be given incentives for implementing mitigation measures. Haque (1997) studies coastal Bangladesh after a hurricane in 1991, administering a survey asking residents about their planning concerns before during and after the event years later. He finds

that indigenous communities were able to adequately understand and communicate the risk throughout the hazardous situation. Using the issues identified, he encourages the inclusion of risk communication and hazard mitigation plans in the comprehensive plans of all communities. At the very least, even if a community cannot properly mitigate the hazards that affect it, it can still employ communication to evacuate its residents when hazardous conditions arise (Haque, 1997). But, many communities in hazardous areas already have local knowledge of these risks.

Rather than look to the federal, state, and local government, or participation by the local community, some urban planners examine the private sector to successfully mitigate hazards, while others disagree with involving the market in hazard mitigation. Tseng and Chen (2012) study risk and hazard mitigation in areas susceptible to natural disaster, and the way the businesses in those areas responded to these disasters. They then create a tool to calculate earthquake loss for planning projects, finding that the key to effective hazard mitigation and disaster management is public/private participation in comprehensive planning. McGranahan, Balk and Anderson review settlement patterns of the areas of the coast less than 10 meters, or 32.8 feet, above sea level, and find that many areas of the coast, particularly in developing countries, are experiencing overpopulation in coastal areas. They caution that top down planning and market forces do not help with successful environmental adaptation (2007, p. 35).

Still other urban planners urge the adoption of a systems approach to mitigate hazards, working with local communities, taking the environment into account, and planning development to take a more long-term, global view. Mileti (1999), using a historical review of disasters and hazard mitigation, explains that hazards cannot be effectively mitigated using

traditional planning methods (p. 2). He finds that looking at hazard mitigation using a systems approach is more effective, in which the physical, social and infrastructural systems of an area are incorporated into the hazard analysis (p. 3). This approach goes beyond land use planning, and touches on social inequalities and aging infrastructure. He explains that the “influencers” on our current systems are climate change, the growing inequalities between social groups, and the continuous building of infrastructure (p. 3). He further explains that many hazard mitigation tools, such as levees and floodwalls, often postpone the inevitable, stopping hazards and disasters in the short term, but making the environment more hazardous in the long term (p. 3). Therefore, Mileti finds that the utilization of the mitigation tools of land use planning, building codes, insurance, engineering and warnings to promote a more sustainable form of hazard mitigation result in effective hazard mitigation (p. 155).

Campbell, examining sustainable development in planning processes, also asserts that people can improve land use planning by working with the environment (1996, p. 312). He finds that protecting the environment, the economy and social equity results in sustainable development (Campbell, 1996, p. 396). Campbell notes the overuse of the term sustainability, and whether the term can still influence development. On the contrary, Mileti points out that hazard mitigation is difficult in an institutional society, as it is hard to share knowledge locally and across disciplines (1999, p. 146). Mileti finds that examining hazard mitigation using a systems approach, looking at the issue globally, and making decisions based on long term effects can help lead to a more sustainable form of hazard mitigation (p. 26-29).

Hazard mitigation cannot always address all issues globally and holistically. Hamza and Zetter study structural changes in the urban areas of developing countries, and point out that planning for hazard mitigation is difficult, as most planning is susceptible to market

forces, which do not always coincide with environmental protection (1998, p. 296). Yet, according to McGranahan, Balk & Anderson (2007), as much as two thirds of the population of large urban areas throughout the world lives in coastal areas, in environmentally risky locations. With so much of the population in vulnerable areas, depending on the market to mitigate and plan for hazards is a risky situation.

Many scholars and environmental planners study how to reduce the negative effects of disaster, through better response and recovery and hazard mitigation. These measures can be implemented at the federal, state, regional, or community level. Effective planning policy and risk communication, coupled with few environmental hazards result in strong communities, while poor planning and hazardous environments result in environmentally vulnerable communities. The responses to physical vulnerability in the past consisted of governmental megaprojects such as levees and dams, but current methods favor nonstructural measures, such as improved drainage. The Mississippi River delta has become an epicenter of megaprojects, the lack of which would make residing in the area untenable. The combination of structural and nonstructural measures can help keep the area more resilient. The responses to social vulnerability, on the other hand, are harder to address.

### ***Vulnerability***

The negative effects of hazards and disasters are often blamed on vulnerability, and this vulnerability can be both physical and social. Alexander explains that the best way to fully understand aspects of vulnerability and disaster is to research natural events and social evolution together (2000, p. 250). Similarly, Blaikie et al. find that risks and vulnerability are connected in the way that they affect individual people (2003, p. 2). They define



vulnerability as, “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard” (p. 9). Therefore, the literature states that risk, vulnerability, and hazard are all connected in some way, but there are different viewpoints as to which factors are the cause and which the effect. Nevertheless, the most at risk communities are those that are the most vulnerable, whether the vulnerability is social or physical. Even in the most vulnerable communities, resilience and adaptive strategies occur.

There are many different definitions of social vulnerability in the literature (Adger, 1999; Cutter & Emrich, 2006; National Research Council, 2006). Some scholars focus on the threat to people (National Research Council, 2006), while others point to the structural processes that increase a population’s vulnerability (Adger, 1999; Cutter & Emrich, 2006). Social and physical vulnerabilities are often examined in different contexts. Social vulnerabilities cause communities to have a harder time recovering from disaster because of societal factors such as low incomes. Other communities may be physically, or environmentally, vulnerable, with the income to recover but in a location that is repeatedly at risk to hazards and disasters. But, these two categories are not mutually exclusive, as separating them completely would harm both disaster research and hazard mitigation processes (Blaikie et al., 2003, p. 2). Still, social and physical vulnerability have different definitions,

The National Research Council claims that social vulnerability “represents threats to the well-being of human populations (e.g., deaths, injuries, other medical impacts, disruptions of behavior and system functioning) and related economic losses” (National Research Council, 2006, p. 19). Yet, this definition does not take into account the process of

climate change, or the social systems that place human populations in the circumstances they exist within. Adger studies vulnerability to climate change in coastal northern Vietnam after the loss of central planning using a quantitative and qualitative household survey, as well as official interviews and district level data. He defines social vulnerability as “the exposure of groups or individuals to stress as a result of the impacts of climate change and related climate extremes” (Adger, 1999, p. 252). He claims that while individual vulnerability stems from access to resources and income, vulnerability of a larger region stems from environmental factors. Still, Adger’s definition does not touch on the structural processes that influence society.

Researchers measure aspects of social vulnerability using an index. Cutter and Emrich (2006) define social vulnerability in a paper that analyzes social vulnerability metrics and methods, specifically Cutter’s social vulnerability index. The social vulnerability index makes use of multiple variables including demographics, the built form, and socioeconomic characteristics, in order to explain the social vulnerabilities inherent in the Gulf Coast that resulted in so much devastation after Hurricane Katrina. They define social vulnerability as “the product of social inequalities... [and] the susceptibility of social groups to the impacts of hazards” (Cutter & Emrich, 2006, p. 103). They assert that the combination of physical and social vulnerability can be catastrophic, and that response and recovery after disaster depends on the level of social vulnerability in a geographic area. A combination of Adger and Cutter and Emrich’s definition broadens the definition of social vulnerability to include social systems as well as the impacts of climate change. Social vulnerability is a result of social systems that place people in direct contact with hazards that are becoming more extreme as the climate changes.

Therefore, social systems create hazardous conditions and disasters, as opposed to natural processes (Blaikie et al., 2003, p. 4). Blaikie et al., after systematically analyzing disasters throughout history, find that people and social processes are the main causes of vulnerability (2003, p. 278). Many social characteristics can contribute to this increased risk, including gender, age, physical disability, religion, ethnicity, class, and socioeconomic status (Blaikie et al, 2003, p. 29). Furthermore, the main causes of social vulnerability are economic, social and political processes and structures (Blaikie et al, 2003, p. 45).

The effects of multiple disasters on one community or population repeatedly can compound social vulnerability (Cutter & Emrich, 2006). McGranahan, Balk and Anderson (2007) explain that the most vulnerable populations are those with low incomes living in urban, low-lying coastal areas. Ecosystem users, on the other hand, do not reside in urban environments, and the physical vulnerabilities of their environment also contribute to their resilience. For example, the ridges of the Mississippi River delta are ideal for farming, while the access to water is ideal for fishing, crabbing and oystering.

Cutter, Mitchell and Scott (2000) utilize socioeconomic characteristics as well as physical characteristics to study the social and physical vulnerability of Georgetown County, South Carolina. With GIS, they analyze vulnerability throughout the county by identifying environmental and social vulnerabilities. They find that the combination of high physical and high social vulnerability can be devastating to a community, while high physical vulnerability coupled with low social vulnerability and high social vulnerability coupled with low physical vulnerability are not as harmful.

Although social vulnerability can be enough to transform a natural event into a natural disaster, physical vulnerability is an issue as well. If a community is both socially and

physically vulnerable, their vulnerability is multiplied. Much of the literature details vulnerability as it pertains to environmental, or physical, factors such as climate change, environmental hazards and natural disaster (Alexander, 2000; McGranahan, Balk & Anderson, 2007; National Research Council, 2006). Alexander defines vulnerability as “the potential for casualty, destruction, damage, disruption or other form of loss with respect to a particular elements” (2000, p. 12). Physical vulnerability often focuses on infrastructural issues as well as setting. According to the National Research Council, “physical vulnerability represents threats to physical structures and infrastructures, the natural environment, and related economic losses” (2006, p. 19). Furthermore, climate change and rising sea levels are increasing the physical vulnerabilities in many areas (McGranahan, Balk & Anderson, 2007). If a socially vulnerable community exists in a physically vulnerable location, they are even more at risk to hazards and disasters. Still, communities can lessen their social and physical vulnerabilities through resilience.

### ***Resilience***

Resilience provides one way to combat physical, social and climactic vulnerabilities. Scholars regard resilience as the opposite of vulnerability. Community resilience is the ability of a community to successfully bounce back from a hazard and/or disaster structurally, socially, and economically (McLellan & Elran, 2012). As the climate changes, it would be beneficial if communities that are vulnerable could become more resilient; if the characteristics of resilience could be transferred to vulnerable communities. In addition, communities can be both vulnerable and resilient, depending on their social and physical characteristics.

There are multiple studies that examine aspects of resilience (Berke, Newman, Lee, Combs, Kolosna, & Salvesen, 2015; Davoudi, Brooks & Mehmood, 2013; Kerner & Thomas, 2014; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008; Shaw & Sharma, 2011; Sherrieb, Norris & Galea, 2010). These studies state that the concept of resilience comes from multiple disciplines (Davoudi, Brooks & Mehmood, 2013), and can include the ability to plan for land use, risks and disaster (Shaw & Sharma, 2011). They also find that resilience depends on social capital and economic development (Norris et al., 2008; Sherrieb, Norris & Galea, 2010), and can be a function of the ability to adapt to different circumstances (Kerner & Thomas, 2014).

Many scholars view resilience through an urban planning lens. Shaw & Sharma (2011), using a questionnaire with 125 variables weighted in order to determine resilience of a locality, find that the elements of community resilience are governance, society and economy, coastal resource management, land use and structural design, risk knowledge, warning and evacuation, emergency response, and disaster recovery (p. 25). The elements of resilience they study to produce this tool were governance, society and economy, coastal resource management, land use and structural design, risk knowledge, warning and evacuation, emergency response, and disaster recovery (p. 25). They then employ this tool to measure resilience in cities throughout Asia, and designed a multi-step process to improve resilience in those cities, comprised of assessment, planning, and implementation (p. 286). Creating a resilience index is an interesting tool, but it may not explain how communities become more resilient, or help them to become less vulnerable. In addition, not all vulnerable communities have planning resources, or a strong central planning force.

Berke, Newman, Lee, Combs, Kolosna, & Salvesen, (2015) also design a way to measure resilience, in this case, in the city of Washington, North Carolina. The city is coastal, and thus will soon deal with climate change and rising sea levels. The team design a “resilience scorecard” that examined physical and social vulnerability to flooding and rising sea levels (Berke et al., 2015, p. 287). According to the authors, “a resilience scorecard should account for all the plans that govern land use and development in hazard areas” (Berke et al., 2015, p. 288). Therefore, the scorecard evaluates the integration of plans in the community, and examines them in light of the hazards and vulnerabilities in the area (Berke et al., 2015, p. 289). This evaluation allows planners to question and improve the integration of planning in vulnerable locations. Requiring this scorecard at the state or federal level could help localities increase their resilience. Including it in the Community Rating System program, which allows communities to lower their flood insurance through flood mitigation activities, or other programs linked to community benefits could help alter land use trends in the future.

Other scholars look beyond urban planning to the social aspect of resilience. According to Alexander, those who are socially connected are more resilient than those who are not (1997, p. 295). Norris et al. (2008) develop a theory of community resilience. They identify four elements of adaptive resilient communities: economic development, social capital, information and communication, and community competence (p. 136). They define social capital as “sense of community, place attachment, and citizen participation” (p. 139). They suggest communities improve their resilience by increasing social capital, community level planning, and adaptation. Sherrieb, Norris and Galea (2010) went on to adopt the community resilience model developed by Norris et al. to study resilience in eighty-two

counties in Mississippi. They use secondary data as well as a survey to test two of the aspects of resilience in the model: social capital and economic development (p. 233). They measure aspects of social capital and economic development to create a resilience index for each county. To study economic development, they used secondary economic data at the county level, and to study social capital, they ask questions about social support, social participation, and community bonds. Researchers can employ their methods to study the capacity of community resilience in other counties throughout the country. Still, social capital and economic development may not be the only characteristics that contribute to community resilience.

Some scholars find it useful to look at resilience as an amalgam of multiple characteristics. A workshop conducted by the Resilient America Roundtable of the National Academies (2015) in Washington D.C. asserts that in order to make decisions involving community resilience, a locality can make use of the indicators of vulnerable populations, critical and environmental infrastructure, social factors, and built infrastructure (p. 23). Therefore, resilience emerges from both the social and the built environment. Kerner and Thomas sort the attributes of resilience into three categories: stability, readiness and adaptive capacity (2014, p. 682). These three categories can include social and physical characteristics, as well as the ability to be resilient in the future.

Although scholars created definitions and characteristics of resilience, there is still an opportunity for research that explains how to operationalize it. In addition, the term can be overused, such that the essence of the word no longer has any meaning. Contemporary literature is more focused on defining resilience than enumerating ways to create it, and “even though there seems to be an ostensible agreement that resilience can serve as a useful

concept, it is still far from being a tool that can be used by the people who need it” (Elran, 2012, p. 13-14). Bara points out that “the current trend in policy and academia seems to go towards operationalizing resilience to translate the concept into practice,” and a few academics have begun the journey to operationalization (2012, p. 230).

The increasing effects of climate change may affect resilience and vulnerability more strongly than in the past. Climate change may make vulnerabilities more pronounced, or make the various characteristics of resilience in a community weaker. With increasing climate change, rising water levels, and increasing inequality among populations, it may be that resilience is not enough to protect communities from disasters. In order to survive, communities may have to learn how to adapt.

### *Adaptation*

Adaptation, as opposed to mitigation, often refers specifically to changes at the community level. Furthermore, as Susskind points out, “mitigation (i.e. risk reduction) and adaptation (i.e. risk management) are not at odds, even though some people think they are” (2010, p. 6). According to Norris et al., adaptation refers to “‘population wellness,’ a high prevalence of wellness in the community, defined as high and non-disparate levels of mental and behavioral health, role functioning, and quality of life in constituent populations” (2008, p. 133). Adaptation exists somewhere outside of the traditional disaster cycle of mitigation, preparedness, response and recovery, as it does not fit inside any one piece of the cycle, rather, it takes place during all of them. Adaptation can also refer to mitigation measures accomplished at the community level, without outside support (Kleim, 2008). Communities living in hazardous areas that are more vulnerable to risks may have to learn to manage those



risks as the climate changes, and these communities may have to adapt to climate change using new methods. Scholars explore the many facets of adaptation, including changing climate, ability to adapt, planning for adaptation, and social networks.

Some scholars examine the effects of climate change in urban areas. Huq, Kovats, Reid and Satterthwaite (2007) explore the issue of climate change and how it will affect the world's cities in the coming years. They explain that "the lives and livelihoods of hundreds of millions of people will be affected by what is done (or not done) in cities with regard to climate change over the next 5–10 years" (p. 3). They further explain that climate change will increase instances of severe weather, especially in areas already susceptible to such instances, and will also increase flooding. Wilk, Hjerpe, Jonsson, Andre and Glaas (2013), in a guidebook for adapting to climate change based on assessments of climate change vulnerability, describe vulnerability to climate change as a "combination of exposure, sensitivity and adaptive capacity or ability to manage climate change" (2013, p. 14). Further, adaptation is "the process of making appropriate changes to better cope with climate uncertainties or to reduce its negative effects" (Shaw & Sharma, 2011, p. 18). Therefore, adaptation is a method that localities can rely on to adjust to changes in climate.

The Economics of Climate Adaptation Working Group, after working with local governments and community members in 8 different areas facing climate change throughout the world to develop a framework for adapting to climate change, find that although communities in at risk locations can adopt tools to prepare for climate change, it will be costly. This expense could prevent localities from adequately preparing for climate change. There are ways localities can prepare to adapt to climate change that can boost those localities' economies. According to the group, "decision-makers need a robust yet rapid way

to identify the adaptation measures required in the near-term to avert the greatest possible loss at the lowest possible cost to society” (Economics of Climate Adaptation Working Group, 2009, p. 16).

Like the term resilience, the term adaptation can consist of multiple characteristics. Fankhauser, Smith and Tol (1999), in an analytical paper that examines how communities can adapt to climate change, claim that adaptations to climate change may include improving in resilience and flexibility, refining information, and redesigning infrastructure. Resilience, risk information, and the built form are all related to the urban planning field. Therefore, in order to prepare for climate change, communities can utilize adaptation planning.

Adaptation planning involves understanding the capacity a locality has to adapt. Kerner and Thomas define adaptive capacity as having the characteristics of response diversity, collaborative capacity, connectivity, abundance/reserves, and learning capacity (2014, p. 682). These characteristics can include both physical adaptations, such as wetland restoration, and social adaptations, such as improving the local economy.

### ***Physical Adaptation***

As climate change continues, sea level rise and more extreme weather events will impact vulnerable areas. These areas can adapt to climate change by being more prepared for flooding, high winds, extreme temperatures and even drought. Physical adaptation measures, like hazard mitigation measures, can be structural or nonstructural, but unlike hazard mitigation measures, are often accomplished at the local level.

Urban planning strategies use adaptation planning to alter localities to coexist with the physical environment. Susskind (2010), in an article that reviews methods of adaptation

planning, points out that mitigation plans are more effective when they focus on adaptation, or “how to reduce the destructiveness of the impacts likely to occur”, rather than mitigation (2010, p. 3). He calls this process adaptation planning, and suggests that this type of planning be action-oriented, adaptive, strategic, and broadly supported (p. 5). Still, adaptation planning may have the same issues as hazard mitigation planning, in that it is difficult to get communities to participate, as the affected populations may not be at the table, or officials may not communicate risks effectively.

A few scholars study the process of adaptation planning and its successes and downfalls. Mukheiber and Ziervogel explore how to implement a municipal approach to climate change using the city of Cape Town, South Africa as a case study. They point out that “to date there has not been a consolidated or coordinated approach to adaptation to projected climate impacts on a municipal scale” (2007, p. 144). They assert that it may be more effective to deal with climate change on the city level, as planners can “prioritize the most urgent local adaptation activities and identify the required local human and financial resources” (2007, p. 148). They list ten steps to making a municipal adaptation plan: assess climate change, assess vulnerabilities, review and map development plans, make adaptation options and prioritize areas, make the plan, then implement, review and evaluate the adaptations (p. 146-147). They also emphasize the importance of consulting local stakeholders, as well as climate change experts, in order to successfully create adaptation measures (p. 148). These findings could be a successful way to adapt to climate change; but they still can suffer the pitfalls and inefficiencies often found in other urban planning strategies.

Other scholars look at adaptation to climate change at a more local scale, examining adaptation at the community level. De Sherbinin, Schiller and Plusipher (2007) study vulnerability to climate change using three case studies: Mumbai, Rio de Janeiro and Shanghai. They combine top down vulnerability assessments with bottom up vulnerability to map the overall vulnerability in the three cities by collecting data on predicted climate change, socioeconomic status, the physical environment, infrastructure and social capital. They find that adaptation requires resources that are politically difficult to procure, the rich do not have as much of a stake in adaptation measures as the poor do, and adaptation plans need long term investments, which are also politically difficult (p. 61). The most effective adaptation plans involve extensive resources, particularly for low-income populations, and long term planning.

Beyond resources and planning longevity, adaptation planning can also include structural and nonstructural measures. Alam and Rabbani (2007) explore the effects of climate change on Dhaka, the capital city of Bangladesh, in order to understand structural adaptations to climate change. They review the flood events and rainfall patterns and trends in the city, in order to understand how weather patterns will continue to change in the future. They also examined present vehicle emissions, and how greenhouse gases will contribute to the heat index of the city. Both the rainfall patterns and the heat index will have an affect on the climate of the city in the future. Alam and Rabbani further study already implemented governmental policies to understand how the city has adapted to climate change thus far. They find that the city has instituted many structural solutions to flooding, such as floodwalls to keep water out and pumping stations to remove excess water in the city. Alam and Rabbani go on to explain that “spatial planning for unbuilt areas of Dhaka should incorporate

aspects of climate change,” as the changing weather patterns and vehicle emissions will continue to change the climate in the city (p. 96). Therefore, when considering the height of floodwalls and other flood prevention measures, cities can adapt more effectively by using climate change forecasting

Climate change will have an impact on large areas of coastal cities in multiple ways. Doussou and Glehouenou-Doussou (2007) examined the effects of sea level rise using Cotonou, a large West African city, as a case study. After analyzing the physical and social vulnerability of the city, they assert that one-tenth of the population of the city will be directly impacted by characteristics of climate change, including rising sea levels, changes in rainfall, higher temperatures, and coastal erosion. Climate change such as rising sea levels in coastal locations can be alleviated through nonstructural adaptation strategies.

Some nonstructural adaptation strategies solely focus on land use and water management. Muller (2007) explores water management strategies in Sub Saharan Africa in light of climate change by looking at historic rainfall patterns and applying them to climate change predictions. He examines how predicted future rainfall would coexist with predicted population growth, and what changes in water management policies would result in adequate water for each community. He finds that, while difficult to predict, “climate change is a slow-onset disaster that offers communities and nations time to adapt” (p. 111). He further finds that while costly, moving from mitigation to adaptation strategies is the most effective way to respond to climate change, because mitigation strategies are even more expensive than adaptation strategies (p. 111). He explains that nonstructural measures, like land use planning, can help to reduce vulnerability to natural disasters if floodplain managers receive

the correct information about flooding, and how it will increase as the climate changes (p. 102).

Communities can plan for climate change using adaptation planning. Adaptation planning includes physical adaptations, such as levees or relocation, and localities can implement these strategies at the municipal or local level. Communities can also implement adaptation strategies over the long term, and take sea level rise, weather, and heat into account. There are additional strategies that involve adaptation in the social realm.

### ***Social Adaptation***

Social adaptations can also help communities adjust to climate change. These adaptations can include improved social networks (Smith, Anderson & Moore, 2012). More effective risk communication can help communities adapt socially as well (Wamsler, 2007). Finally, resettlement is the most extreme social and physical adaptation, wherein the community completely leaves the vulnerable area (McGranahan, Balk & Anderson, 2007).

The ability to adapt socially often stems from the strength of social networks. Smith, Anderson and Moore (2012) measure social capital and place-based factors in Appalachian communities, in order to find the correlation between social capital and place and the ability to adapt to climate change. As climate change has not yet had a large impact on the community, the study was an exploratory one based on adaptation ability, rather than adaptation that had already occurred. The researchers, after conducting interviews and collecting data in three different resource dependent communities, find that accessible social capital, as well as factors of individual, family, and community identity, self-efficacy and self-expression, and economic and ecological meaning all contributed to the knowledge of

climate change and changing environmental circumstances (p. 386). They further claim that “by gaining a clearer understanding of how social capital and place-based social-psychological dependencies affect individuals’ perceived ability to adapt to changing environmental conditions, community leaders and policymakers at various levels of authority will be better equipped to help foster a sustainable ecological and social future” (p. 402-403). This study only focuses on the ability to understand the need to adapt, and does not look at the process of adaptation to climate change.

Scholars study the ability to adapt at all income levels. Wamsler (2007) researches disaster risk management in El Salvador by examining case studies of slum dwellers and aid organizations at the household and institutional level, using interviews, workshops, and a literature review. She finds that most households acted individually when responding to risks, rather than depending on social support or communicated information (p. 140). She explains that there is a disconnect between the urban poor and institutions that could help them, (p. 141).

There are also social adaptations that are specific to the coastal environment, particularly coastal Louisiana. Burley (2010) investigates attachment to place in coastal Louisiana through a series of interviews in coastal communities, and claims that coastal communities experiencing climate change often point to land loss as a major issue. The loss of the land in their community results in a loss of identity, as they are personally attached to the land that they reside on.

According to Gonzales, Kaswan, Verchick, Huang, Bowen and Jamhour (2016), in a study on nonstructural adaptation which included a review of peer reviewed literature and interviews with community members, sense of place and connections with people make it

difficult for residents to leave their communities. This is especially true in coastal Louisiana, where many communities live in the same place for centuries, living off of the land and water. According to the authors, “the loss of the extended family network would be traumatic, and individuals may not consider relocating without a plan to do so with their entire family” (Gonzales et al., 2016, p. 57). The land loss in these areas often forces residents to leave, regardless of their attachment to people and place.

Nonstructural mitigation can help counteract the effects of land loss. Broome, Dubinin and Jenkins (2015) interview officials throughout coastal Louisiana in order to discover the ideas, best practices, challenges and needs for nonstructural mitigation in those areas, when designing a report on nonstructural mitigation strategies in coastal Louisiana. They find that the hazardous conditions in coastal Louisiana cause many residents to migrate away from the coast, and the most popular nonstructural mitigation tactic is elevation. The report mentions there are many more nonstructural adaptations that communities could adopt, but officials and community members are often uninformed, or do not have the resources necessary to implement the measures. In addition, communities can implement both short term and long-term mitigation measures, such as elevating or relocating, but there are not always opportunities to do either. The report explains that “residents have begun slowly moving out of the most southern coastal areas, leaving communities in those areas to struggle for their existence” (Broome, Dubinin & Jenkins, 2015, p. 39). The officials in these coastal areas witness their cities and towns shrinking, and their populations getting smaller and smaller. Further, Jenkins (2016) finds in a study of residents from three coastal Louisiana parishes about nonstructural measures that many residents have already relocated to safer parts of their parishes, starting before Hurricane Katrina. The natural and manmade disasters



of the last decade increased this relocation, leaving many coastal areas almost empty and without necessary services (Jenkins, 2016, p. 33; Plyer, Warren & Bonaguro, 2007).

Other studies find that residents do not want to move away from their coastal environments, no matter how precarious. Burley, Jenkins, Darlington and Azcona (2005) examined responses to land loss in Grand Isle using a phenomenological approach, and explain that “environments, both built and natural, are socially constructed places” (p. 3). Interviewing 30 residents in Grand Isle over a period of several months, the researchers discover that the residents feel unique because of their hazardous location, and feel more attached to that location because of its precarious aspects. This attachment increases their need to stay put, despite coastal erosion and extreme weather events. Despite this attachment, the population of the island is steadily decreasing. In 2000, the population was 1,541; it was 1,296 in 2010, and 1,002 in 2014 (U.S. Census Bureau, 2000, 2010, 2014). Attachment to place may not be a match for increasing environmental vulnerability.

Whyte (2014), after interviewing indigenous women about the subject of climate change and its effects, finds that policy exacerbates the effects of climate change for indigenous communities because indigenous communities do not often have the opportunity to participate in policy decisions. Still, indigenous communities strive to protect the resources that are affected by climate change without participating in policy decisions. My study will show how both climate change and the policy decisions made to combat climate change will affect the adaptive capacity of an indigenous culture. Whyte also claims that indigenous cultures have “persisting responsibilities,” which include the environmental stewardship essential to their culture, but also “emerging responsibilities,” which include responding and adapting to climate change (Whyte, 2014, p. 607). Because of this sense of environmental

responsibility, indigenous women are compelled to devise ways to adapt to changes in climate (Whyte, 2014, p. 612).

The most extreme form of social and physical adaptation is relocating to a new physical and social environment. This response may become more necessary as sea levels continue to rise.

### ***Relocation***

Overdevelopment and urbanization create vulnerable environments across the globe. Adaptation to these vulnerable environments may be a solution, and relocation is an extreme form of adaptation. This relocation is often forced based on environmental pressures. Campbell defines forced relocation as a situation “in which the land, livelihood, and habitat security have been so compromised by climate-change effects that sustained habitation is rendered impossible” (2014, p. 22). As the climate changes, communities in extremely physically and socially vulnerable locations will have to adapt, or relocate altogether. In other words, some communities may have to relocate to less vulnerable areas in order to escape from environmental disaster.

From Native American tribes escaping hazardous environments for thousands of years, to residents recently moving inland as sea-level rise, oil and gas exploration, and other environmental and anthropogenic induced changes make living in coastal locations untenable, relocation is an adaptation measure employed more and more in Southeast Louisiana. According to Dalbom, Hemmerling and Lewis “the ‘relocation’ of individuals in Southeast Louisiana is inevitable” (2014, p. 4). They examine legal tools for relocation, cases of resettlement in Louisiana, and the demographics of communities that may face relocation.

They find that communities in Southeast Louisiana historically resettled due to hurricanes, storm surge, and infrastructure projects. They further explain that, “social vulnerability involves the relative ability of an individual, household, or community to respond appropriately to changing environmental conditions,” particularly when it comes to relocation (Dalbom, Hemmerling & Lewis, 2014, p. 4). These socially vulnerable communities often cannot afford to relocate, and simultaneously cannot afford to mitigate their risks through insurance, elevation, or other mitigation measures. They further find that “much of the at-risk Native American populations reside in the small rural communities found south of Houma,” and this increases their exposure to hazards and risks (Dalbom, Hemmerling & Lewis, 2014, p. 34). The towns south of Houma, Louisiana, including Dulac, Chauvin and Pointe aux Chenes, are located in largely rural areas with fragmenting land. The area south of Houma is a part of southeast Louisiana, which is currently experiencing one of the highest rates of relative sea level rise in the world.

Relative sea level rise is a byproduct of climate change. According to Wheeler, Randolph and London, “in many cases, relocation may be the least cost option under long-term climate change conditions” (2000, p. 218). And, relocation may not coincide with theories of community resilience. Attachment to place is a facet of community resilience, which is taken away when a community relocates. In a study of the relocation of an indigenous community in Indonesia, Adam (2008) finds that relocation resulted in alienation, as community members felt alienated from their homeland. And, according to Campbell, “relocation may be considered the most extreme form of climate migration and is considered by many to be a last-resort adaptation option” (2014, p. 11).

This last-resort option may be necessary for coastal communities affected by climate change. Bronen (2008) calls relocation as a result of the sea level rise caused by climate change “climigration,” and underlines the need to prepare for migrations of this type in the coming future. She explains that many indigenous communities in Alaska are preparing to relocate, or have already relocated, as a result of extreme weather events (Bronen, 2014). This process has been difficult, as there historically has been little governmental funding and few established policies available for complete community relocation (Bronen & Chapin, 2013).

Communities have had to relocate due to extreme weather in the past. Perry and Lindell performed a case study on the community of Allenville, Arizona. The community relocated because of frequent severe flooding (Perry and Lindell, 1997, p. 51). The Army Corps of Engineers assisted in the relocation, and most of the residents relocated together. Thus, because the community had governmental support, and retained its social networks, the relocation was ultimately successful.

The case was different for a community in Great Britain that relocated because of contamination. Speller and Tigger-Ross found that although the community moved together, from Old Awkright, which was a more communally designed community, to New Awkright, which had a more isolated housing scheme, some community members lost their self-efficacy and social continuity as a result of the change in location (2009, p. 366). Even though the community stayed together, the spatial and architectural changes were difficult for some of the community members. The change in building form altered the way the community members socialized, weakening their social networks. The community was the

same, but the layout of the community was different, changing the social connections between community members.

Still, there are communities in vulnerable situations that may be able to bounce back. Campbell, in a study that looks at climate change in the Pacific Islands, points out that although the communities are in a vulnerable situation, they are actually quite resilient (2014, p. 7). They are resilient because they are thriving in an isolated location without outside aid. In addition, many communities in vulnerable situations are attached to their physical location, and their physical environment is integrated with their social lives.

### ***Summary***

Climate change contributes to increase hazards and disasters, particularly in coastal locations. As a slow-moving, long-term disaster, climate change is a byproduct of natural hazards. Like other disasters, climate change impacts people and the environment in disproportional ways. Communities in socially and physically vulnerable situations experience the natural hazards and disasters from climate change more than communities in less vulnerable situations, and these communities are often the locations where entities focus their hazard mitigation planning efforts. Like hazards and disasters, hazard mitigation planning policies affect vulnerable communities disproportionately as well. There are planning mechanisms available to reduce risk to hazards, but they are not always successful.

Vulnerable communities can also have inherent resilience that helps them to adapt physically and socially to hazards, disasters and planning policy. Beyond planning, communities can access resilience, as well as adaptive capacity, to protect themselves from hazards and disasters. This can include harnessing the local knowledge of risk management,

or accessing social networks to respond and prepare for disaster. Residents of coastal locations adapt both physically and socially to hazardous environments. In order to stay in a place so threatened by environmental hazards, these residents raise their homes, move up the bayou, or simply stay put and hope for the best, refusing to leave the unique environment that has become a part of their lives. Extreme changes in the environment can result in extreme adaptations, such as relocation of coastal communities as the effects of climate change get more extreme. Understanding adaptation methods will help coastal communities continue to adapt to hazardous conditions in the future. In addition, empowering coastal communities to contribute local knowledge to planning policy can increase the effectiveness of policy implementation. The next chapter discusses the testing of adaptive capacity in the face of climate change and mitigation policy implemented to combat climate change using a case study of the Pointe-au-Chien Indian Tribe.

### **Chapter 3: Research Design – Testing Adaptive Capacity in the Face of Climate Change**

This chapter delves into the qualitative methods used in this study and the type of data that was collected for the study. The chapter also deals with issues of reliability and validity in the study and the methods used to analyze the data. In addition, the chapter explores how researchers could conduct the study using quantitative methods. Finally, the chapter explains the limitations of the study, and details the original research project that inspired the case study.

#### ***Qualitative Research***

This study uses qualitative research, specifically a single instrumental case study, including field research, interviews, focus groups, and other data to help to answer my research questions related to adaptive capacity. Qualitative research utilizes multiple sources of data, such as interviews, focus groups, content review, and observations, in order to find the common themes in the data. This method of data collection focuses on finding patterns and meanings in the data, rather than using mathematical or statistical methods. Analyzing the data for emerging themes and meaning allows for a comprehensive analysis that uses both deductive and inductive reasoning to detail the significant themes found in the data. Quantitative research, such as surveys, can produce more numerical data, but short surveys do not provide the rich narrative that qualitative research and in-depth case studies contain. For this study, qualitative research was a more effective way of telling the story of the tribe.

### ***Case Study***

The qualitative method utilized in this study is a single instrumental case study (Yin, 2009; Creswell, 2012). A single instrumental case study makes use of one single case to study one single issue. An effective case study has a defined case and uses multiple sources of data, but a single instrumental case study can be challenging, as there are no other cases to compare it to (Creswell, 2012). The case study includes interviews, focus groups and field observations. All of these methods help to discover codes and themes in the data. In this case study, I studied a coastal Native American community in southeast Louisiana, specifically, the Pointe-au-Chien Indian Tribe. The tribe is physically vulnerable, as it is located in an area with one of the highest rates of relative sea level rise in the world, and it is socially vulnerable, as it is not a federally recognized tribe and is often not included in planning and policy decisions. The tribe is conversely physically resilient, as they have adapted to their situation by moving up the bayou, elevating their homes, and continuing to live off of the land and water. Additionally, the tribe is socially resilient, as they have strong social networks and connectedness because of their kinship networks and ancestral history. This dichotomy between vulnerability and resiliency makes the tribe a unique case study, but also one that can apply to other coastal communities dealing with relative sea level rise or other types of climate change. By studying the Pointe-au-Chien Indian Tribe, I was able to document how the community adapts to the hazards and disasters in their changing environment, how they respond to the land loss and sea level rise in their community, and how they respond to the policy measures implemented to combat changes in their local environment.



### *Qualitative Methods*

The methods used in the study were semi-structured interviews, focus groups, and participant observation (Creswell, 2009; Creswell, 2012). The interviews involved face to face discussions with the participants in the study, while the focus groups included discussions with 4 to 8 participants (Creswell, 2009). Both discussions were semi-structured. The interviewer had a general idea of the themes the discussion should touch on, but allowed the discussion to occur organically. The interviews and focus groups were conducted between July 2012 and May 2016.

### *Field Research/Observations*

I conducted field research and observations as both a participant and a non-participant. I was present for half of the interviews and focus groups, while I transcribed and coded all of the interviews and focus groups. Researchers can code both participant and non-participant observations to come to conclusions about the data. I also took photographs and notes during the field research in order to further document the area and underline the points that the participants made.

### *Interviews*

The interviews conducted in this study were semi-structured, and followed an organic flow of conversation, rather than relying on a list of specific questions. The main themes of the conversation centered on the changes in the environment, and the planning ideas each participant had for mitigating and adapting to these changes.

### *Focus Groups*

Focus groups, like interviews, can also be structured or semi-structured. In addition, they are equally effective through giving the investigator supervision over the questions and answers, while allowing them to observe the participants (Creswell, 2009). Through focus groups, participants can provide information about their lives, their community, and their history, and share ideas with other members of the focus group. This allows for a more robust answer to the questions, as it is a group response. Similar to the interviews, the focus group conversations focused on environmental changes and the responses to those changes, but also provided time for the participants to comment on the data collected thus far, and any changes that needed to be made. The focus groups also allowed the participants to voice their concerns on other issues related to environmental change, such as policy decisions, tribal planning efforts, and tribal relationships.

### **Project Origins**

This project is a part of a grant funded through National Oceanic and Atmospheric Administration's (NOAA) Gulf of Mexico Coastal Resilience Networks Program under Cooperative Agreement NA10OAR4170078 with the University of Southern Mississippi (USM), and the Mississippi-Alabama Sea Grant Consortium (MASGC), with additional funding and support provided by Louisiana Sea Grant. The project, entitled "Determining localized risk perception and impacts of predicted sea level rise to enhance stakeholder mitigation planning through visualization tools," is a collaborative project between remote sensing and GIS experts, planners and sociologists, and coastal residents. Because the project is collaborative, and is a combined planning process with scientists and local experts, rather

than one that treats the local experts like research subjects, it is exempted from the Institutional Review Board process. The goal of the project is to make use of the residents' traditional ecological knowledge (TEK) to map vulnerabilities and sustainabilities in their environment, so that they can plan for hazards in the future (Bethel, Brien, Esposito, Miller, Buras, Laska, Philippe, Peterson & Richards, 2014). According to Bethel et al. (2014), Sci-TEK is "the technique of blending geospatial technology and traditional science with TEK" (2014, p. 1083).

The goal of the sea level rise study was to collaborate with the tribe to identify vulnerability and sustainability factors in their community, and to map those factors to help the tribe plan for mitigation in the present and adaptation in the future. The project uses the Sci-TEK method, developed by Bethel et al. (2014). This method combines Remote Sensing, science-based datasets, Geographic Information Systems, and local traditional ecological knowledge (TEK) to produce maps to aid in adaptation planning (Bethel et al., 2014). The local TEK stems from interviews with stakeholders in the community. The project team consisted of a Remote Sensing expert, a Geographic Information Systems expert, and a social science expert. The TEK experts included four tribal members identified as experts in environmental change. The project team recorded these four interviews, and coded them for themes, then grouped the themes into vulnerability and sustainability factors for mapping purposes.

As the social scientist on the team, I participated in, transcribed and coded the interviews. I then worked with the physical scientists to create maps that reflected the codes identified in the interviews. The team designed the maps from the inductive codes that emerged from the interviews. The project team is working to map all of the factors to bring

to a tribal planning meeting and get feedback on the maps, and to further facilitate adaptation planning for the tribe. The maps are included in the discussion in the next chapter as images of the themes identified by the tribal members.

The project team also plans to facilitate a community mapping workshop with the tribe, which will utilize public participation geographic information systems (PPGIS) exercises. The participants will use weTable technology, developed by Texas Sea Grant and used by Louisiana Sea Grant, to interact with the maps. The weTable, based on the Nintendo Wii gaming platform, provides opportunities for individuals and organizations to share data, seek input, and support informed decision-making. The technology projects computerized images onto a flat surface so that participants can visualize, interact and provide feedback on the maps. This will allow the tribe to better visualize and make plans for their future adaptation and mitigation strategies.

I used the data from the study, including the interviews, focus groups, observations, and planning meeting to examine the adaptive capacity of the tribe, extending the initial questions of the study to look for both physical and social adaptation. I used the participants' responses concerning land loss, sea level rise, and mitigation measures to understand their adaptive capacity in the face of climate change and mitigation measures implemented to combat climate change. This examination was used to make recommendations on how the community, and other coastal communities, can adapt in the future.

## **Data**

The tribe identified four members of the Pointe-au-Chien Indian Tribe that they considered to be local experts on the climate change affecting their community. This

knowledge stems from their lifelong use of the local ecosystem, as well as the knowledge passed down from previous tribal generations. The team asked the experts if they were interested in contributing to a collaborative project exploring sea level rise and coastal hazard mitigation and adaptation strategies in their community. The experts were middle-aged and older members of the community, who had lived in the area their entire lives. These experts lived off of the land and the water throughout this time, working as local fishermen.

The interviews conducted included four extensive interviews and four follow up interviews to check the accuracy of the data. The initial interviews were approximately five hours long, and were coupled with the field observations. Each interview took place in the Pointe aux Chenes area, with the majority of the interview conducted on a boat, while the participants pointed out important environmental issues, such as areas of cultural relevance, extreme land loss, and ideas for restoration.

The project team also conducted three focus groups with members of the community. The three one hour focus groups conducted in this study were semi-structured, and followed an organic flow of conversation, rather than relying on a list of specific questions. The first focus group was comprised of four people, and included an identified expert and members of his immediate family, the second focus group included the six attendees of a tribal council meeting, and the third focus group included five members of the tribe's federal recognition committee. The tribal council and federal recognition committee includes members of the tribe of many ages, from late twenties to eighties, and both genders. Many members of the tribe make a living as fishermen, or within the community, as schoolteachers and community advocates. Others have moved further up the bayou, and live and work closer to Houma, which is twenty miles north of Pointe aux Chenes.

The questions in the interviews and focus groups touched on the variables in the adaptive capacity metric. These variables include response diversity, collaborative capacity, connectivity, abundance/reserves, and learning capacity (Kerner & Thomas, 2014). Kerner and Thomas define response diversity as “the variety and disparity of steps, measures, and functions by which an operation can carry out a task or achieve a mission” (2014, p. 681). In order to understand the diversity of their response, the team talked to the community members about evacuation, hurricane preparedness, house elevation, and mitigation projects such as marsh restoration and levees. According to Kerner and Thomas, collaborative capacity is “the capacity to act through coordinated engagement” (2014, p. 681). To understand collaborative capacity, the team talked to the community members about their level of association inside and outside of the community, such as the availability and frequency of tribal meetings, participation in community meetings in the parish, knowledge of state level coastal planning, and obtaining federal recognition. Connectivity is defined as “how readily resources and information can be exchanged to ensure continued functionality” (Kerner & Thomas, 2014, p. 681). To understand connectivity, the team talked to the community members about their kinship networks and historical ancestry. Kerner and Thomas describe abundance/reserves as “the on-hand resource stores (capital) upon which a system can rely when responding to stress” (2014, p. 681). To understand the community’s resources, the team talked to the community members about their vocation and reliance on the ecosystem. Finally, Kerner and Thomas explain learning capacity as “the ability to acquire, through training, experience, or observation, the knowledge, skills, and capabilities needed to ensure system functionality” (2014, p. 681). To understand learning capacity, the team talked to the community members questions about how they have adapted to sea level

rise and climate change thus far (see Appendix A for a list of interview and focus group questions).

The participant observation included observing the tribe members at home and at work, and at member check meetings conducted with the research project team. At the member check meetings, the project team shared the maps and codes created from the collective data. The participants provided feedback on the maps, codes and themes, identifying areas that needed clarification. The team then used this feedback to further revise the themes and maps. I recorded field notes at each of these sites, during, before and after interviews, and while participating in the discussions (Creswell, 2009). The interviews, focus groups and member check meetings resulted in over 24 hours of data and over 250 pages of transcript.

### **Validity and Reliability**

Throughout the study, I addressed issues of validity and reliability. Qualitative validity involves ensuring the accuracy of findings, while reliability means the research approach was consistent (Creswell, 2009). In order to ensure that the study was valid, I conducted member check meetings with members of the community after analyzing my research, in order to ensure the conclusions I came to were accurate (Babbie, 2007), and used consistent methodology throughout the study (Creswell, 2009). In order to make sure the study was reliable, I conducted an intercoder reliability assessment, wherein an independent researcher was given my codebook and asked to randomly code 20 lines of text. If the researcher codes the text similarly, then the data are reliable. I then linked the case study to the literature, in order to embed my findings into a theory (Babbie, 2007). After the analyzing

the themes, I compared the characteristics of adaptive capacity identified from the community to the characteristics inherent in the metric outlined by Kerner and Thomas (2014). This comparison helped to show how the hypothesized variables diversity of response, ability to collaborate, connectivity, resources, and ability to learn, will be affected by climate change. By analyzing this data, this study determined how climate change, and policy responses to climate change, will affect the tribe's adaptive capacity.

### **Data Analysis**

I analyzed the data by coding the individual interviews and focus groups and then identifying the themes within them. I noted and transcribed the data from the interviews and focus groups. I coded the transcriptions using inductive and deductive categories, and coded the participant observations as well. According to Creswell, an effective case study identifies themes and meaning, and then organizes them into a narrative (2012, Loc 2141). The interviews and focus groups were coded using Dedoose software. The software aids researchers in using systematic methods to code text. It also provides analytical tables and charts, such as code clouds and tables of the number of codes by interview subject. These analytical tools help to synthesize the data when coming to conclusions about the findings. Coding the transcripts, observations and data analyses helped to identify the themes related to adaptive capacity. Once I identified the themes in each data collection method used, I analyzed all of the themes for the themes common to all using Saldana's method of parent and child codes to deconstruct and summarize the themes common to all (Saldana, 2012). The deductive codes were the parent codes, while the inductive codes, the codes that emerged from the data, were the child codes. I placed each inductive code under each



deductive code in order to understand how the data fit with the adaptive capacity variables. I then organized the themes common to all into a narrative explaining the effects climate change had on the tribe's adaptive capacity.

### **Limitations**

This study has limitations related to qualitative design. First, this study is a single instrumental case study. Since this study is one case study, there are no other cases to compare the community to within the study. Nonetheless, according to Creswell, single instrumental case studies are effective if they use comprehensive data collection with multiple sources (2012, Loc 2124). This study utilized interviews, focus groups, and participant observation in order to comprehensively analyze the data. Interviews and focus groups rely on data that is skewed by participant experience, and participants may alter their answers because of the presence of the researcher (Creswell, 2009). Further, the researcher may skew the participant observations, or the participants may view the observations as an invasion of privacy (Creswell, 2009). Gaining entrée with the participants through other community members and being explicit about the research helped lessen the impact of these limitations. Additionally, conducting member checks throughout the research process helped ensure the data collected was accurate and representative of the experiences relayed by the study participants. The team revealed the data collected to the study participants at stages throughout the research project, and finalized and presented the results to the community for final feedback and analysis.

The study also has limitations related to setting. The particular coastal community in the study is one tied to their location through both the ecosystem and their ancestry. The

findings in this case study may apply more to indigenous coastal communities that are ecosystem users rather than residents that do not rely on the local ecosystem. Still, researchers can apply the adaptation methods to other coastal communities, regardless of their relationship to the land. Since the community experiences one of the highest rates of relative sea level rise in the world, this study can apply to other coastal communities that will experience sea level rise. The methods used were comprehensive, and the case study was in-depth with multiple sources. The study is applicable to other indigenous coastal communities that are intricately tied to their surrounding ecosystem in Louisiana. It could also be applied to other coastal communities made up of ecosystem users and in deltaic environments living with structural and nonstructural mitigation methods in the United States, and worldwide.

### ***Summary***

This chapter explained the qualitative methods, data and analysis used in the study, as well as an exploration of how researchers could conduct the study using quantitative methods, and the original research project that the study emerged from. The next chapter will discuss the data collected, and the common themes identified in this data.

## Chapter 4: Findings and Discussion

This chapter discusses the codes and themes evident in community adaptive capacity, using the interviews and focus groups with the Pointe-au-Chien Indian Tribe. The codes are divided into each variable under the adaptive capacity metric, in order to understand each facet of adaptive capacity. The chapter offers multiple examples of adaptation methods used by the representatives of the tribe and the representatives' local knowledge about environmental changes. The chapter further details the maps designed for the tribe's adaptation planning through the collaborative efforts of the tribe and the project team.

### *Examining Adaptive Capacity*

In order to understand the adaptive capacity of the Pointe-au-Chien Indian Tribe, I examined the variables in Kerner and Thomas's metric: response diversity, connectivity, abundance/reserves, learning capacity, and collaborative capacity. Although the tribe has all of the characteristics that comprise the adaptive capacity metric, all of the variables are threatened by the changes in the environment, and the planning and policy measures enacted to combat those changes, particularly relative sea level rise.

Table 1 lists the inductive and in vivo codes (which are codes that are made up of the exact words used by the participants) that emerged from the qualitative research, categorized under the deductive codes pulled from the adaptive capacity metric. The inductive codes related to the participants' responses to natural and manmade disaster are listed under the deductive code **response diversity**; the inductive codes related to the participants' social and environmental connectedness are listed under the deductive code **connectivity**; the inductive

codes related to the ecosystem services in the area are listed under the deductive code **abundance/reserves**; the inductive codes related to the participants’ ability to learn and create solutions for their physical vulnerabilities are listed under the deductive code **learning capacity**; and the inductive codes related to the participants’ interrelationships, as well as their relationships without outside entities, are listed under the deductive code **collaborative capacity**.

**Table 1 – Distribution by Deductive Code<sup>1</sup>**

<b>Response Diversity</b>	<b>Connectivity</b>	<b>Abundance/ Reserves</b>	<b>Learning Capacity</b>	<b>Collaborative Capacity</b>
Resident solution: buy new land	Culturally relevant sites	Environmental change	Resident solution: shoreline protection	Parish lines
Resident solution: house elevation	Lost communities	Sea level rise	Resident solution: shoreline restoration	Land ownership
Attachment to place	Levees	Accelerated sea level rise	Levees	Oil and gas industry
Relocation	Land loss	Elevation change	Spoil banks	Taking responsibility for environmental harm
Moving up the bayou	Erosion/ Subsidence	Widening canals	Resident solution: spoil banks	“Fighting to be part of the conversation”
Younger generations moving away		Increased storm surge	Cultural subsistence areas	
Lost barrier islands		Increased current	Resident solution: marsh creation	
		Levees		
		Cultural subsistence areas	Resident solution: levees	
		Loss of utility	Resident solution: rock off canals	
		Loss of trapping industry	Resident solution: barrier islands	
		Less fishing/ Shrimping		
		Leasing the land for		

<sup>1</sup> All tables created by Tara Lambeth

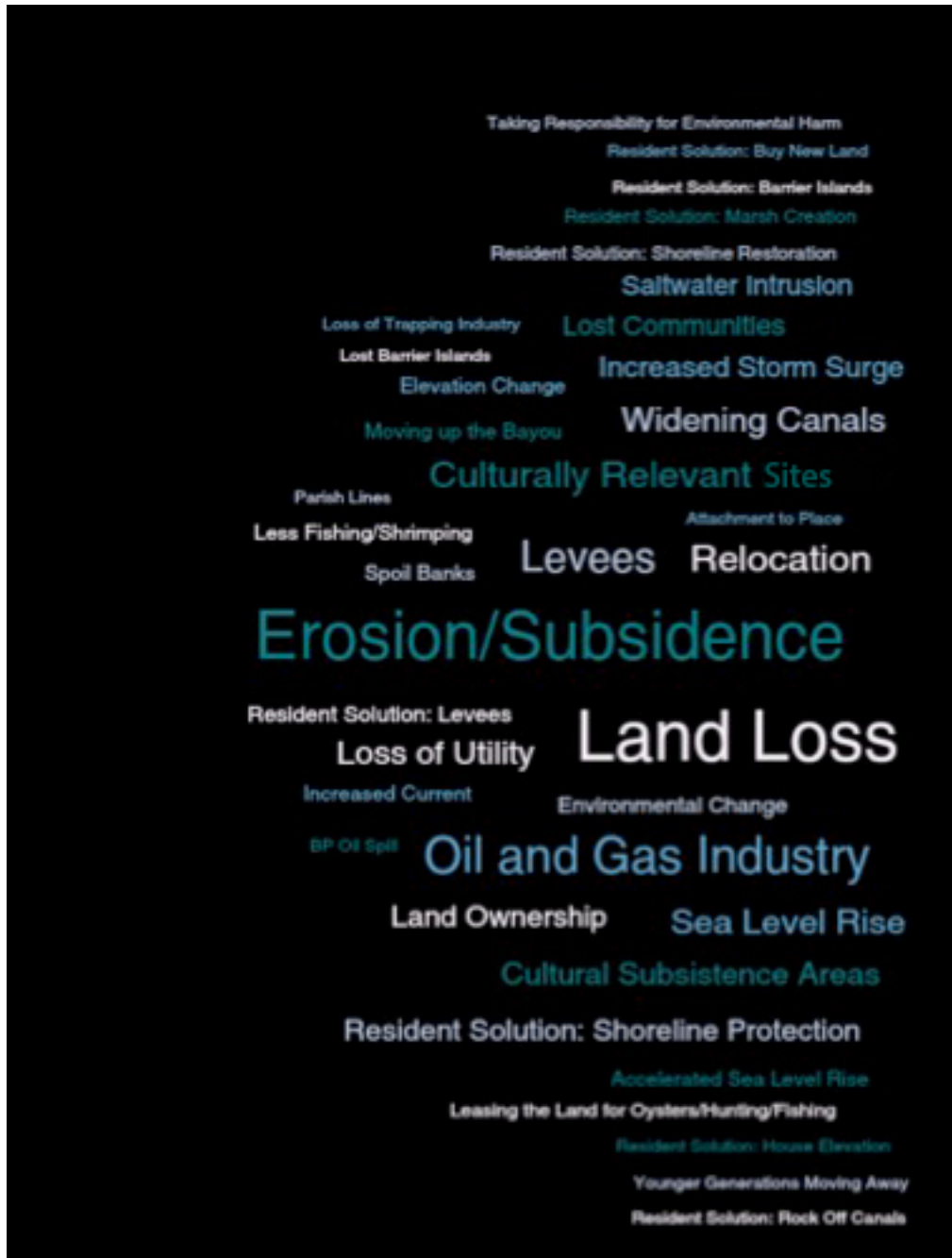
		oysters/hunting/ fishing		
		Saltwater intrusion		
		BP oil spill		

Kerner and Thomas’s definitions place the inductive codes under each deductive code. For example, the codes under response diversity pertain to methods the study participants use to respond to the hazards and disasters in their environment, such as house elevation and relocation. The codes listed under the connectivity deductive code include those that have to do with connectivity to the land, such as land loss, and connectivity to culture and community, such as lost communities. The codes placed under abundance/reserves deductive code include those that have to do with environmental change, such as widening canals and sea level rise, both of which effect the resources in the tribe’s environment. The codes listed under the learning capacity deductive code include those that detail the ways the study participants learned to adapt to their changing environment, such as building levees and rocking off canals. Finally, the codes listed under collaborative capacity include those that affect the participants’ ability to collaborate with entities outside of the community, such as the oil and gas industry and “fighting to be part of the conversation.” This chapter discusses in depth the description of the adaptive capacity coding and details each deductive code with subsequent inductive and in vivo coding.

Figure 4 reflects the codes that emerged from the qualitative research in a more visual form. The inductive codes that were the most prevalent are larger, while those that were less prevalent are smaller. The codes related to disintegration of earth, erosion/subsidence and land loss, were the most prevalent. These issues are most visible to the representatives of the tribe, and mentioned the most often. The oil and gas industry, also very visible in the tribe’s environment, was mentioned frequently. In addition, the

interviewees mentioned levees, culturally relevant sites, and cultural subsistence areas repeatedly. Levees are abundant in the area, and used as a mitigation method by the parish and state against the land loss and erosion/subsidence. In fact, the first levees were built in southeast Louisiana between 1718 and 1727 (Rogers, 2016). In addition, Terrebonne Parish has been working on the Morganza to the Gulf levee since 2008. While it is not complete yet, it will eventually extend across the southern portion of the parish. Currently, the constructed portions of the levee are 10 feet tall, but the parish will build it higher as funding becomes available. Members of the tribe have constructed smaller levees to protect their community as well. However, levees do not always protect the the tribe's culturally relevant sites or cultural subsistence areas, threatening the tribe's way of life and connection to their culture. In fact, the Morganza to the Gulf project excludes most of the tribe's cultural and subsistence sites. Figure 4 reveals the tension between the tribe and their physically vulnerable environment. Code clouds are a visual way to reveal the codes that emerge from qualitative data. The clouds show the codes that were more prevalent in the data in a larger font, while the codes less prevalent are depicted in a smaller font. These code clouds make it easy to see and understand the main themes in the data without looking at a table of numerical data.

Figure 4 - Code Cloud



Source: Dedoose

Table 2 lists the inductive code application by interviewee in a different way. The number of times an interviewee mentioned each code is listed under each interviewee (labeled 1, 2, 3 and 4 for anonymity), and the total times each code occurred is listed under the totals column. Again, this shows the prevalence of the land loss and erosion/subsidence

codes, as well as the frequent references to the oil and gas industry. Although the interviewees mentioned some environmental changes less often, such as the BP oil spill, the loss of the trapping industry, lost barrier islands, and younger generations moving away, the conglomeration of these changes show the variety of ways the tribal members experience the changes in their environment. The study participants mentioned the more extreme environmental changes, such as sea level rise and widening canals, more often. The interviewees detailed various ways to respond to the changes in their environment, with levees and relocation mentioned the most, but other options, such as shoreline restoration, mentioned as well. Table 2 not only emphasizes the important aspects in the tribe's environment, such as culturally relevant sites and cultural subsistence areas, but also the loss the tribe experiences, including loss of utility, lost communities, and lost land.

**Table 2 - Code Application by Interviewee**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>Totals</b>
Land Loss	14	36	38	21	109
Erosion/Subsidence	11	37	36	21	105
Oil and Gas Industry	4	10	36	20	70
Levees	2	14	29	11	56
Relocation	6	10	24	9	49
Culturally Relevant Sites	6	6	28	8	48
Sea Level Rise	3	21	13	5	42
Widening Canals	5	12	16	8	41
Loss of Utility	5	4	21	7	37
Cultural Subsistence Areas	5	6	13	9	33
Increased Storm Surge	6	8	14	3	31
Resident Solution: Shoreline Protection		2	28	1	31
Land Ownership	13	3	12	2	30
Lost Communities	4	5	13	6	28
Saltwater Intrusion	3	7	10	5	25
Environmental Change	11	4		2	17
Resident Solution: Levees	2	5	6	4	17
Spoil Banks	1	1	6	6	14
Increased Current		2	7	5	14
Moving up the Bayou	3	2	6	3	14



Elevation Change		3	5	5	13
Less Fishing/Shrimping		5	6	2	13
Accelerated Sea Level Rise	1	9	2	1	13
Resident Solution: Spoil Banks	1	4	5	2	12
Resident Solution: Shoreline Restoration	1	1	5	2	9
Resident Solution: Marsh Creation		2	4	2	8
Leasing the Land for Oysters/Hunting/Fishing	2		5	1	8
Loss of Trapping Industry	3		3	1	7
Resident Solution: Barrier Islands		1	4	2	7
Parish Lines	1		6		7
Resident Solution: House Elevation	1	1	3	1	6
BP Oil Spill	1	1	3		5
Lost Barrier Islands	1	1		3	5
Attachment to Place		1	4		5
Resident Solution: Buy New Land	2		3		5
Younger Generations Moving Away	1		3	1	5
Resident Solution: Rock Off Canals		1	2	1	4
Taking Responsibility for Environmental Harm	2		1	1	4
Fighting to be Part of the Conversation	1	1			2

***Response Diversity***

The first adaptive capacity deductive code measured was response diversity, through coding the ways the representatives of the tribe respond to the vulnerabilities in their environment. According to Kerner and Thomas, response diversity includes all of the ways a community responds to an issue, comprising the steps the community takes, and the various methods it uses to respond. The elders chosen to speak for the Pointe-au-Chien Indian Tribe utilize many different methods to respond to their physical and social vulnerability, including elevating their homes, adapting to having water in their environment in order to stay in place, evacuating during storms, moving incrementally further north up the bayou as conditions become more vulnerable, and relocating to another town, parish or state altogether. Therefore, the inductive codes incorporated into this deductive code include resident

solution: house elevation; attachment to place; resident solution: buy new land; moving up the bayou; lost barrier islands; younger generations moving away; and relocation. All of these codes include responses to changes in the environment, and this section is organized by the least extreme responses to the most extreme responses to environmental change.

**Table 3 - Response Diversity Codes**

<b>Response Diversity</b>
Resident solution: house elevation
Attachment to place
Resident solution: buy new land
Moving up the bayou
Lost barrier islands
Younger generations moving away
Relocation

One of the most disruptive changes to the environment the tribe responds to is flooding, and one of the most popular responses to flooding is house elevation. Throughout the years, as multiple storms buffeted the Pointe-au-Chien Indian Tribe, many families elevated their homes, some up to twelve feet or more. These elevations occurred after storm surges from Hurricane Rita (2005), Ike (2008), Gustav (2008) and Isaac (2012) pushed water into the tribal members' homes. Hurricane Katrina, which devastated much of Southeast Louisiana, only caused wind damage in the community, while Rita caused many homes to flood. Because of their isolated location outside of the hurricane protection system and near the Gulf of Mexico, the tribe often receives storm surge and flooding that does not reach other more populated areas.

Figure 5 - Elevated Home in Pointe aux Chenes



Source: Tara Lambeth

House elevation helps to reduce flood effects, as the community members may get water in their yards, but their homes stay dry. Some homes are older, and would not remain intact if elevated: “they wouldn’t be able to survive the elevation, they would fall apart.” Other members of the tribe cannot make use of the funding available from parish mitigation grants to elevate their homes, because they live in a house that has been passed down for generations as family property, and do not have a title to the house to present to the parish government. Still, according to a member of the tribe, “most of them that could be elevated is up.” Many members of the tribe elevated incrementally as storms repeatedly flooded their homes. A married couple, although they live further up the bayou than other members of the tribe, raised their home up to 14 feet high. The couple changed the original design of their home by increasing the height by ten feet.

“We made out the house four foot off the ground, and then we had to elevate the front part because we were going to build a brick house and instead of building a brick house we built this house, so now we 14 feet off the ground.”

Elevating a home can be expensive, even if one has access to a grant. Many federal grants only cover seventy-five percent of the cost. The average cost of a house elevation in Terrebonne Parish is \$86 per square foot to lift a house 15 feet. Therefore, a 1,000 square foot home could cost \$86,000 to elevate. A quarter of that cost is \$21,500, a large investment, particularly for tribal members who already own their homes. A respondent noted, “they got programs that help you elevate, so whoever didn’t elevate it’s because they didn’t want to.” Further, the grant funds available for primary homes are not frequently available for community structures, such as churches. The same respondent pointed out, “they’d have to pay for that, so they’re not going to help.” As relative sea level rise continues to impact the community, the houses and structures that are not elevated will be prone to flooding and storm surge. This will be particularly devastating to the historic buildings important to the tribe that cannot receive funding for elevation, such as schools and churches.

The tribal member’s attachment to their community, or attachment to place, encourages them to adapt to the changes in their environment. The tribe, as ecosystem users, lives off of the land and water in their immediate area, and has to respond to changes in both the land and the water. The members of the tribe own boats to travel and fish along the bayous near their homes. These bayous run along most of their front yards, serving as a place to store their boats directly in front of their homes. Currently, the members of the tribe can drive vehicles to their homes as well. As relative sea level rise continues to affect the community, there will be more water and less land in the area. Mitigation measures, such as levees and marsh restoration, can help mitigate this relative sea level rise, but the community may have to adapt in other ways as well. According to one tribal elder,

“I’m going to stay as long as I can, as long as I live hopefully. That’s my plan. Might have to take the boat to the house. But if they put that levee, it should protect it a little bit.”

The parish is currently installing a ten-foot levee, which will run from Bayou Du Large to Bayou Lafourche. In the future, the parish plans to raise the height of the levee as funds are made available, and as environmental conditions require higher elevation.

**Figure 6 – Bayou Pointe-au-Chien**

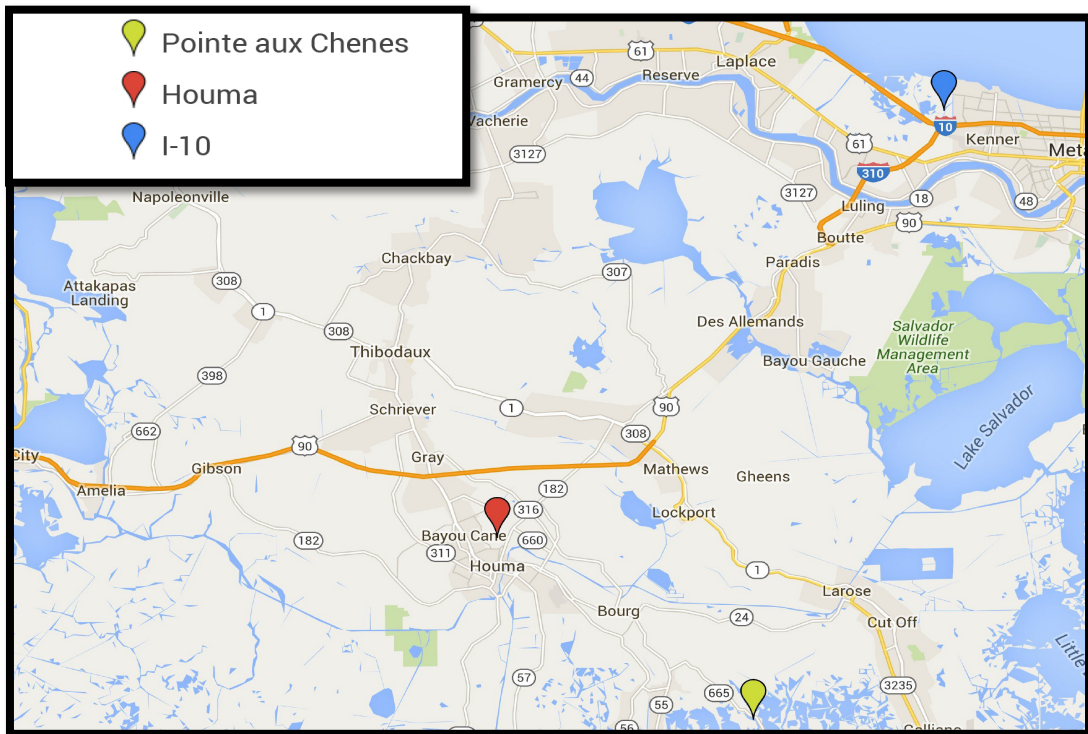


**Source: Tara Lambeth**

Since they are already so connected with the water, the study respondents are prepared to use the boats they already own to continue to live in their homes, and acknowledge that they may one day live in a primarily aquatic environment. This adaptation measure would leave them even more isolated, and make it harder to respond to an immediate hazardous event. Further, the members of the tribe that want to stay, who are attached to their community, acknowledge that future generations will most likely not be able to do so. As weather events become more extreme due to the effects of climate change, the area may not be livable for future generations, even those accustomed to living off of the water.

Hurricanes and tropical storms are a part of life in this coastal Louisiana community, and respondents use various methods to respond to these hazardous situations. Because the tribe is located so far south, they must travel north to escape the dangers and storm surge of hurricanes and storms. The parish evacuation plan suggests communities south of the Intracoastal Waterway, where members of the tribe reside, should evacuate for even category 1 and category 2 storms. Category numbers are based on wind speed, which is not always the most important factor to consider when gauging the damaging affects of a storm. As sea level rise increases, storm surge will become more important than wind speed in many cases. Evacuation routes from Terrebonne Parish lead to areas above I-10, including cities such as Alexandria and Shreveport.

Figure 7 - Map of PAC, Houma and I-10



Source: Google

The respondents used evacuation to northern Louisiana as a response to storms in the past, but it is often difficult and strenuous. A married couple in the tribe took turns explaining the issues they had evacuating for Hurricane Gustav:

“The only time we took off and went so far was for Hurricane Gustav, and we ended up in Shreveport, and we...” “Slept in the truck.” “Him and his brother and his brother’s son and a friend, they had four in his truck, and me and my sister in law and our dogs were in my little car. And we was in the Home Depot parking lot. No vacancies in the hotels. And that parking lot was full. Just about full. They had people that had mattresses in the parking lot and a bunch of people in the parking lot.”

When the representatives of the tribe do evacuate for storms, they return as quickly as possible and begin the rebuilding process. “We come back as soon as we can, as soon as they let us in we come back.” When they return, they immediately remove debris and repair damaged structures for the rest of the community. For many members of the tribe, evacuation is not an adequate or easy response to storms. Those who have experienced stressful situations evacuating say they will not leave their homes for storms any longer. The tribal elders would like to build a shelter to evacuate to, further up the bayou and away from the areas more prone to flooding and storm surge. This response is still in the idea phase, but they would like to see it implemented. This measure is not a response to sea level rise, but a response to a short-term hazardous event, such as a hurricane.

“Well, what I would like to see, I’d like us to buy us a piece of property somewhere, but we don’t really need it for sea level rise, mostly we need it for

storm evacuation. I'd like to see us buy us a place, a little higher up, to go for a storm, and then if we ever have to move out of here we'd have another place to go."

This evacuation place would be invaluable to the participants, as "a lot of people don't know where to go" when a storm is coming. Similar to elevation, this idea will only be successful with grant funding, which the respondents have had difficulty accessing for community structures. The tribe does have an elevated community building used for tribal meetings, but it is only one room. It was built with donations from tribal members. Furthermore, it is located in a vulnerable area, twenty miles south of Houma, which is at least an hour south of I-10 (see Figure 7). The community evacuation structure would have to be on land further north, on land with higher elevation, to better protect the members of the tribe from hurricanes, flooding and storm surge. If needed, the structure could serve as a location for the community to migrate to in the long-term if sea level rise and land loss become to severe.

The tribe has historically resided in a coastal location, and responded to the changes in their environment in multiple ways. Flooding, land loss, land gain, and extreme weather events caused the tribe to migrate throughout the bayou for thousands of years. Increased relative sea level rise, saltwater intrusion, and the effects of oil and gas exploration in recent years resulted in accelerated environmental change, urging a quicker response and swifter adaptation measures. As the environment changed throughout time, the tribe gradually moved up the bayou, north of the Gulf of Mexico and onto more solid land, in order to escape land loss, subsidence, and the flooding and storm surge that come with it. Along with general subsidence and land loss throughout the area, many of the barrier islands that served to protect the community from storm surge eroded and disappeared.



“Right now everything is Lake Chien, Lake Felicity, all this here, you don’t have no more land. Everything is open out there they don’t have no more islands. No they ain’t got nothing no more.”

The tribal member is describing how lakes that were once separated by barrier islands are now becoming even larger bodies of water. The loss of barrier islands leaves the community vulnerable to flooding and storm surge. When the barrier islands were there, the area was not as susceptible.

“That’s why we used to not get so much water before, because we had all the islands out there, and it would slow it down, so before it could even get up the bayou, well the water, it would start to recede.”

**Figure 8 - Deteriorating Land in the Bayou**

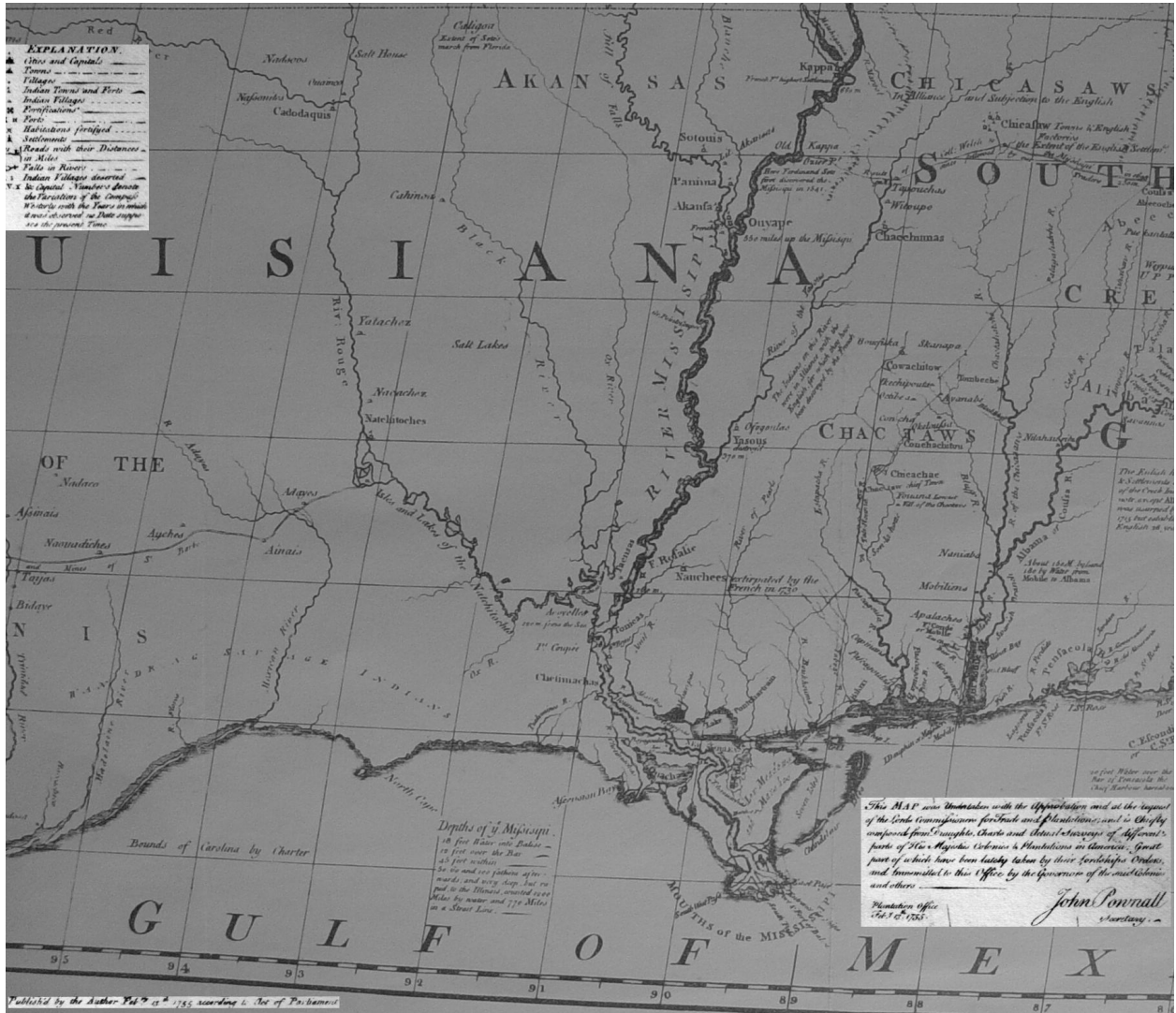


**Source: Tara Lambeth**

The loss of barrier islands caused members of the tribe to move up the bayou to more protected areas. “People lived all over the bayou.” “But they moved up.” Traveling down the bayou by boat to Faleau, which is well past the community’s current location, reveals ghost towns, abandoned homes and structures that once housed the tribe’s ancestors. Using a boat,

anyone can find these ghost towns throughout the bayou, although many of them are underwater. Historic maps reveal the extent of the tribe's residence in what is now Terrebonne Parish. The maps on the following pages were drawn by French settlers in 1755 and 1763 respectively, and label the Native American territory throughout Louisiana. The maps label several different tribes in what is now Terrebonne Parish, including the Chitimachas, who were ancestors of the tribe. In the past, the tribe could move to areas with more resources or less vulnerability to storms, but these resource-laden areas are being eroded by climate change and oil and gas exploration. Soon, habitats will change so drastically that it will not be possible to reside in and use the ecosystem simultaneously.

Figure 9 – French Map of Louisiana, 1755



Source: usgwararchives.net

Figure 9 reveals the extent of Native American territory in Louisiana in the mid-eighteenth century. Native American communities line the Mississippi River and the Gulf of Mexico.

Figure 10 - French Map of Louisiana, 1763



Source: usgwararchives.net

An 1893 map reveals housing structures all the way to the bend of the bayou. Because of land loss and sea level rise, structures do not reach anywhere near that far now. The land has either disappeared altogether, or abandoned homes have crumbled, slowly falling into the surrounding water. A tribal member describes the loss of communities down the bayou:

Figure 11 - Bayou Faleau



Source: Tara Lambeth

“They used to live on this side of the bayou too.” “Yeah, both sides of the bayou,” “Not much left,” “Nope.” “Everybody moved out.” “They had another gang that lived further down the bayou, that stayed down there, another family that lived down there, but they all moved out too.”

The families that move often just relocate a mile or more up the bayou, but some leave altogether, settling in Houma or areas further north. Many were forced to move up the bayou after a succession of bad storms damaged their homes. This migration has occurred for decades, as communities destroyed by extreme weather and the inhabitants moved further up the bayou, to less dangerous areas. But those less dangerous areas become more dangerous as time goes on, and the members of the tribe must pick up and move north again.

Migration and relocation is another response to changes in the coastal environment. These relocations occurred over centuries, but continue to occur from storms in recent years. Furthermore, the available land used for migration is disappearing. The ridges used for farming barely reach above the bayous, and saltwater intrusion and oil and gas exploration

are harming the available fish, crabs and oysters. A respondent describes how Hurricane Isaac in 2012 affected a neighbor's home:

**Figure 12 - Land Loss after Hurricanes Katrina and Rita**



**Source: Patty Ferguson, [pactribe.tripod.com](http://pactribe.tripod.com)**

“Isaac threw the, he had the top, the metal top on [the roof], and after Isaac passed, it was on the Terrebonne side. The whole top of the house was on the Terrebonne side. Threw it completely across the bayou.”

Another participant in the study described his struggles to repair his home in between storms:

“When Katrina was coming, well we took off, I [had] just finished putting a new roof on, and Katrina come so we took off, we went, I don't remember where we went but, and then the one after that, when Rita came, it took the whole house.”

Relocation is often the only effective response to severe weather, and the tribe has a history of moving up the bayou due to hurricanes. An 1811 earthquake and subsequent tsunami had a devastating effect on the area, and there were dangerous hurricanes from the years 1888-

1893. In an oral history map, a member of the tribe identified 1906 as a year when over 100 people died during a hurricane. Burial mounds throughout historic tribal lands may be evidence of these storms, and the community migrations that occurred. Although the tribe migrated in the past because of weather events, the storms, accelerated relative sea level rise, and oil and gas exploration in recent years resulted in more frequent and permanent relocations. These relocations are revealed in the census tract data for the area. The estimated American Indian population of the census tract that contains Pointe aux Chenes was 757 in 2000, 690 in 2010, and 504 in 2014 (US Census Bureau).

Relocation by the younger generations in the tribe is the last response the tribe uses to combat their physical vulnerability. The respondents stated that relocation is more popular in the younger generations, but almost everyone in the tribe has had to relocate at some point, even if it was just up the bayou. Older members of the tribe remember when their community extended well into the bayou, and can map the lots and farms where tribal members once lived.

“The young ones move out and the old ones die out. Everybody keeps moving up.”

The younger members of the tribe relocate closer to Bourg or Houma, or go as far as New Orleans and Baton Rouge. This relocation is often final.

“The ones that’s gone ain’t coming back. The one’s that’s there don’t want to leave, but the one’s that’s gone ain’t coming back. I don’t think they’ll come back. They’re gone.”

This relocation happens for a variety of reasons, including lack of land, changes in jobs, or access to the amenities available in towns or cities. When asked why the

younger generations leave the community, a respondent said, “I don’t know why really, maybe because more convenience, water, electricity, because right now young people are moving from Pointe aux Chenes further up.” Land loss is an important factor in the relocation as well:

“We don’t have enough land for our younger generation to stay here, so pretty soon this is going to be an elderly community because we don’t have any room for them to build, so they’re moving, whenever they get married they’ll move out of the community.”

The participants in the study say they do not want to relocate. Even though some members of the Isle de Jean Charles tribe, a tribe located on an island a few miles from Pointe aux Chenes, are looking for a place to relocate, the elders chosen to speak for the tribe do not want to do so. The respondents state they are protective of their community and the land, and want to watch over the sacred sites in the bayous. They want to live where they grew up, and continue to fish and live off of the land the way their ancestors did. The respondents also want to continue to be self-sufficient and make use of the community they built. In addition, the study participants have a church and a school in their community that they have used for generations, and want to continue making use of in the future. They are disconnected from their community when they have to attend school or church in other locations as a result of flooding or other concerns. The elders point out that relocation severs their sense of being tied to both the community and the land.

Despite their desire to remain in one place, the participants in the study also recognize how quickly the environment is changing, and understand that remaining in place may not be an adequate response in the future. They are aware that in a short amount of time, much of



the land they live on will disappear: “they predict in 50 years, behind the levees will be gone.” An older couple described how they bought a mausoleum even further up the bayou from where they currently live, to ensure that their bodies would remain protected from the rising water. In the mausoleum, the couple bought the highest compartment, so that their bodies would remain elevated, much like their house is now.

“We bought us a mausoleum, whatever you call the drawers, in Bourg because we figured this, down here, this was all going to be gone in a few years.”

“Yeah we bought it, last time before the storm, we had to wait a couple of weeks, when the water get in it doesn’t want to get out. When the water gets here it stays a couple of weeks. Down the bayou, it floods today, but tomorrow it can go, and the further up the road the longer it stays. So we figured well, we’ll transfer our-” “We don’t want to drown as fast. “I told that guy he said why do you want to move? I said look, I said, I don’t want to get drowned. He said what difference does it make you won’t even know? I don’t want to get drowned. Then I got a better chance to survive a little bit longer. You’ll be dead already. I said well I don’t want to drown, I said.” “At least we’re not going to be floating all over.” “We got the third deal.” “Over here, over here, we’re on the fourth level. Fourth level, you can barely push somebody up there. The third level is pretty high but it’s high, because it’s higher, the ground is higher.”

When asked if they had bought a mausoleum for their children, the couple responded, “they can take care of themselves. They’re not going to be down here anyway, they’re going to be

somewhere else.” They realize that they will most likely be the last generation of their family living in the community.

The members chosen to speak for the Pointe-au-Chien Indian Tribe respond in a variety of ways to the vulnerabilities and changes in their environment, including making changes to their homes, adapting to having water in their environment, evacuating during storms, moving further north up the bayou as hazards and disasters get worse, and relocating to new communities altogether. Using a variety of responses to hazards and disasters allows them to continue their way of life, but social connections are important to their continued existence as well. The tribe’s survival is dependent upon its social relationships, as members of the tribe assist one another in work, community activities, and community planning. Relocation can sever the connection the tribe has with its younger members, threatening the future way of life for the tribe.

### ***Connectivity***

Beyond response diversity, connectivity is an essential part of adaptive capacity, as it pertains to both the physical and the social environment. The tribe is intricately connected to the land and to its people. As the land fragments and disappears, the connections between tribal members fragment and disappear as well. Old communities and cemeteries are inundated by rising water, and tribal heritage sites are threatened by levee protection projects. The inductive codes under the connectivity deductive code include land loss, erosion, subsidence, culturally relevant sites, levees and lost communities. Land loss, erosion, and subsidence have impacted the tribe’s connection to their culturally relevant areas. Additionally, mitigation measures such as levees have disconnected the tribe from their

ancestral lands. Through these alterations, the tribe strives to maintain the connection to the land and their people. This section is organized into a brief synopsis of the tribe’s current and historic connectivity, followed by how the land loss, erosion, and subsidence, coupled with the installation of mitigation projects such as levees, divide the tribe from their culturally relevant sites and result in lost communities.

**Table 4 - Connectivity Codes**

<b>Connectivity</b>
Land loss
Erosion/subsidence
Culturally relevant sites
Levees
Lost communities

The social connectivity of the tribe is evidenced through their self-government. A Tribal Council, Chairman and Second Chairman lead the Pointe-au-Chien Indian Tribe. In addition, an Elders Circle supervises the tribal council. The members of the tribal government are also members of the tribe. Tribal membership is established through kinship. The tribe adopted a Constitution and Articles of Incorporation in 1993, and these documents were filed with the Louisiana Secretary of State. In addition to being self-governing, the tribe is also an incorporated nonprofit known as the Pointe-au-Chien Indian Tribe, incorporated in 2001. Furthermore, the tribe has a series of committees, including the oral history committee, the membership committee, the social committee, and the relief committee. The Tribal Council charged the oral history committee with compiling oral history interviews, which can be used to connect the tribe to its past, as well as used as pieces of evidence for its federal recognition application. The membership committee keeps a count of all of the tribal members, and reviews new membership applications. The social committee holds social events for the tribe twice a year. In addition to social events, the tribe also holds monthly

meetings of the Tribal Council. Additionally, members of the tribe participate in planning and political meetings in South Louisiana. Perhaps most important for the tribe, the relief committee handles the tribe's responses to natural and manmade disasters.

**Figure 13 - Palmetto House, Pointe aux Chenes, 1930-1940**



Source: Speck Collection, [pactribe.tripod.com](http://pactribe.tripod.com)

Historically, the tribe descends from the Chitimacha, Acolapissa, Atakapa, and Biloxi Indians. These tribes have resided in South Louisiana for thousands of years, and are ecosystem users of the area. The area that the respondents currently live in is part of the area historically used by indigenous ecosystem users as well. The tribe is also French-speaking, as a result of French speaking men who married into the tribe in the past. Unfortunately, an anthropologist incorrectly identified the tribe as members of the Houma Tribe in the early 20<sup>th</sup> century. Since then, the tribe has had difficulty proving their unique history and heritage, because apart from the anthropologist's findings, and limited historical documentation, it only exists in oral history form.

The tribe's connection to the land and water stems from their ability to live off of and care for both environments. In the 1850s, when there was more land, the tribe had large

farms, hunted and trapped (Pactribe.com, 2016). Now, as in the past, the tribe catches fish, crab, shrimp and oysters. The tribe's tight knit social connections originate from the fact that they were completely isolated until the mid-twentieth century, and unable to attend school in the parish until the 1960s or 70s (Pactribe.com, 2016). This isolation also kept the tribe removed from decision and policymaking, and limited their education and career opportunities (Pactribe.com, 2016). Although isolation allows the tribe to claim they are an historic tribal entity, it also makes it difficult to find documentation that proves this is the case. According to the participants in the study, this isolation makes it difficult to survive and succeed, but this isolation also allowed the tribe to learn how to educate its population, and thrive without outside aid.

Land loss, erosion, and subsidence are prominent inductive codes under the connectivity deductive code. The tribe is not only disconnected from policy and the outside community, but is becoming more and more disconnected from the land as well. Land loss makes the tribe's isolated, remote location even more vulnerable: "this right here was all land, land all the way to the Gulf, now it's open water." Land becoming open water results in more storm surge and erosion, exposing the community to the elements more and more. This loss of land is steadily increasing, according to one respondent, "we walked along land, now you can't walk anymore. Just in a couple of years." The changes in the environment are drastic, happening quickly, and removing modes of travel to tribal lands. One participant explained, "That's the way it was before. Everybody mostly walked." According to another participant:

“That bayou was maybe not quite as wide as this not five years ago. We used to walk from here to my uncles’. There were trees all over, it was full of trees.”

The land loss is a result of erosion, subsidence and sea level rise. These environmental changes are exacerbated by hurricanes and tropical storms.

“That there, a few years ago, they had land all the way from that light all the way to the end of that point, and now you don’t have nothing, it’s just water. A storm and erosion, everything is wiped out.”

Land loss, erosion, and subsidence separate the community from their culturally relevant sites, such as previous communities and burial sites. Tribal members remember where their ancestors lived, well down the bayou from where they live now, on land that has disappeared or is disappearing: “grandpa used to live right here...had a house right here, and her aunt lived on this side of the bayou.” Not only were there communities further down the bayou, but there were also historic sites important to their heritage. Many of their ancestors were buried in cemeteries that are now threatened by relative sea level rise:

“Right there they used to have a cemetery. People used to live here. There were people living here thirty years ago. That’s where my great-great-grandpa got buried. I just bought a plot at Mary Magdalene, the Catholic Church, but I changed my mind. Fifty years from now that cemetery will be like this.”

Although many of their family members were buried in the cemeteries, the participants in the study do not have the option to be buried with them, as they will soon be completely inundated by water. According to one respondent: “Yeah, they used to be high, the burial sites, now they’re even with the water. During high tide they’re on the water.” The

cemeteries are unmarked, but are the only link the tribe has to their ancestors. Additionally, the participants in the study do not think cemeteries further up the bayou from where they currently live will exist by the time they need to use them. For a culture dependent on kinship relations to survive, disconnection from ancestors is a critical division from society (Pactribe.com, 2016).

To maintain connectivity to the land, the respondents would like to protect it, particularly their culturally relevant sites. Although the land inundated by relative sea level rise is historic tribal land, the tribe lacks the ability to properly protect it. State planning projects do not currently take the tribe's historical cultural sites into consideration. Therefore, some mitigation projects harm the tribe's culturally relevant sites. This may be because the tribe is not a federally recognized tribe, and cannot apply for funds to protect these culturally relevant sites:

“And all of our cemeteries, all of the cemeteries are going to be left out of that Morganza. They're not going to save them, now maybe if we would be federally recognized, then maybe.”

Without the aid of planning projects or land grants, the elders of the tribe strive to keep the cemeteries protected, building fences and sharing the memory of where the cemeteries were: “we just wanted to let them know that they're gone but we'll never forget them.” The fences were toppled by storm surge, and relative sea level rise threatens the land the cemeteries are on. Without outside aid, the tribe may not be able to adequately protect these essential cultural points.

Mitigation measures implemented by planners also do not take the tribe's culturally relevant sites into account. A small levee the parish plans to build leaves some culturally

relevant sites outside of the planned protected area. This includes the schoolhouse where many members of the tribe attended school.

“This old schoolhouse here, that old building, they put the levee and the lock and stuff, these are going to be outside, that’s heritage for the community.” “I went to school in that building. It used to be up the bayou and they brought it down here.”

The schoolhouse, while further up the bayou than the cemeteries, is still in a vulnerable area. The relative sea level rise and mitigation measures in the community combine to leave areas important to the tribe vulnerable to climate change now and in the future. The tribe is at risk of being disconnected from important cultural areas, dividing them from their history and ancestors. Additionally, the planned structural megaprojects do not take the location of the community into account. The planned Morganza to the Gulf levee directly borders the Pointe aux Chenes community, putting structures further down the bayou at risk, and increasing the possibility of storm surge directly outside of the residential community (see Figure 13). Environmental changes and the mitigation projects implemented in response to those changes are harming the tribe’s connection to the land



Figure 14 - Proposed Levees and Local Levees in Pointe aux Chenes



Source: CPRA's Risk and Resilience Viewer

Connectivity is not only about connectivity to the land, but connectivity to people as well. According to one member of the tribe, “we’re all related...distant cousins, so everybody’s related, so they’re all my relatives.” Extreme weather events have caused members of the tribe to move to less vulnerable locations, resulting in numerous lost communities. For example, in 2005, Katrina and Rita damaged many homes in the Pointe aux Chenes area, and quite a few families moved up the bayou to more protected areas. Relocated tribe members keep in touch at holidays and celebrations. There are monthly tribal meetings that many members of the tribe attend. In addition, members of the tribe come back for weddings and Mardi Gras celebrations. Although the tribe reconnects during meetings

and holidays, increased land loss could spread the tribe further apart, and make social reconnection more difficult.

Land loss, erosion, and subsidence are breaking the connection the tribe has with its ancestral land, its historic sites, and resulting in lost communities. As land is lost, the tribe loses connection to its ancestors, previous communities, and other tribal members. As the land disappears, the social connections in the tribe disappear as well.

### *Abundance/reserves*

Changes in the environment not only threaten the tribe's connectivity, but also threaten their access to resources. Many resources the tribe acquired from the land and the water no longer exist. Land that used to support agriculture is no longer viable, as saltwater intrusion and rising water changes the landscape. Furthermore, species members of the tribe used to trap or catch for food and supplies are no longer able to survive in the area. The inductive codes for this deductive code include environmental change, sea level rise, accelerated sea level rise, elevation change, widening canals, increased storm surge, increased current, levees, cultural subsistence areas, loss of utility, loss of trapping industry, less fishing/shrimping, leasing the land for oysters/hunting/fishing, saltwater intrusion, and BP oil spill. Environmental changes such as sea level rise, storm surge, saltwater intrusion and flooding have all affected the tribe's reserves. This section is organized by the various environmental changes that affect the tribe's resources, the mitigation measures that have an effect on the resources, the depletion of various means of subsistence, saltwater intrusion, and the effects of the Deepwater Horizon oil spill.

**Table 5 - Abundance/Reserves Codes**

<b>Abundance/Reserves</b>
Environmental change
Elevation change
Sea level rise
Accelerated sea level rise
Elevation change
Widening canals
Increased storm surge
Increased current
Levees
Cultural subsistence areas
Loss of utility
Loss of trapping industry
Less fishing/shrimping
Leasing the land for oysters/hunting/fishing
Saltwater intrusion
BP oil spill

One of the environmental changes that deeply affects the tribe’s resources is sea level rise. As a result of both man-made and natural causes, such as oil spills, hurricanes, and subsidence due to altering the course of the Mississippi River and oil and gas extraction activities, the area where the tribe resides has one of the highest rates of relative sea level rise in the world. The participants in the study observe this rise firsthand, as the land is disappearing so quickly that canals and bayous have widened drastically in less than fifty years.

“Just like Cut Off Canal, that widened up.” “You used to jump across it.”

“About fifty years ago it was about a quarter the width.”

Canals that were once used for drainage are now used for transportation, and canals that were once the width of a boat are now the width of a two-lane highway. One respondent described the change in a nearby bayou:

“The bayou is about only a little wider than the boat right there. Like the Pointe aux Chenes bayou 50 years ago. The one we live by over there. It used to be like a drainage canal. For the houses.”

The widening canals cause the tribe to experience storms and heavy rain more acutely than other areas in the region, because of their exposure to wind, flooding and storm surge. The canals increase the current and storm surge in the area. One tribal elder uses the example of Hurricane Lilly to emphasize the increased vulnerability of their location:

“Like Hurricane Lilly. They were classifying that as a tropical storm. But it was a hurricane for us over here. Bad, bad weather. Over 100 mph.”

Both sea level rise and widening canals exacerbate the environmental changes in the area.

Mitigation measures implemented at the state and local level also affect the tribe’s exposure to hazards, and thus help to deplete their resources as well. Additionally, the Army Corps of Engineers’ alteration of the environment through mitigation measures also has an effect on the tribe’s environment. The inability for the river to rebuild land, coupled with pumps used to remove rainwater from the area, drastically increase land loss and subsidence in the environment. Furthermore, levees put in place without barrier islands or reinforced wetlands could increase storm surge for communities like the tribe who border the planned levee locations. The Morganza to the Gulf levee will increase the degradation of the wetlands, altering the resources available in the tribe’s surrounding environment. For example, the degradation of the wetlands leads to increased storm surge, which results in saltwater intrusion and changes the composition of fish species in the area. Although meteorologists classify storms by category based solely on wind speed, the respondents are familiar with how their environment responds to storms and heavy rain, and are worried

about mitigation measures that may not take these environmental vulnerabilities into account. For example, the pump stations and levees in Terrebonne and Lafourche Parish may not be enough to mitigate against a heavy rain event.

“That’s what I was telling them, them people that is building them levees, I said the way you’ve got everything set up, everything pumps into the system, so if you get a lot of rain, what’s going to happen is you’re going to get in trouble.”

Industrial development in the region continues to deplete the tribe’s access to resources and reduces the number of cultural subsistence areas. The oil and gas industry and man-made disasters such as the Deepwater Horizon oil spill harmed the trapping industry, as well as the fishing and shrimping in the area. According to the Pointe-au-Chien Indian Tribe website:

“Historically, the tribe was a hunting, fishing, agricultural and cattle community. Today, the Tribe relies primarily on fishing due to the devastation of the land by oil companies, lack of protection of the barrier islands, and the lack of fresh water replenishment which has resulted in salt water intrusion and the devastation of the land. But now, even the fishing lifestyle is threatened” (Pactribe.com, 2016).

Many members of the tribe used to trap muskrats and nutria, but they are no longer living in the area. A participant in the study described their access to resources in the past: “And like years back, where our ancestors, our grandparents and all used to fish, we used to trap, we went shrimping and trapping.” The tribe continues to fish, shrimp, crab, and oyster, but does not trap any longer, although a member of the tribe recalls trapping not too long ago: “I had

to learn how to put the nutria skins on the boards after he would skin them, but we haven't done that in years, since he stopped trapping." In addition, the presence of oil companies can make shrimping dangerous. One respondent remembers trawling over an unmarked pipeline: "I used to go shrimping in there. I used to throw my trawl along the bank. I could have busted my boat." Further, the members of the tribe who do crab, fish, shrimp and oyster are required to lease the water they use for these activities from the state or oil companies who own it. This land ownership is evidenced in signs throughout the bayous, as one tribal elder pointed out: "look they got a big old sign right here – no crab, no hunt." One member of the tribe mentioned issues with locals pilfering their catch before he retrieves it. Although members of the tribe continue to access resources from the water, the disappearance of land for trapping and farming deeply affects them, as they were historically self-sufficient. A married couple described the self-sufficiency of their ancestors:

"This was part of the community here." "My mom, when she was a baby she lived over here." "She was born here. And your grandpa was born here too. They lived down here for the trapping, and they had a big community here. This is where they planted the sugar cane and fruit trees and everything. They had everything they wanted; they even made their own grits. The bricks are still there where they used to make the sugar."

Losing access to resources the tribal elders once used harms their ability to adapt to changes in the land and water. The tribe must create new ways to access resources in order to continue to live off of the land and water.

Another change in the environment is the saltwater intrusion in the area, a result of both land loss and sea level rise. As the land disappears, the salinity in the water changes

from fresh to saltwater. Saltwater intrusion affects the available resources as well. Land that used to be lined with oak trees is now lined with their ghosts, as the increased salt in the environment killed them. A representative of the tribe pointed out these deceased oak trees:

“Yeah a lot of new oak trees on the ridge right here, they’ve got quite a few young trees. A lot of the old ones died. You see the skeletons.”

**Figure 15 - Dead Oak Trees on Eroding Ridge**



**Source: Tara Lambeth**

The land the oak tree bones sit on was once used for farming and traveling to other parts of the community. Members of the tribe used the land to plant rice, corn, beans potatoes and sugar cane. Now, it is a small ridge of land lined with the reminder of what the trees used to be. Saltwater intrusion also affects the duck population, which decreased as the environment became saltier: “too much saltwater.” The study respondents remember when there used to be a greater duck population, which they would hunt and use for food. One respondent explained how the food and reserves also came from the land they used for farming:

“They grew their own...they had chickens and pigs We used to come down and they’d kill a pig. They used to catch their fish, yeah they used to fish, and they used to sell that.”

Members of the tribe continue to farm, but on smaller pieces of land further up the bayou. The tribal elders remember when the farmland extended well down the bayou towards the Gulf of Mexico: “They used to plant all the way by Lake Felicity.” The loss of land and disconnect from previously usable land reduces the tribe’s agricultural resources.

Man-made disasters have similarly had an effect on the tribe’s environment. The Deepwater Horizon oil spill leaked oil into one of the areas the tribal members use frequently for fishing, Lake Chien (Pactribe.com, 2016). The spill also resulted in an early closure of the shrimping industry, which many members of the tribe use as their vocation. Even when fishing and shrimping resumed, the dispersant placed in the water to dissipate the oil further polluted the environment and the species within it. The oil spill had a big impact on the tribe’s resources, not only reducing the fish and oysters in the area, but also making the ones that remained unsafe to eat. One participant described how the oil spill affected his access to resources:

“Everybody was stressed out. I was mad. With the oil company. I was really, really, really pissed off.” “Have you had a normal fishing year since then?”

“No, but what it was it wasn’t just taking my source of income, it was taking my food, because I didn’t know if I could trust the food to eat it.” “Do you eat it now?” “I eat some, but not like I did. I eat oysters maybe four times since.”

One respondent believes the oil spill irreparably altered their environment: “Just like BP’s got the world thinking that they put everything back to normal. But it’s not. I don’t think it’ll



ever get back to normal.” The spill closed the shrimping season for almost three months in 2010, and the dispersant used to clean up the spill further polluted the water. Events like the oil spill affect the tribe’s access to food, and threaten their livelihood.

As ecosystem users, the Pointe-au-Chien Indian Tribe is connected to the available resources in the area, on both land and water. Unfortunately, the changes in the tribe’s environment, such as saltwater intrusion, land loss, and changes in the ecosystem, reduce their access to resources.

### ***Learning Capacity***

Like response diversity, connectivity, and abundance/reserves, learning capacity affects the ways the tribe can effectively adapt. The elders of the tribe developed many methods to adapt to their changing environment, including altering their housing structures, installing dams and levees, reducing erosion and land loss, keeping the marsh healthy through prescribed burns, and using the spoil banks dug by oil companies to reduce storm surge. The inductive codes for this deductive code include resident solution: levees, resident solution: shoreline protection, resident solution: shoreline restoration, resident solution: marsh creation; resident solution: rock off canals, resident solution: barrier islands, levees, cultural subsistence areas, spoil banks and resident solution: spoil banks. Most of the resident solution inductive codes are included in the learning capacity deductive code; because they constitute the different ways the study participants devised to reduce their risk, not as merely a response, but a way to learn from hazards and disasters and plan to protect themselves in the future. This chapter details the various mitigation measures the study respondents devised to adapt to their environment.

**Table 6 - Learning Capacity Codes**

<b>Learning Capacity</b>
Resident solution: levees
Resident solution: shoreline protection
Resident solution: shoreline restoration
Resident solution: marsh creation
Resident solution: rock off canals
Resident solution: barrier islands
Levees
Cultural subsistence areas
Spoil banks
Resident solution: spoil banks

One of the main adaptation methods the respondents use to protect themselves is the use of small levees and dams. Small levees and dams do not have as large of an effect on the environment as levees installed as a part of large structural mitigation projects. Members of the tribe have been building dams for years. As one participant explained, they were originally used to keep the water fresh for their farm animals:

“Now the little bayou, not the Cut Off Canal, but the Bayou Pointe aux Chenes tip, but in between there, for the people to keep that water for their cows and all, they had dams in there, where it would keep the fresh water in there for their cows. They had three dams in there.” “Are they still there?”  
 “Yeah, they’re still closed up.”

Now, some members of the tribe install manmade levees in the bayous, to help curb the increased current and prevent more land loss.

The tribal elders not only implements protective measures, but also share what they have learned about these measures with others in the community. Beyond implementing local mitigation strategies, tribal members participate in parish and state planning meetings, and share ideas about mitigation projects. For example, the tribe was on the Steering Committee

for the 2015 Terrebonne Parish Hazard Mitigation Plan Update, and members of the tribe attended community meetings on the 2012 Coastal Master Plan and the state's recently awarded HUD resilience grant. As of now, their ideas have not been implemented. One respondent devised a way to alter the Morganza to the Gulf project, in order to protect more areas of the coast: "My plan would have saved all of Isle de Jean Charles too, because it would pass through here and go towards Montagut, and it would have saved the island." Although he shared this idea with the planning agency, it is no longer included in the Morganza to the Gulf project. According to another respondent, "he suggested that years ago, and at first they had the island in there, and all the sudden it changed." The members chosen to speak for the tribe suspect that this sudden change has to do with the number of oil and gas pipelines in the area, and the fact that implementing wetland restoration and building a levee in that area would be too dangerous.

The lack of investment by local and state government causes members of the tribe to employ smaller local strategies to combat the land loss and erosion in the area. One member of the tribe explained how he has adapted what was once merely a resource for food into a local adaptation measure to protect the shoreline. This combines the use of abundance/reserves with the use of learning capacity, resulting in a way to doubly adapt to an environmental change:

"Is that oyster shells?" "Yeah that's mine. I'll put that out, but I think I'll wait one more year, because the dispersant is still in the system." "You have oyster leases?" "Yeah." "Do you know where you'll put it?" "Yeah." "To stop erosion?" "No, for oystering. I could put some out to protect that mound. I thought about that."

He is referring to a ceremonial mound off of Pointe aux Chenes Bayou that is quickly eroding, and which members of the tribe are currently trying to save. Oyster shells are a mitigation measure used to prevent further erosion and land loss. The shells can be used as a breakwater to reduce current that contributes to land loss, and serve as a barrier to reduce further erosion. The mound the tribal member would like to protect with oyster shells has existed for hundreds of years, but the modifications to the wetlands made by oil companies caused it to erode. The mound was most likely built by ancestors of the tribe to protect them from flooding, as it is located at a much higher elevation than the rest of the land around it. One participant expounded on the environmental changes around the mound, as well as its historic significance:

“Louisiana land cut the boundary line; it was only 3 feet wide when they cut this, now it’s a bayou, starting to wash this mound away. I want to try and bulkhead that, but I don’t know how, the people who built this, it was a lot of hard work; it was done by hand, homemade baskets. That’s a lot of baskets of dirt. It could be a burial mound. It could be a place to live. The river used to overflow every year, so they had to build something to stay on. They probably had 3 or 4 families living on this mound, they have 2 further down. At least pretty close to 70 feet of bulkhead material. I hate to see it wash away. I’m gonna have to try and do something.”

Like their ancestors, the participants in the study would like to protect and build up the areas with higher ground, in order to be safer from flood inundation.

The tribal elders also use their local knowledge to point out trouble spots and come up with solutions to protect their environment. While fishing, shrimping, and oystering,

members of the tribe note areas of the bayou that are eroding quickly, or areas where the current is increasing. They further note the effect mitigation measures have on the erosion and increased current. One study participant described how to improve the effectiveness of a local levee:

“But you see over here, we need to build that little outlet right there, on the other side right there, if they don’t put something there, that’s going to eat, because since they put that little levee, it’s been eating more on that other side than over here, the land’s been eaten. They have to put some rocks or something.”

Some protections, such as levees installed by the parish, while acting as a short-term solution, can result in more alterations to the environment. Levees can result in more erosion and increased current, because they serve as a barrier the water struggles to get around. The respondents point out that levees may not be enough, and the land around the levees should be protected from erosion as well. One participant pointed out the erosion caused by a levee in the area:

“Now for land loss...you see right over here, on the point over here, they made that little levee where they’re supposed to put that floodgate there. But on the other side is Cutoff Canal. Since they put that levee, it ate double than what it used to before they put that levee down, you know, it’s eating further and further in. If they don’t do something soon with the Cutoff, you know, then the levee is going to be in the Cutoff too.”

Marsh creation is one idea that the study participants mentioned to combat the effects of the levees on the environment. One respondent pointed out that creating marsh would

“protect the levee that they are going to build.” He suggested that “if they even put a rock jetty, something, to protect here” because “if the water’s high, it’s coming straight over that levee.” In other words, a levee alone is not enough to protect the community from storm surge. A rock jetty would help to “break everything up” and “slow things down” before the water reaches the levee. Another tribal member pointed out, “they’re still going to have to fix the beach, if the beach is not fixed, the levee is not gonna last for long.” Still another representative of the tribe suggests that whoever is doing the restoration “put rock around what’s left, just rock everything, it would prolong it anyway.” Although some planned mitigation projects could help them in the future, the respondents would like a shorter-term protection plan. One of the projects included in the Coastal Protection and Restoration Authority (CPRA)’s 2012 Coastal Master Plan is a diversion project, which would build up sediment from the Atchafalya Basin in order to better protect lower coastal areas. However, diversion projects, which divert the sediment from the Gulf of Mexico to areas that need wetland restoration, could take many years, and the tribe needs protection in the more immediate future:

“They have quite a few diversions but it’s going to take years and years.

That’s why I’m thinking these mounds [created by tribal ancestors] are there for a reason.”

Diversion projects, marsh creation, beach restoration, rock jetties and levees would give the community multiple lines of defense from flooding and storm surge. In fact, one of the goals of CPRA’s 2012 Coastal Master Plan is to utilize a “multiple lines of defense approach,” including nonstructural projects such as elevation, floodproofing, acquisition and relocation. The tribe’s knowledge about where to place these lines of defense could contribute to the

effectiveness of the Coastal Master Plan. Additionally, the tribe has historic knowledge of how the land has changed in the past, knowledge that has been passed down for generations. The state does not access any of this knowledge when planning structural megaprojects in the community.

Members of the tribe also learned to work with the environment to create cultural subsistence areas. One respondent detailed how a member of the tribe used mangroves to help grow grass on a ridge in the bayou, which he uses to feed his cows:

“See the mangroves, in the bushes right there, look how green they are. Just trying to get the grass to grow. Before you couldn’t even walk the ridge it was so dirty with grass...you couldn’t even pass through there.”

The ridge was once connected to the rest of the community by land, but is now separated from it by water. The tribal member was able to bring a mower and livestock to the ridge by boat, to continue using it for grazing. A respondent was also able to adapt a piece of land that was once a sugar mill run by the tribe’s ancestor, and use it to feed their livestock, as well as keep the marsh healthy.

“Yeah I wanted to come back and mark the corners right here. I was going to fence it in, but then if somebody lights the marsh it’ll burn anyway, so I figured just mark the corners.” “Do people still burn it [the marsh]?” “Every now and then, it makes the marsh greener.”

One study participant came up with a solution that makes use of oil and gas industry development. Although oil companies contribute to the land loss in the area, this participant devised a way the industry can help protect the area from storm surge, using the same soil they dredge for the pipelines.

“They got a few places, they bring back a rig, and they call it a wheel wash, they take two tug boats and wash out the canal, so my suggestion is dig it and put it on the south bank, just put it on the south bank, that way when the storm comes it would stop the surge.”

The south bank of the canal is the bank exposed to the Gulf of Mexico. Placing ridges on that bank would create a series of terraces, which would slow down the surge coming from that direction. Although digging canals usually results in a more vulnerable environment, digging canals in this manner would help to mitigate against this vulnerability. The oil and gas industry does not currently utilize this strategy when performing extraction activities. But, the terraces would perform the work the barrier islands did in the past, slowing down storm surge before it reaches the community (Grzegorzewski, Cialone & Wamsley, 2011).

Through protecting their environment in various ways from erosion, land loss, and storm surge, as well as devising new ways to use resources to adapt to vulnerabilities, the members of the Pointe-au-Chien Indian Tribe learned to survive in a physically vulnerable location. Social networks within and outside of the community help the tribe to survive as well.

### ***Collaborative Capacity***

Response diversity, connectivity, abundance/reserves and learning capacity all add to the adaptive capacity of the tribe. The last deductive code that contributes to this adaptive capacity is collaborative capacity. Members of the tribe collaborate internally, sharing resources and knowledge throughout the community. Although members of the tribe have been able to connect, respond and learn how to adapt to their changing environment, they



often do not have a voice in the larger region. One respondent addressed the lack of knowledge of the extreme environmental changes in the area: “Isn’t that sad? Like how come nobody cares? I went to this event and people were like what are you talking about? There’s no like consciousness about what’s going on down here.” The inductive codes for this deductive code include the oil and gas industry, parish lines, land ownership, taking responsibility for environmental harm, and “fighting to be part of the conversation.” These codes include local, regional and state policies, such as parish boundaries, the developments of the oil and gas industry, and the fight to be at the table when these policies are decided. This section details the mitigation requirements in the area and the methods the respondents use to collaborate with the oil and gas industry, as well as regional, state and federal entities.

**Table 7 - Collaborative Capacity Codes**

<b>Collaborative Capacity</b>
Oil and gas industry
Parish lines
Land ownership
Taking responsibility for environmental harm
“Fighting to be part of the conversation”

The first difficulty with the participants’ collaborative capacity to is the mitigation requirements in the area. Local mitigation requirements such as required house elevation height are difficult to navigate for the participants, as the requirements do not remain static. Elevation, while an effective flood protection method, has many requirements that change over time. The Federal Emergency Management Agency (FEMA), through updated flood mapping and the National Flood Insurance program, now requires houses to be elevated higher than in the past. Local officials require residents to elevate higher if they are substantially damaged after a storm, or they will not be eligible for flood insurance.

“Well I would’ve built back over here, but when I went to get my permit they told me I had to be a foot higher than what I am right now, and I already had all the foundation, and whenever they told me that I said, man, I said I ain’t going no foot higher.”

In addition, the flood insurance requirements in the area are unaffordable for many members of the tribe. “This year, my house is going to be paid for and no more flood insurance, no flood people ain’t going to get no more money from me.” Other members of the tribe are not able to afford flood insurance because the elevation of their home no longer meets regulations.

“We don’t have insurance on ours it’s too expensive.” “It was 12 feet but it went up, it might be 15 feet now. Now we’re not high enough so flood insurance skyrockets.”

The elevation requirements are particularly difficult on the community because many respondents remember when there were no elevation requirements at all: “Before it was you didn’t have to go, now you have to go 20 feet.” The subsidence and land loss in the area translates to the flood maps as well, as residents have to elevate higher as conditions become more risky. The Pointe aux Chenes area is in a VE, or velocity flood zone, which means the community is susceptible to both flooding and storm surge. The Base Flood Elevation, or the height of the 100-year flood, in the area ranges from 12 to 15 ft. With a ground elevation between 2.8 and 3.1 feet, houses need to be raised 10 to 12 feet to qualify for flood insurance. Raising a home too high increases susceptibility to increased wind; “they say it’s worse for the wind if you’re high.” In the coastal Pointe aux Chenes area, the winds from hurricanes and tropical storms can reach up to 100 mph.

The tribe works to improve their collaborative capacity with other tribes in the area through the First People's Council of Louisiana. This council is made up of six state recognized Native American tribes in Louisiana. The Pointe-au-Chien Indian Tribe was a founding member of this council, which formed in 2012. The council works to collaborate with other tribes, agencies, and nonprofits to protect the natural ecosystems in Louisiana, so that the Native American tribes that live off of and protect these ecosystems can continue to survive. The council works to bring science and education to the protection of natural resources across all of the tribal lands. Their goal is to coordinate with other tribes, private organizations, local governments, and state and federal agencies, to conserve their tribal lands.

The oil and gas industry is often a threat to these ecosystems, and the oil and gas industry did not collaborate with tribal members when conducting explorations in tribal areas (O'Rourke & Connolly, 2003). This oil and gas exploration resulted in environmental degradation and increased physical vulnerability. The mapping adaptive capacity section at the end of this chapter contains a map revealing the land loss surrounding the canals in the area. The canals cut by these companies often widen, resulting in increased current and more vulnerability to storm surge. Two of the respondents have watched these canals widen over time. "And then when oil came up, the canal was cut 40 feet wide." "It's over 300 feet wide now." Companies often dig the canals in areas that are already vulnerable to erosion and storm surge, do not place the soil in a thoughtful way that could help reduce erosion or current, and often do not refill the canals when they are through with them. According to one participant, "whenever the oil companies dug this out, they just piled it up right there, everything else washed away probably." This is an issue in the bayous all around Pointe aux

Chenes. Canals that were never refilled erode, resulting in increased exposure to storm surge. According to one tribal elder, “it’s a big, big part of the damage that’s been done.” The cuts in the landscape make the community even more vulnerable to extreme weather, increasing their exposure to water. One representative of the tribe noted the effect the cut canals have on storm surge: “See this right there, this should be all solid land, all them cut canals, that would be a sort of buffer that would stop the water from getting up there so quick.” Another member of the tribe described the erosion process:

**Figure 16 - Dredged Pipeline in the Bayou**



**Source: Tara Lambeth**

“If you go by where they laid a pipeline, like the pipeline they got over there from down and all the way, they go all the way to Venice, but if you dig that and you don’t put the land back there, it is going to widen up every time they gonna have a storm you know, and boats run through there, and if they would’ve...because, like they were supposed to, you know they were supposed to dig for the pipeline, but then put that dirt back in there, but they took out, but they never did that.”

While the extraction activities of the oil and gas industry harm the environment, they are still essential for the local economy, and even employed members of the tribe over the years. One tribal member pointed out the tension between members of the tribe and the industry: “we need oil and gas, but they need to be more responsible for you know the land...the land and the water, really.”

Another barrier to collaborative capacity stems from the tribe’s placement, as the tribe resides on a piece of land that straddles Lafourche and Terrebonne Parishes. In fact, Pointe aux Chenes is often listed as the boundary between Lafourche and Terrebonne parishes. This setting causes the need to collaborate with not just one parish government, but two. One study participant, when discussing the parish governments, said: “They don’t worry about us. Lafourche Parish don’t care about us and Terrebonne Parish don’t care about us.” One respondent mentioned that members of the tribe named the waterways and islands in their community, but these names are not reflected on maps of the area. According to another tribal elder, “Yeah the names they got on these maps is not what we call it. We have other names for it.” Despite their lack of agency in the parish, some parish mitigation projects put in place by the Terrebonne Levee and Conservation District should benefit the tribe. The levee currently being constructed in the Pointe aux Chenes area, for example, requires cost sharing by the parish. This required cost share caused an issue with the levee construction, as both parishes should have committed resources. However, the Terrebonne Levee and Conservation District District is leading the project. Therefore, the fact that the project spans parishes has slowed down its completion.

Terrebonne Parish uses sales tax to fund structural projects through the Terrebonne Levee and Conservation District. The parish uses state and local funds to fund these projects,

rather than relying purely on federal funding. The parish raised funds to build 10-foot levees throughout the coastal area, which should be completed by 2017. These levees will include wetlands on both sides, water control structures, and wetland terraces to further reduce surge. The levees follow existing ridges of waterways, some of which border the Pointe aux Chenes area, which are the areas of highest elevation. The parish also has floodgates and locks planned for the future. The Bubba Dove Floodgate and the Houma Navigation Complex lock are expected to prevent 3,400 acres of land loss in the parish, while moving the salinity line in the parish south, reducing saltwater intrusion. Additionally, the complex will provide a safe harbor for boats during storms. Members of the Pointe-au-Chien Tribe may be able to use this safe harbor when they evacuate. The construction of the complex is expected to start in 2018. The parish is also starting work on a floodgate in Pointe aux Chenes, and beginning restoration projects on barrier islands south of the community. Increasing the landmass of barrier islands could help to reduce storm surge. But not all of these projects will directly benefit the tribe, and the tribal members are not consulted when the parish makes priorities for restoration. The large size of the Morganza to the Gulf project is not always conducive to examining the affects it will have on small communities. Additionally, funding for the project came solely from the parish and state, with no federal investment. One member of the tribe explained the advantages of barrier islands over levees:

“If I was in charge of the restoration, I would be rebuilding barrier islands instead of putting up levees because with barrier islands, it slows down the surge, and the water comes in at a slow pace, and has time to spread before it, but before it gets to go too far it starts to recede, so and with these levees, they

pile up against the levees which makes us have more water, and then it starts to spread.”

The study participants have reached out to parish leadership multiple times for help with mitigation projects: “I asked our Parish President, Terrebonne, to put some rock there,” but they often end up implementing the projects by themselves.

“And people tried to protect, that’s why it would be wider than that if the people themselves, not because of the parish, it’s the people that build bulkheads and do different things, you know. But it’s not because of our government that that’s being done, it’s the people down here that do it.”

The tribe’s collaborative capacity with state entities could improve as well. The tribe is included in the state’s Coastal Master Plan, as the plan includes marsh restoration directly outside of the Pointe aux Chenes marina (see Figure 17). Most of the respondents do not think that they are included in the plan, as they were not consulted, and they were not included in the first edition. The respondents state that they are “fighting to be part of the conversation,” and that their traditional ecological knowledge could be an asset to the restoration planning process. The participants in the study think that the planning process often leaves out social aspects, and the state implements “programming” after the “planning” is done. The second edition of the Coastal Master Plan was released in 2014. The tribal elders note that the levee included in the second edition is too close to their community, and will not protect the wetlands and marshes that slow down storm surge outside of their community. In fact, other members of the community previously sold their land to provide fill for the levees. The participants point out that since the levee will be built so close to their community, the storm surge will be exacerbated just outside, rendering them more vulnerable if the levee

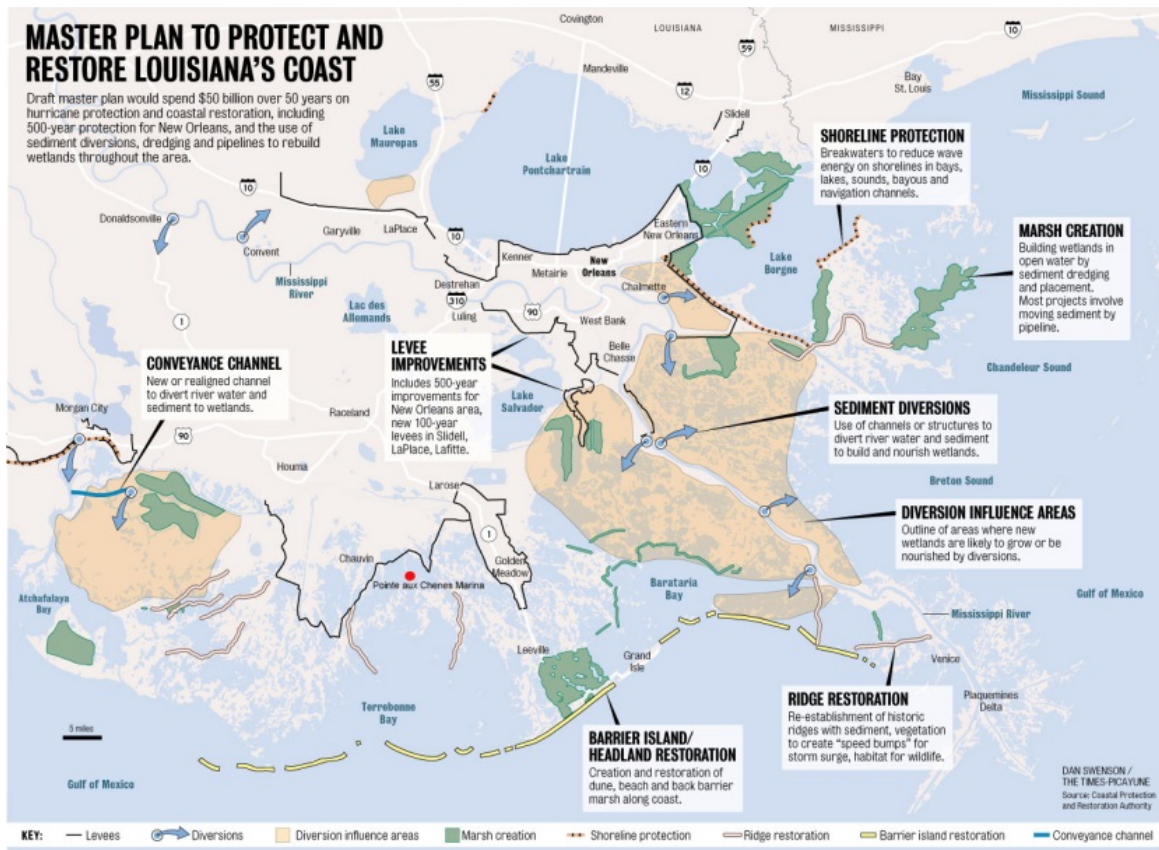
fails. The respondents also state that they could be included in some of the planned projects, such as pumping sediment from the Atchafalaya:

“The master plan don’t even have no plan for us over here. They leave us completely out. They say we’re too far from the Mississippi; too far from the Atchafalaya, but my suggestion would be again, how far can you pump from the Atchafalaya towards us, and how far can you pump from the Mississippi towards us; just pile it up and pump it from there to here.”

The Coastal Protection and Restoration Authority (CPRA) is currently looking into expanding the Atchafalaya sediment diversion. The authority conducted a series of studies examining using sediment from the Atchafalaya Basin to restore the coastline. The studies model the use of this sediment, and how it would change the coast over time. The Atchafalaya could be used to build wetlands in the central Terrebonne basin, pushing freshwater through the Intracoastal Waterway and pushing out water with high salinity. This could help build up sediment in Bayou Dularge and by the Houma Navigation Canal. However, building up sediment using a diversion project is a long and costly process. A long distance sediment pipeline could push sediment as far as Pointe aux Chenes, but there are no resources available to pump it that far at this time. Nevertheless, CPRA is designing a diversion channel that would increase the fresh marsh and reduce the wetland loss just south of the Atchafalaya Basin.



Figure 17 - 2012 Coastal Master Plan



Source: CPRA

Although mitigation projects can help to protect the tribe’s community, some mitigation planning projects inadvertently resulted in more harm to the local environment and the cultural heritage sites important to the respondents. Members of the tribe are still working to identify all of their cultural heritage sites, and restoration projects may cover or move them before they are all identified. One respondent described how a levee cut into one of their ceremonial mounds:

“Well I know when they cut over here for the Morganza, they cut on the side of a mound, and it’s now kind of collapsing, and so we contacted \_\_\_\_\_, because I think the Corps let the levee board deal with it, and he was like oh I

don't know let me look into that. I'm like I think that you have to do something to shore it up because it's your fault."

Even though the mitigation project resulted in the erosion of one of their ceremonial mounds, one tribal elder stated that there is an opportunity to protect their lands when implementing the Morganza to the Gulf project, but the pipelines in the area may make it too difficult:

"This is where I suggested they build the path for Morganza to the Gulf". It would give us at least that much more land." "But they're not in it to save land I don't think." "The only reason I think they didn't pass my suggestion, you see all these pipelines they got here? It would cause the oil companies too much problems."

Another member of the tribe questioned why they were left out of the first edition of the Coastal Master Plan, which is focused on coastal restoration in Southeast Louisiana:

"So they're redoing it right now, but then they just had another round of projects that were being proposed, but in the preliminary scoping they had projects over here and over here, but none south of us. Terrebonne Bay and whatever they just kind of skipped over it. You totally skipped the fastest eroding area."

There could be multiple reasons the state has not included the Terrebonne Bay area in the coastal restoration plan. It could be that the state thinks it is too late to protect an area that is eroding so quickly. Or, the oil and gas exploration in the area could make it difficult to implement large mitigation projects.

The newest update of the Coastal Master Plan may include more projects that are beneficial to the tribe. In 2015, the CPRA planning team held community meetings in Lafitte,

Houma and Mandeville to share the Risk and Resilience Viewer, which shows CPRA's planned Master Plan projects of and how they will impact coastal communities in the state. A member of the Pointe-au-Chien Tribal Council was able to attend the meeting in Houma. In May 2016, CPRA started the public participation process for the 2017 Coastal Master Plan. The plan includes both structural and nonstructural projects, and focuses on a multiple lines of defense strategy. The structural projects include levees, while the nonstructural projects include floodproofing commercial buildings, elevating residential buildings, and providing an option for voluntary acquisitions of residential properties. CPRA chooses projects based on modeling and cost benefit analyses. The planning team will meet with stakeholders such as nonprofits, elected officials and community groups, and advisory groups such as the steering committee and science and engineering board. The team will also conduct briefings and presentations with levee districts, business associations, advocacy organizations, and governmental group to receive feedback on the plan. Further, the team will engage parish stakeholders in 2016 and early 2017 in a roundtable format to receive more feedback on the plan. In the fall of 2016, the team will hold four more community meetings by partnering with local organizations to receive feedback from community members. CPRA will finalize the plan in April of 2017. If the authority includes the tribal members in these planned community outreach meetings, perhaps they will be able to attend and provide local ecological knowledge as well as feedback on future coastal protection and restoration projects. The state's history of implementing large structural projects to fight with natural environmental processes is changing. The state is looking to implement more nonstructural measures, and use natural processes to aid in the building of land. The participants' local

knowledge of these natural processes would increase the effectiveness of the Coastal Master Plan.

**Figure 18 - Coastal Restoration Project Outside of Pointe aux Chenes**



**Source: Tara Lambeth**

The time it takes to develop a plan and implement a project is also an impediment to effective collaboration. In March 2016, the state began a marsh restoration project just outside of the Pointe aux Chenes marina. The tribe was not consulted about this project, and the implementation of the project made it difficult for tribal members to crab in the nearby area. A member of the tribe mentioned that he liked to see those kinds of projects and that they would like to see more of them in the future. Not all of the projects in the Coastal Master Plan are funded, and there is a hierarchy of planning projects based on available funding and need. The state prioritizes projects by analyzing cost benefits, the length of time it will take, the available partners for the project, the public support for the project, and the risk of the project. Another member of the tribe pointed out that if the mitigation planning projects in the Coastal Master Plan take many years, it may not be helpful to protect the area around Pointe aux Chenes because it is disappearing so quickly:

“This place even won’t even be here in 40 years. They get a few storms...believe me. You ought to come when the water’s real high from the south, you know, the tide reading about two foot of rain. Sometime it goes on the road over here. Not a storm just a regular wind.”

A further barrier to collaboration is receiving recognition by the state and federal governments. The state recognized the tribe as an official Indian tribe in 2004, but the tribe is still working on federal recognition. The tribe applied in 1996, but was denied by the Bureau of Indian Affairs because of the need to prove the tribe’s history prior to 1830. The tribe is trying to prove they are a unique Indian community apart from the other tribes in southeast Louisiana. In order to obtain federal recognition, the tribe must prove they are historically tied to the land they live on. Federal recognition would give the tribe funding and allow its aboriginal land title case to move forward. The tribe would also be eligible to have the land put into trust. This land trust could help the tribe protect themselves from further oil and gas exploration.

While increasing their resilience and ability to survive in the area, the historic isolation of the tribe has hurt the tribe’s agency in outside affairs. Although the tribe straddles the bayou that separates Terrebonne and Lafourche parishes, and the members of the tribe on the Terrebonne side are a part of the Terrebonne voting district, while those who live on the Lafourche side vote in the Lafourche parish elections. Bordering parishes forces the tribe to communicate with two different parish governments, and while recognized by the state and both parishes, the tribe does not have the federal recognition that would give them more funding and decision-making power. Additionally, the federal recognition process requires that tribes prove exclusivity and ties to a specific area. This causes contention among tribes

located in nearby areas, as they are all working to prove their unique ancestry and separate political and social communities. The inherent capacity the tribe has to protect themselves allows them to continue to live in a physically vulnerable area, but the lack of connection with government policy has hurt the tribe's ability to fully adapt. There is room for the regional, state and federal government to interact more with the members of the tribe, particularly on mitigation and adaptation measures. The tribe's knowledge about hazards and mitigation strategies would be invaluable to governmental mitigation measures, as they have knowledge of the workings of the environment before any structural projects were installed, or the natural deltaic processes of the Mississippi River were altered. Alerting planning authorities to the existence of this invaluable knowledge would help to increase the effectiveness of mitigation strategies.

In order to understand the adaptive capacity of the Pointe-au-Chien Indian Tribe, I examined the variables in Kerner and Thomas's metric: response diversity, connectivity, abundance/reserves, learning capacity, and collaborative capacity. I examined these to understand the tribe's ability to adapt to the climate change it faces, including the highest rate of relative sea level rise in the world. The respondents have had many diverse responses to the hazards in the area, and are connected to other tribal members. Although the study participants respond to the vulnerabilities in its environment in a variety of ways, some of their responses may not be effective if the changes in the environment become too severe. As seas continue to rise, relocation may be the only response left. This would sever the tribe's connection to the land and their people, and remove them from the resources in the area that have allowed them to survive for centuries. The only effective relocation would occur if the tribe could relocate and maintain their culture and traditions, while continuing to live off of

the land and water. The representatives of the tribe use the reserves in the environment to survive, but these reserves have been harmed by natural and manmade disasters. The tribal elders have learned to adapt to these natural and manmade disasters, but the frequency of the disasters has become challenging. Finally, although those chosen to speak for the tribe collaborate effectively with each other, they are not always consulted and involved in the implementation of policy decisions. The tribe has learned to adapt to vulnerabilities in their environment over time, but effective adaptation is tied to the ability to collaborate with others within and outside their community. The collaborative challenges the tribe faces presents an obstacle to their adaptive capacity, and ability to respond to policy measures enacted in response to changes in the environment.

### ***Mapping Adaptive Capacity***

As mentioned in the Research Design chapter, this case study emerged from a collaborative research project. The goal of the project was to identify areas of concern about relative sea level rise, as well as ideas for mitigating the relative sea level rise. The items identified were then used to make maps to help facilitate the tribe's future adaptation planning. While the mapping project focused on specific environmental changes and areas for mitigation and adaptation planning, my case study delved further into the interview data to identify themes related to adaptive capacity and examine the relationship between the tribe's adaptation processes and governmental mitigation policies and the implementation of those policies. The maps produced by the team reflect the themes brought up by the representatives of the tribe visually, revealing the extreme land loss, erosion and subsidence in the area, as well as the impacts oil and gas extraction have had on the environment.

The project team produced ten maps that portray the tribe’s vulnerabilities and sustainabilities. I used the same inductive codes for my case study, but the team designed the latent codes for the mapping project to reflect easily mapped and visualized topics. The maps mirror each other, as each vulnerability map has a corresponding sustainability map. The theme of each map emerged from the codes identified in the interviews with the members of the tribe (see Table 8). In the interviews, the members of the tribe identified issues with the changes in the environment, solutions for mitigating those changes, and important cultural resources that they would like to protect. The inductive codes are the themes that emerged from the interviews, while the parent latent codes are the codes that the team created for each individual map after grouping and analyzing the inductive codes. The latent codes reveal the underlying meaning of the inductive codes (Cho & Lee, 2014).

**Table 8 - Inductive Mapping Codes with Latent Codes**

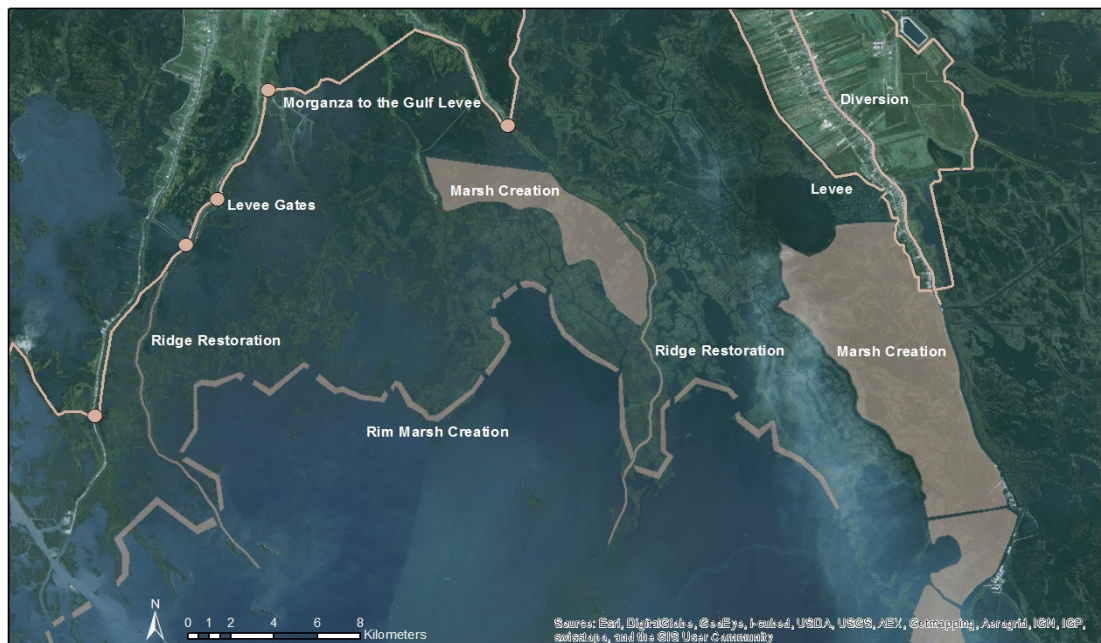
<b>Levee Alignment – Sustainability</b>	<b>Levee Alignment - Vulnerability</b>
Resident Solution: Levees	Levees
Resident Solution: Marsh Creation	
<b>Shoreline Protection – Sustainability</b>	<b>Land Loss - Vulnerability</b>
Resident Solution: Shoreline Protection	Land Loss
Resident Solution: Shoreline Restoration	Erosion/Subsidence
Resident Solution: Rock Off Canals	Saltwater Intrusion
	Lost Barrier Islands
<b>Speed Bump – Sustainability</b>	<b>Oil Canal Erosion - Vulnerability</b>
Resident Solution: Spoil Banks	Widening Canals
	Spoil Banks
<b>Adaptability - Sustainability</b>	<b>Loss of Utility - Vulnerability</b>
Resident Solution: Buy New Land	Sea Level Rise
Culturally Relevant Sites	Accelerated Sea Level Rise
Resident Solution: House Elevation	Relocation
Cultural Subsistence Areas	Increased Storm Surge
Attachment to Place	Loss of Trapping Industry
	Less Fishing/Shrimping
	Moving up the Bayou



	Younger Generations Moving Away
	Lost Communities
	Increased Current
	BP Oil Spill

The first set of maps the project team created were Levee Alignment – Sustainability and Levee Alignment – Vulnerability. The sustainability map emerged from the codes resident solution: levees and resident solution: marsh creation. The vulnerability map emerged from the code levees. These maps reflect how the mitigation measures identified by the participants could help protect them, and how the mitigation measures identified by the parish and the state could conversely hurt them. The respondents think the placement of the Morganza to the Gulf levee should be further out in the bayou, in order to protect the marsh and reduce storm surge. The planned placement of the levee is currently very close to the community, which could contribute to land loss outside of the community.

**Figure 19 - Levee Alignment - Sustainability**

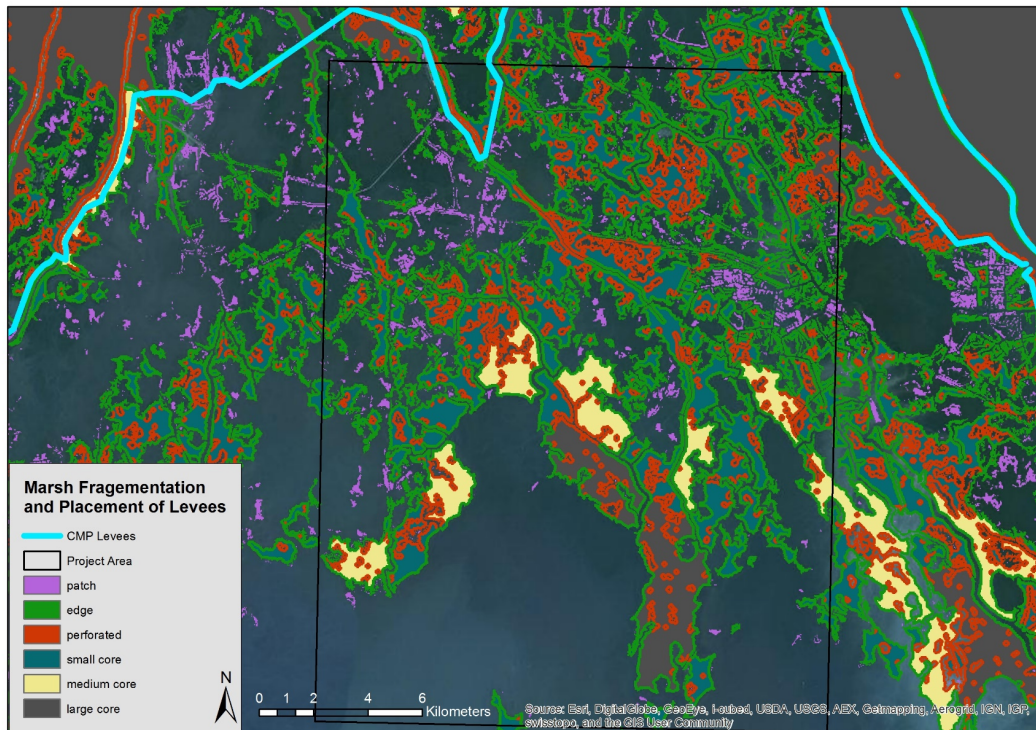


Source: Louisiana Sea Grant

Figure 19 shows the proposed Morganza to the Gulf levee alignment. The parish plans to complete the levee alignment in 2017. When the project is complete, a 10-foot levee will surround coastal Terrebonne Parish. The map also shows the proposed marsh creation that will coincide with the building of the levees. The creation of marsh, along with the placement of the levees, will help to lessen storm surge in coastal Terrebonne Parish. The levee will surround Pointe aux Chenes, and will therefore help to reduce storm surge in that area.

Figure 20 depicts the levee alignment in lower Terrebonne Parish as well, but reveals the vulnerabilities associated with building a levee. The introduction of levees in the environment results in marsh fragmentation, as the levees interrupt the natural coastal processes that usually occur. The map shows the extent of marsh fragmentation outside of the built levee system.

Figure 20 - Levee Alignment - Vulnerability

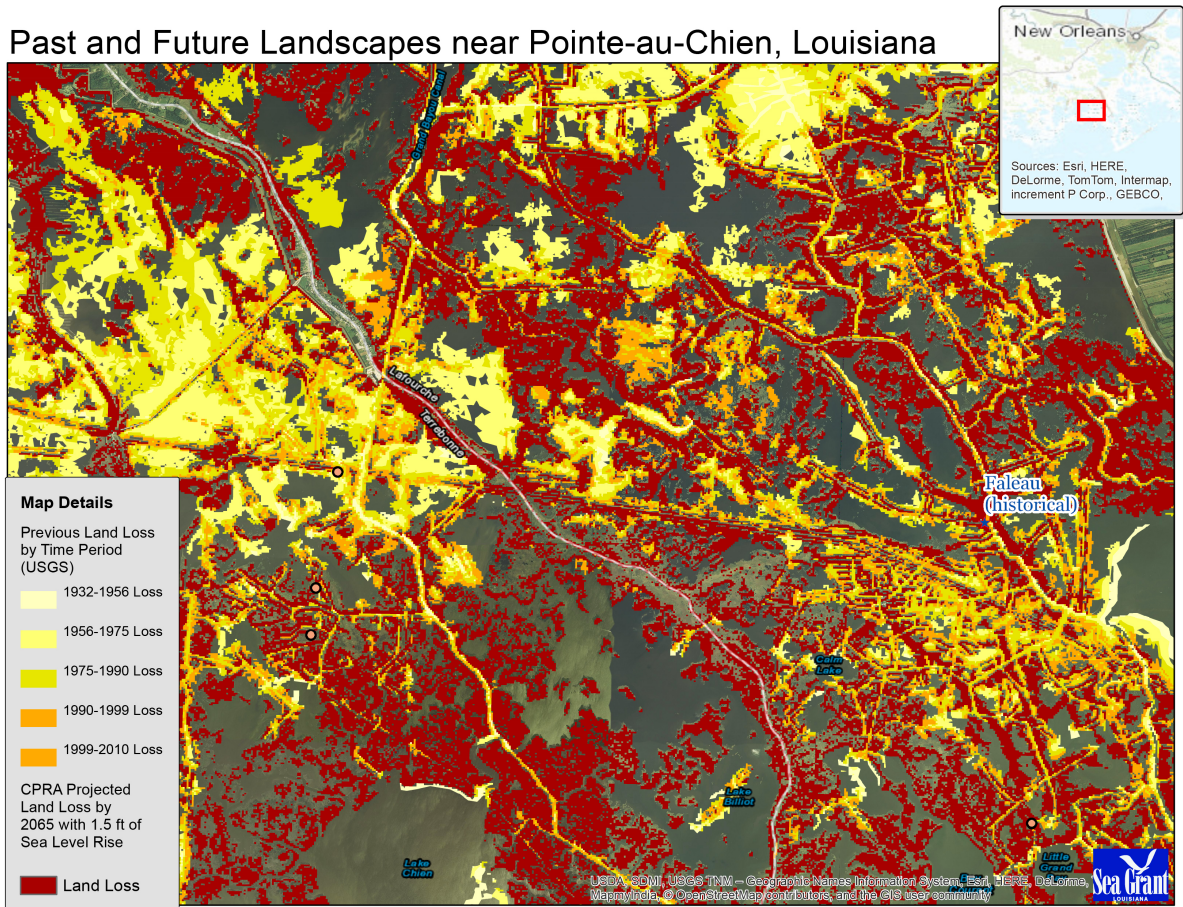


Source: Louisiana Sea Grant

The second set of maps the project team created were shoreline protection – sustainability and land loss – vulnerability. The sustainability map emerged from the codes resident solution: shoreline protection, resident solution: shoreline restoration and resident solution: rock off canals. The vulnerability map emerged from the codes land loss, erosion/subsidence, saltwater intrusion and lost barrier islands. While the members of the tribe recognize the extreme land loss affecting the area, they have ideas on how to mitigate it.

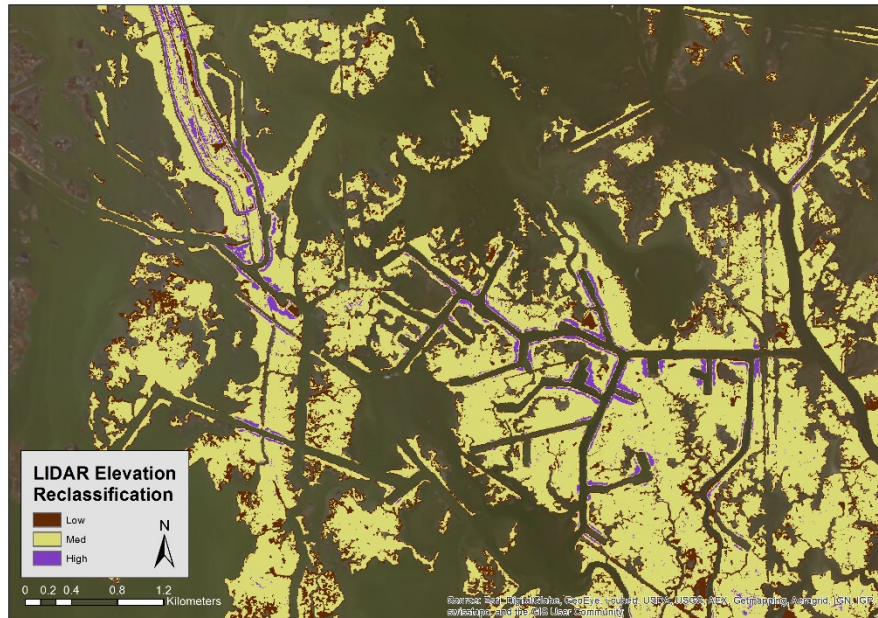
Figure 21 reveals the land loss in Lower Terrebonne Parish, surrounding Pointe aux Chenes, from 1932 to 2010. In less than eighty years, an enormous amount of land has disappeared, including large pieces of marsh as well as barrier islands. The loss of this land exposes Pointe aux Chenes to the elements, leaving the area vulnerable to higher tides and more extreme storm surge. The project team is still drafting the sustainability side of this map, shoreline protection.

Figure 21 - Land Loss in Pointe aux Chenes, 1932-2010



The third set of maps the project team created were speed bump – sustainability and oil canal erosion – vulnerability. The sustainability map emerged out of the code resident solution: spoil banks and the vulnerability map emerged from the codes widening canals and spoil banks. Although the oil and gas industry harmed the environment by digging canals that get wider and wider, a member of the tribal elders believe these companies could help protect the area, by building the spoil they dig from the canals into speed bumps that would serve to reduce storm surge and protect the Pointe aux Chenes community.

**Figure 22 - Spoil Bank Elevation**

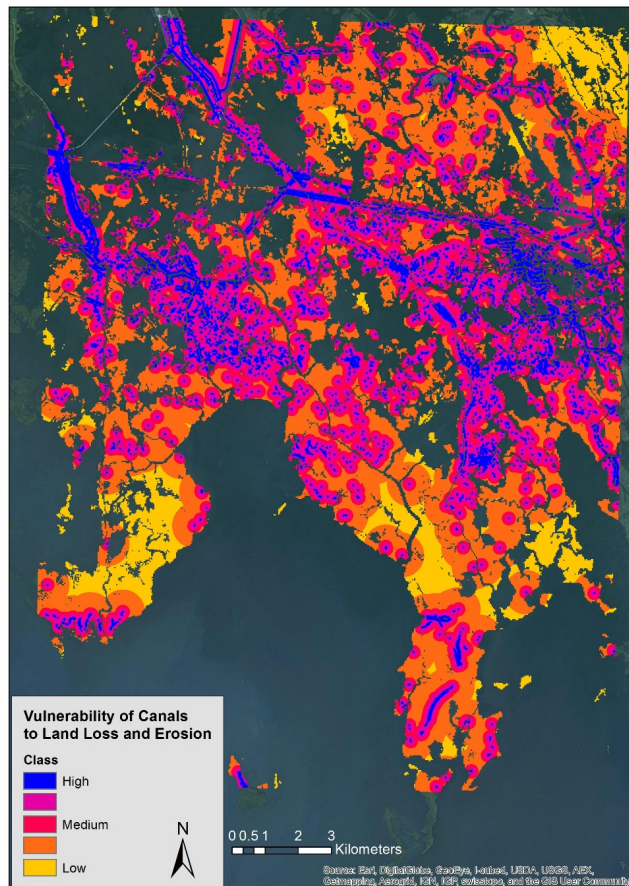


**Source: Louisiana Sea Grant**

Figure 22 reveals the elevation along oil canals in the bayous outside of Pointe aux Chenes. The map is an enlarged section of the larger map of the Pointe aux Chenes area. The team enlarged the map to show the elevated spoil bank areas. Some of the spoil banks in the area eroded over time, but this map depicts the spoil banks that are still elevated above the marsh. Because they are elevated above the marsh, the highlighted purple sections in the map reveal the spoil banks that could function as speed bumps. If spoil was strategically placed along these canals, it could result in terracing along the bayous. These terraces would serve as speed bumps that would help to reduce storm surge, and better protect the community from tropical storm and hurricane events. Right now, the spoil is not strategically placed, and therefore the community is missing out on a mitigation opportunity that would come from already planned development. In this way, the oil and gas industry could help to mitigate some of the results of the extraction activities in the area, rather than exacerbating the environmental change.

Figure 23 depicts the vulnerability of the canals in the area to land loss and erosion, partly as a result of the extraction activities of the oil and gas industry. The blue color shows high fragmentation, the pink color shows medium fragmentation, and the yellow color shows low fragmentation. The fragmentation is highest where canals have been cut through bayous. The map particularly highlights the canals that widened significantly over time, as evidenced by the large amount of blue on the map. According to the TEK experts, these blue areas contribute the most to the vulnerability factor portrayed in the map.

**Figure 23 - Vulnerability of Canals to Land Loss and Erosion**



**Source: Louisiana Sea Grant**

The fourth set of maps the project team will create are adaptability – sustainability and loss of utility – vulnerability. The sustainability map emerged from the codes resident solution: buy new land, culturally relevant sites, resident solution: house elevation, cultural

subsistence areas, and attachment to place. The vulnerability map emerged from the codes sea level rise, accelerated sea level rise, relocation, increased storm surge, loss of trapping industry, less fishing/shrimping, moving up the bayou, younger generations moving away, lost communities, increased current, and the BP oil spill. The sea level rise and increased storm surge in the area has forced the tribe to move up the bayou or relocate altogether. The tribe can protect itself from these vulnerabilities by buying an evacuation spot, continuing to elevate their homes, and adapting to continue to live off of the water and the land. The project team is still drafting these two maps.

The project team designed the maps in collaboration with the tribe so that the tribe can identify issues in order to continue adapting to their environmental situation. The vulnerability and sustainability maps that emerged from the interview codes further emphasize the adaptive capacity of the tribe, and will help the tribe plan for additional adaptation measures in the future. The team plans to overlay all of the vulnerability factors on a single composite vulnerability map, and overlay all of the sustainability factors on a single composite sustainability map. This effort will help the tribe visualize its perceived sustainability and vulnerability factors related to projected sea level rise effects in an integrated and comprehensive format. Sea level rise projections and associated local storm surge models will be used to overlay and intersect with the TEK-based composite maps utilizing the interactive weTable technology, so the tribe can gain an increased understanding of the likely impacts these coastal hazards will have on its vulnerability and sustainability factors, and use this information to enhance planning for the future. Not only are the maps a visual representation of the issues and themes related to the tribe's adaptive capacity, they are

also a tool the tribe can use to participate in policy discussions. In this way, the maps enable the tribe to reveal their issues and ideas for adaptation measures to policymakers.

### *Summary*

The environmental changes and policy responses to those environmental changes affect the adaptive capacity of the Pointe-au-Chien Indian Tribe. The tribe continues to adapt to these changes at a local level, but is often left out of policy decisions. Policy decisions, particularly those that deal with mitigation strategies, could benefit from the tribe's local knowledge about environmental processes in the area over time. In addition, the tribe would have more capacity to preserve their traditions and culture if they were included in policy decisions. The next chapter compares the case study to the theory and literature in order to further understand the adaptive capacity of the tribe, and examines the plans that affect this adaptive capacity, in order to understand how enabling the tribe to participate in mitigation policy could improve the tribe's ability to adapt.



## **Chapter 5: Links to Literature and Theory and Analysis**

This chapter links the adaptive capacity discussion back to theory and literature, and examines the local, regional and federal plans that affect the tribe's adaptive capacity. The examination of these plans reveals the policy responses to climate change in the area. The chapter then explores the adaptive capacity metric and how the data, literature and plan review inform the tribe's adaptive capacity as it faces environmental changes from both climate change and policy responses to climate change.

### ***Link to Hazard Mitigation, Disaster and Urban Planning Theory***

The Pointe-au-Chien Indian Tribe is familiar with aspects of social and physical vulnerability. Although the tribe is in a physically vulnerable location, they are resilient through their social ties and innate knowledge of their ancestral home (Scott, 1998). They live the dichotomy of physical and social vulnerability daily, becoming more vulnerable through relative sea level rise and some mitigation projects, while, as ecosystem users, continuing to live and thrive off of a vulnerable landscape (Bogard, 1988; Soja, 1989). The members of the tribe work to protect themselves from hazards through elevating their homes, and fight for the autonomy to protect their culturally relevant areas. They use their knowledge of the area to understand what parts of the bayou are becoming more vulnerable, and what may need protection in the future.

The tribe developed unique ways to respond to and mitigate disasters. Since the tribe is located in an isolated region, and has been for centuries, they often respond to disasters without outside help, either sheltering in place, evacuating to another location, or moving up

the bayou permanently when the location becomes too vulnerable (White, 1974). As ecosystem users and experts on their area, the tribe has firsthand knowledge of the hazards that they face (Bogard, 1988). Rather than altering the environment that they reside in, they adapt to environmental changes over time (Mileti, 1999).

Although relative sea level rise is a single disastrous event, it is a slow moving one, and contributes to multiple immediate disastrous events, such as storm surge from hurricanes. As a single community of ecosystem users, the hazard mitigation methods of the tribe may not apply to all coastal communities, but they do apply to other indigenous ecosystem users dealing with relative sea level rise and the increase in hazards and disasters that goes along with it (Scott, 1998).

The tribe has experience with mitigation measures that result in increased risk, such as homes that are elevated so high they are in danger of wind damage, or levees that are built so close to a community that they increase the intensity of storm surge (Comfort et al., 1999). The tribe's local knowledge allows them to understand the long-term effects of these mitigation methods, and their ideas would be invaluable for local, state and federal plans (Scott, 1998).

The tribe has the "metis" to adapt to changes in the environment, and has done so for centuries (Scott, 1998). This contributes to the tribe's resilience (Godschalk, 2003). While the tribe gained its resilience through living off of the land independently and having strong social ties, it could be even more resilient through federal recognition. This federal recognition would allow the tribe to better combat the physical and social vulnerabilities that will make relative sea level rise in the area such a devastating disaster. The tribe would be able to protect and conserve their ancestral land through land trusts, grow their economy

through grants, and preserve their culture through museums and educational services, like other similar tribes in Louisiana. The tribe could then continue to use their local knowledge to mitigate effectively for this hazard and adapt to hazardous situations in the future (Tierney, 1999; Comfort et al., 1999; Scott, 1998). This autonomy and agency to use their local knowledge and protect and conserve their land is what would make the tribe ultimately resilient. As climate change affects other coastal communities, the knowledge of what needs to be protected, coupled with the autonomy to make changes to protect those vulnerabilities, will be what helps coastal communities be resilient into the future.

### ***Link to Literature –Disaster Studies and Planning Literature***

If disasters reveal underlying issues in the environment and in society (Olshansky & Chang, 2009), then relative sea level rise, as a slow moving disaster (Muller, 2007), is a slow reveal of those issues. Relative sea level rise effects the environment, through erosion and rising water, and society, by inundating human environments (Doussou & Glehouenou-Doussou, 2007). The process of relative sea level rise will significantly alter the Pointe aux Chenes community, in ways no other disaster has in the past. Understanding how the Pointe-au-Chien Indian Tribe adapts to relative sea level rise will help reveal how other communities in similar situations can adapt as well.

Climate change and the resulting relative sea level rise are both a hazard and a disaster (Mileti, 1999). In the short term, relative sea level rise is a hazard that can cause increased storm surge and erosion (Doussou & Glehouenou-Doussou, 2007). In the long term, it is a disaster that can tear communities from their homes (Dalbom, Hemmerling & Lewis, 2014). Relative sea level rise is a disaster particularly to the coastal locations that it

affects, especially those that are ecosystem users like the Pointe-au-Chien Indian Tribe, and it is a disaster on an environmental, economic and social scale (Bronen, 2008).

Because climate change is a slow moving, long-term disaster, communities responding to it can be in any part of the disaster cycle – mitigation, preparedness, response and recovery (Tierney, 1999). The Pointe-au-Chien Indian Tribe is currently recovering from increased storm surge from tropical storms and hurricanes in the past as well as subsidence, erosion and rising sea levels, responding to the mitigation methods the state is implementing in their area, and mitigating and preparing for the next hazardous event by elevating their homes or moving up the bayou.

Experts and leaders in the tribe have the ability to mitigate and respond to these disasters at the community level, but do not always have a voice at the regional (parish), state and federal levels. While the community is inherently therapeutic, or willing to help each other, within their community (Barton, 1969; Picou & Marshall, 2007; Picou, Marshall, and Gill 2004) by providing and sharing resources, climate change is a slow moving disaster that does not receive the attention and philanthropy of low probability high consequence events like hurricanes.

The tribe is socially resilient, but vulnerable in their ability to collaborate with policymakers. In some ways, the tribe is left out of the external social system when it comes to policy, which conversely makes their internal social system more independent and strong. The ability to thrive in isolation means the tribe does not have to depend on others to survive, but also means the tribe may not be invited to share their knowledge on policy issues. This dichotomy in their social vulnerability has allowed the tribe to survive living in an isolated coastal area, while at the same time the tribe is fighting to be part of the conversation

regarding regional, state and federal policy (Bogard, 1988; Soja, 1989). The tribe understands the hazards and risks in their coastal location, and has for centuries (Haque, 1997; Holub & Fuchs, 2009). The tribe also participates in planning processes at the regional level, and is trying to participate in processes at the state and federal level as well (Innes, 1996). The tribe works with the environment while trying to mitigate hazards, but many mitigation methods implemented by planning authorities are only short-term solutions (Mileti, 1999). In an area with such high relative sea level rise, a more long-term solution may be required. There are many plans that propose short-term and long-term solutions for the area.

### ***Plan Review***

This next section reviews the plans that affect the Pointe-au-Chien Indian Tribe, in order to delve deeper into the impacts of planning policy on the community. While the region and state are working to implement hazard mitigation measures such as CPRA's marsh restoration efforts around the tribe's community, the Morganza to the Gulf project, and local parish levees, the planning authorities did not make use of the tribe's local knowledge when developing these projects. For example, the state held community meetings sharing the planned projects and what the results of the projects could be in the future throughout Louisiana, but did not ask for feedback on the projects themselves, just the Risk and Resilience viewer that explains the projects to the public. Tribal members also attended parish planning meetings for the Morganza to the Gulf project but were not able to convince planning officials to change the placement of the levee. These efforts could harm the community in the future, as the placement of a levee can increase storm surge and contribute to the degradation of the wetlands. Members of the tribe fully support effective mitigation in

their community, but have difficulty communicating these strategies to policymakers who do not invite them to the table. If policymakers were to understand the breadth of the tribe's knowledge about the environmental changes in coastal Louisiana, the tribe would possibly have more of a voice in planning policies.

Located in a vulnerable coastal location, the Pointe aux Chenes area is replete with mitigation measures, both structural and nonstructural. The structural mitigation measures include local levees, while the nonstructural mitigation measures include marsh restoration and house elevation (Broome, Dubinin & Jenkins, 2015). House elevation is implemented at the individual level, often by assistance from the parish government. Marsh restoration and levees are implemented at the state, regional and federal levels.

At the regional level, the Pointe-au-Chien Indian Tribe is recognized by both Terrebonne and Lafourche parishes, and the Pointe aux Chenes area is listed in numerous local hazard mitigation plans (Godschalk et al., 1999). Parish recognition allows the tribe to have its own schools and government. Terrebonne and Lafourche parishes, which the tribe borders, both have hazard mitigation plans. While the critical facilities in Pointe aux Chenes are listed and mapped in the Terrebonne Hazard Mitigation Plan Update (2009), the tribe itself is not mentioned. The Terrebonne Hazard Mitigation Plan Update (2015), on the other hand, included the Pointe-au-Chien Indian Tribe on the Hazard Mitigation Plan Update Steering Committee, and the Pointe aux Chenes community is mentioned as an unincorporated community within Terrebonne Parish. The tribe is willing to participate in hazard mitigation if they are invited to the table, and Terrebonne Parish has made progress encouraging the tribe's participation (Godschalk, Brody & Burby, 2003). The plan goes on to list a planned non-federal levee in the Pointe aux Chenes area, the elevation of a pump in the

area, and lists the critical facilities in the area. Similarly, the Lafourche Hazard Mitigation Plan Update (2010) lists a pump station in the community, and makes note of the Wildlife Management Area nearby, but does not mention the tribe either. The plan does mention the United Houma Nation, a neighboring tribe, and a meeting that was held with the tribe in 2009 discussing the hazard mitigation planning process (p. c 2-6). The Lafourche Hazard Mitigation Plan Update (2015) does not mention the tribe, or any other tribe, or the area at all.

At the state level (Godschalk et al., 1999), the Coastal Master Plan also addresses the Pointe aux Chenes area. Louisiana's 2012 Coastal Master Plan makes note of a planned "restoration of approximately 57,000 feet (130 acres) of historic ridge along the southern portions of Bayou Pointe au Chene to provide coastal upland habitat, restore natural hydrology, and provide wave and storm attenuation" (p. 126). While this project will directly affect the tribe and their community, the study participants were not aware of the planned restoration, or consulted about the location or extensiveness of the mitigation method. In addition, the only mention of indigenous or native peoples in coastal Louisiana is located in the section labeled "a vital regional and national asset" (2012, p. 20). This section points out that the planning team received a comment from the public, "which quoted a well known Native American saying, 'Treat the earth well. We do not inherit it from our ancestors; we borrow it from our children'" (2012, p. 20). Additionally, the tribe was officially recognized by the State of Louisiana in 2004. State recognition allows the tribe to apply for some federal funding for various tribal needs, as well as access to student scholarships, although does not carry the weight of federal recognition.

There are multiple aspects at the federal level that allow communities to mitigate hazards (Burby, 2006). The update of a hazard mitigation plan, for example, gives localities access to FEMA funding when a disaster occurs. For Native American tribes, there is another process that can give communities access to grant funding – federal recognition. The tribe applied for federal recognition in 1996, and was asked to provide more information in 2008. The tribe continues to work on the federal recognition effort. The federal recognition process requires documentation of a unique history and heritage over hundreds of years, and this documentation requires extensive research. In 2005, the tribe received a grant to continue researching and recording their history and cultural heritage.

There are only four federally recognized tribes in Louisiana: the Chitimacha Tribe of Louisiana, the Coushatta Tribe of Louisiana, the Jena Band of Choctaw Indians, and the Tunica-Biloxi Indian Tribe of Louisiana. Many of the tribe's ancestors and neighboring tribes have undergone or are currently undergoing the federal recognition process. The United Houma Nation, which the Acolapissa joined in the 1700s, began the federal recognition process in 1979, submitted an application in 1985, and was denied in 1994. The tribe filed a rebuttal to this finding in 1996, and is still currently waiting for an answer from the Bureau of Indian Affairs. The Atakapa began the federal recognition application in 2007 and obtained nonprofit status to work towards this goal. The Tunica-Biloxi Tribe was federally recognized in 1981, and used this recognition to create a reservation of 1,717 acres of land trust in Avoyelles and Rapides Parishes. Additionally, the tribe opened the Paragon Casino Resort, which contributes to the tribe's economy, and built a Cultural and Educational Resources Center (CERC) in order to protect and share their culture and ancestry. The Chitimacha Tribe of Louisiana was federally recognized in 1916. The tribe owns 963 acres,



445 of which are in trust. After federal recognition, the tribe formed a constitutional government and adopted a constitution. Additionally, the tribe owns cultural institutions such as schools and museums, economic drivers such as entertainment complexes, construction and technical service companies, and local service agencies such as police and fire departments, and assisted living facilities. All of these entities make the tribe the “second largest employer in St. Mary Parish” ([www.chitimacha.gov](http://www.chitimacha.gov)). Most importantly, federal recognition allowed the tribe to preserve their culture through a museum, cultural/historic preservation office, and a Rosetta Stone Software project, which teaches all tribal members their original language. For the Pointe-au-Chien Indian Tribe, federal recognition could help protect their disappearing lands, preserve their traditions and culture, improve their economic and educational opportunities, and allow them to apply for grants for conservation and restoration projects.

The federal recognition process was originally led by the Bureau of Indian Affairs (BIA). According to the BIA:

“The purpose of the Federal acknowledgement regulations is to acknowledge that a government-to-government relationship exists between the United States and tribes which have existed since first contact with non-Indians.

Through the process, the Government determines whether it should extend such a relationship to a particular petitioner (United States Department of the Interior, Office of Federal Acknowledgement, 1997, p. 4).

In 1997, the Office of Federal Acknowledgement (OFA) took over the federal recognition process. The OFA staff provides technical assistance for tribes that need help with their petition. The process requires tribes to define their members, describe their community and

activities, and research their tribal history in order to find its origins (1997, p. 20). The tribe should provide continuous documentation for both recent and past years. The BIA also allows the use of oral history to support the tribe's petition. The tribe is currently translating and transcribing oral histories to help contribute historic data to their application. For the petition to be successful, the tribe must "demonstrate continued tribal existence" (1997, p. 36). The tribe can have members who married outside of the tribe, as long as they remained in contact (p. 40).

Tribes that prove that they are a single historic tribe, an amalgamation of tribes, or a piece of a historic tribe, are all eligible for federal recognition (1997, p. 39). Fragmented tribes, tribes that are no longer in contact, tribes that were not in continued existence, or tribes that are made up of a group of new tribes will not be recognized. This requirement is difficult to meet, as Native American tribes were historically torn apart by the Indian Removal Acts in the late 1800s. The OFA recently denied a Florida tribe recognition because they were split into factions by the Trail of Tears. Historically, these tribes were considered to be "remnant" tribes and were therefore not recognized as single entities. In 1897, a legal case concluded there were no tribal related Native Americans in the state of Louisiana, most likely because the tribal members that resided in Louisiana were not on reservations (*Cycol vs. State of LA*, 1897). Tribes in Louisiana were often encouraged to renounce their tribal membership, and American Indians were not allowed to attend school in Louisiana until the late 1960s. In fact, the OFA has pointed out to the tribe that the period from 1940 to 1988 is one of the time spans that particularly lacks documentation. The tribe is obtaining interview and oral history data to help fill this gap. Because Native American tribes were historically undocumented, removed or ignored, it makes it difficult to prove tribal ancestry and land

ownership throughout time. In addition, tribes that went through the federal recognition process once and were denied cannot apply again.

Tribes that are federally recognized have to meet seven criteria. The criteria include that the tribe has been a self-governing entity in existence since 1900, and has been a community continuously since that time and has been self-lead since that time. They also have to submit a document of that governance, have current descendants from historic members, prove that the majority of the members are not already members of a recognized tribe, and that the tribe's relationship with the United States was not terminated by Congress. In July 2015, the OFA revised the federal recognition process "to make the process and criteria more transparent, promote consistent implementation, and increase timeliness and efficiency, while maintaining the integrity and substantive rigor of the process" (Federal Register, 2015).

The Pointe-au-Chien Indian Tribe is working to be federally recognized and gain these cultural advantages. In order to improve their collaborative capacity with the federal government, the tribe holds monthly planning meetings to develop their federal recognition strategy. At these meetings, members of the tribe bring food to share with the group, and volunteer their time to work on various recognition projects, including identifying ancestors, researching the history of the tribe, and compiling oral histories. The tribe received a grant to assist them in their recognition work, and have just started year two of the three-year grant. The tribe has to prove that they have both a social and political community. The tribe met the social community requirements from 1900 to the present, and they are documenting the political community by researching leadership, marriages, and where members of the tribe lived. If more than 50% of the tribal members reside in a community for a span of time, it

meets the criteria for the time period. The tribe created a database of every member of their tribe, and are researching their ancestry. Federal recognition requires the tribe to provide documentation on all of their members, such as birth certificates. The creation of the database has been difficult, as historic documents report different spellings of tribal names. The tribe is consulting historical records, such as those made by the Works Progress Administration in the 1930s, to pinpoint the locations of tribal homes in the past. The military enumeration of widows from the Revolutionary War and history letters from the Houma Chamber of Commerce also mention members of the tribe. As of May 2016, the tribe identified 3,846 members and ancestors; and 680 living members. In addition to detailing their membership, the tribe also has to prove a 50% endogamy rate from the past decade. This means that at least 50% of the members of the tribe have intermarried in the past decade. This endogamy proves the ancestry and political leadership of the tribe. The tribe has to further prove their exclusivity to the Pointe aux Chenes area, as well as their connection to one another. While they are documenting their ancestry, the tribe is also documenting sacred sites, to prove their historical ties to the land as well as identify areas they would like to protect from environmental change. The tribe reached out to academics in the field to help them with the federal recognition process, therefore increasing their collaborative capacity with the local university community. The federal recognition process could allow the tribe to put their historic land into trust and protect it from further environmental degradation. Moving away from the area would mean the tribe would move away from their protected land. If their community is not adequately protected, living on the land could become untenable, and the tribe may have to find a place to relocate to in the future.

### ***Link to Literature – Vulnerability, Resilience and Adaptation***

Beyond the study of disaster and planning theory, the vulnerability, resilience and adaptation methods used by the tribe affect their adaptive capacity. The Pointe-au-Chien Indian Tribe contends with both physical and social vulnerabilities (Blaikie et al., 2003). While the tribe is self-sufficient and resilient, their social vulnerabilities stem from the hazards in their location and the built form of that location that can increase those hazards (National Research Council, 2006). Further, the tribe's social vulnerabilities are compounded over time, as they are repeatedly recovering from manmade and natural disasters (Cutter & Emrich, 2006). In addition, the tribe is physically vulnerable, living in an area with the highest rate of relative sea level rise in the world (McGranahan, Balk & Anderson, 2007). These social and physical vulnerabilities combine to form a situation where a hazard could very easily become a disaster.

The Pointe-au-Chien Indian Tribe is resilient because it is self-sufficient, socially connected internally and striving to connect externally, and knowledgeable about the hazards in their environment (McLellan & Elran, 2012). Additionally, the tribe has adapted to these hazards over time, responding with knowledge and flexibility (Kerner & Thomas, 2014). This type of resilience stems from the fact that the members of the tribe are ecosystem users that have thrived in their location for centuries (Scott, 1999). This inherent resilience may be difficult for nonindigenous non-ecosystem users to access.

The tribe's resilience comes out of their ability to adapt, specifically at the community level (Norris et al., 2008). This ability is present during all stages of the disaster cycle. Although the tribe has the adaptive capacity necessary to adapt to climate change (Kerner & Thomas, 2014), the severity of the change in their area is becoming an increasing

challenge to this adaptive capacity. This capacity may have to go beyond the ability to be flexible and learn from events, to having the ability to influence and change infrastructure, both structurally and nonstructurally (Wilk et al., 2013). This will involve adaptation planning, which requires resources and long-term planning (Fankhauser, Smith & Tol, 1999). Adaption planning is more effective if the tribe increases their agency and connectivity with regional, state, and federal governments. The tribe is currently increasing their collaborative capacity already by reaching out to academics to help them with their adaptation planning efforts. The tribe's attachment to their home makes this adaptation planning even more necessary (Burley et al., 2005).

### ***Examining the Adaptive Capacity Metric***

Kerner and Thomas (2014) identify attributes in socio-ecological systems that contribute to resilience. This study examined the variables identified by Kerner and Thomas that are characteristics of adaptive capacity. Using these variables to understand adaptive capacity allows for a way to plan for adaptation: “these standardized resilience terms, from which metrics can be derived, can be incorporated into resource management plans and decision-support tools to help managers assess the current resilience status of their systems, gauge progress toward goals, make rational resource allocation decisions, justify funding choices, and enable training and unity of purpose across programs” (Kerner & Thomas, 2014, p. 673). Kerner and Thomas focus on social-ecological systems when identifying the metrics for adaptive capacity, as resilience applies to both social and physical aspects of a community (Kerner & Thomas, 2014, p. 674). Identifying these metrics allows for resilience theory to move from the theoretical to the applied (Kerner & Thomas, 2014, p. 676).

In order to make the attributes useful for analysis, Kerner and Thomas focused on attributes that “are stated in the language of stakeholders; address easily-assessed system attributes without extensive knowledge of new theory; and promote the ready consideration of the broadest range of factors that could affect system resilience” (2014, p. 680). Kerner and Thomas state that making the metrics understandable to stakeholders will make them more implementable, as “stakeholders are the ones who will ultimately decide whether to assess the resilience of their systems, and this hinges on their understanding of the value of these concepts” (2014, p. 681).

Although I only made use of the adaptive capacity resilience attribute, Kerner and Thomas identify three categories of resilience attributes: stability, adaptive capacity, and readiness. Under the stability category, the variables include single points of failure, controllable degradation, resistance, balance and dispersion. The readiness category includes situational awareness, simplicity/understandability, preparedness, false subsidies, and autonomy. The adaptive capacity metric includes response diversity, collaborative capacity, connectivity, abundance/reserves and learning capacity. This study only focuses on the adaptive capacity category, as the authors define it as “the ability of a system to reorganize and reconfigure as needed to cope with disturbances without losing functional capacity and system identity,” while stability is specifically focused on stresses on a system, and readiness is focused on ability to act (Kerner & Thomas, 2014, p. 682). Adaptive capacity seemed to more broadly incorporate the variables included in the stability and readiness categories, and apply more to climactic changes.

Kerner and Thomas also point out that a community needs “enabling traits” such as “strong leadership and initiative” in order to be resilient (2014, p. 683). These traits are listed

under all three resilience categories. According to Kerner and Thomas, “leadership is necessary to motivate, mobilize, and provide direction in response to disruptions, as is initiative to assume responsibility to act” (2014, p. 683). Strong leadership is not effective without connection to external policy, and initiative is not successful if the community is not involved in external policy decisions. Therefore, enabling traits fit better under collaborative capacity, as the ability to collaborate effectively with not just the community, but policy makers, is what makes a community more able to adapt. Kerner and Thomas detail the definitions of each variable listed under adaptive capacity, as well as ways to identify indicators within the variables that can reduce or increase resilience.

**Table 9 - Response Diversity Code Count**

<b>Response Diversity</b>	<b>Count</b>
Relocation	49
Moving up the bayou	14
Resident solution: house elevation	6
Resident solution: buy new land	5
Attachment to place	5
Younger generations moving away	5
Lost barrier islands	5

Kerner and Thomas define response diversity as “the variety and disparity of steps, measures, and functions by which an operation can carry on a task or achieve a mission” (2014, p. 687). The indicators within this variable include the different methods a community can use to complete a task, how many methods are available, what places stress on those methods, and the flexibility of the methods (Kerner & Thomas, 2014, p. 687). The Pointe-au-Chien Indian Tribe uses a variety of methods to respond to hazards and disasters in their environment, and have throughout history. These methods are flexible, and the tribe adapts as it is faced with various hazards, as well as manmade and natural disasters. The responses that occurred the most in the data include moving up the bayou and relocation, which are the



most extreme responses to environmental change in that category. Therefore, climate change and the policy responses to climate change affect the tribe’s ability to respond by forcing them to migrate and relocate.

**Table 10 - Connectivity Code Count**

<b>Connectivity</b>	<b>Count</b>
Land loss	109
Erosion/subsidence	105
Levees	56
Culturally relevant sites	48
Lost communities	28

Kerner and Thomas define connectivity as “how readily resources and information can be exchanged to ensure continued functionality” (2014, p. 688). The indicators within this variable include the methods of exchanging information and resources, the awareness of those methods, the flexibility of use by multiple community members, the ability of connectivity to improve the flexibility of response as well as knowledge of a situation, the resources used to keep the community connected, and the ability to sever connections if they increase issues (Kerner & Thomas, 2014, p. 688). The tribe exchanges information through telephone, word of mouth and social media. Since the tribe is so close knit, every member is aware of and can use those methods. Therefore, the tribe is able to respond effectively using social contacts and direct messaging. The erosion/subsidence and land loss codes were the most prevalent in the data for this deductive code, as fragmentation of land directly affects the connectivity of the tribe to their land and people. Therefore, climate change and the policy responses to climate change sever and erode the connection the tribe has to their ecosystem and ancestors.

**Table 11 - Abundance/Reserves Code Count**

<b>Abundance/Reserves</b>	<b>Count</b>
Levees	56
Sea level rise	42
Widening canals	41
Loss of utility	37
Cultural subsistence areas	33
Increased storm surge	31
Saltwater intrusion	25
Environmental change	17
Increased current	14
Accelerated sea level rise	13
Less fishing/shrimping	13
Elevation change	13
Leasing the land for oysters/hunting/fishing	8
Loss of trapping industry	7
BP oil spill	5

Kerner and Thomas define abundance/reserves as “the on-hand resource stores (capital) upon which a system can rely when responding to stress” (2014, p. 689). The indicators within this variable include the resources immediately available during an event, the knowledge of those resources, what happens when the resources are used to respond to an event, what makes the resources unavailable, and how the community decides there are enough resources (Kerner & Thomas, 2014, p. 689). As ecosystem users, the tribe needs access to the resources in their immediate environment. A hazardous event can break the tribe’s ties to those resources through extreme weather, forced evacuation, or damage to homes and boats. The ability to live off the land and water that makes the tribe so resilient is also a vulnerability when hazards and disasters occur. This may explain why the codes that were most prevalent in the abundance/reserves deductive code had to do with hazards and the mitigation methods put in place to try and reduce those hazards: widening canals, sea level rise, and levees. Therefore, climate change and the policy responses to climate change

directly impact the resources in the tribe’s environment, depleting or completely removing the reserves they need to survive.

**Table 12 - Learning Capacity Code Count**

<b>Learning Capacity</b>	<b>Count</b>
Levees	56
Cultural subsistence areas	33
Resident solution: shoreline protection	31
Resident solution: levees	17
Spoil banks	14
Resident solution: spoil banks	12
Resident solution: shoreline restoration	9
Resident solution: marsh creation	8
Resident solution: barrier islands	7
Resident solution: rock off canals	4

Kerner and Thomas define learning capacity as “the ability to acquire, through training, experience, or observation, the knowledge, skills, and capabilities needed to ensure system functionality” (2014, P. 690). The indicators within this variable include having a “culture of learning,” programs for employing lessons learned, and training to employ lessons learned and support of that training (Kerner & Thomas, 2014, p. 690). The tribe learned many lessons about their environment throughout the centuries, passing these lessons down through oral histories. The tribe implements these lessons on a daily basis, but improved funding and agency could help the tribe implement them at a larger scale for better mitigation of hazards in the future. The codes most prevalent in the learning capacity deductive code: resident solution: shoreline protection, cultural subsistence areas, and levees, reveal the tension between protecting the environment while still subsisting off of it as ecosystem users. Therefore, climate change and the policy responses to climate change strain the learning capacity of the tribe, forcing them to concentrate equally on environmental protection as on their survival.

**Table 13 - Collaborative Capacity Code Count**

<b>Collaborative Capacity</b>	<b>Count</b>
Oil and gas industry	70
Land ownership	30
Parish lines	7
Taking responsibility for environmental harm	4
“Fighting to be part of the conversation”	2

Kerner and Thomas define collaborative capacity as “the capacity to act through coordinated engagement” (2014, p. 688). The indicators within this variable include the ability to collaborate with others in a community, the ability to do so quickly, the understanding of when to collaborate and the skills to do so, and the ability to use collaboration adequately after weighing benefits and costs (Kerner & Thomas, 2014, p. 688). The Pointe-au-Chien tribe is highly able to collaborate within the community, and their social connections allow them to do so quickly. In addition, their historic ties to each other as well as the area result in an innate knowledge of when to collaborate and how, while evaluating the negative and positive outcomes of this collaboration. The ability to collaborate outside of the community is hampered by obstacles to collaboration with policymakers at the regional, state and federal level. By far, the oil and gas industry is the code that occurred most in the data within the collaborative capacity deductive code, as oil and gas extraction has had one of the biggest impacts on the tribe’s environment, increasing the effects of sea level rise and subsidence in the area. The tribe does not have the capacity to change the practices of oil extraction, and so climate change and the policy responses to climate change reduce the tribe’s collaborative capacity.

Kerner and Thomas list a variable under the readiness category that, for this study, would fit better under the adaptive capacity metric. This variable is autonomy, and the

authors define it as “a system manager’s authority to select and employ alternate actions, configurations, and components in response to stress” (Kerner & Thomas, 2014, p. 693). The indicators within this variable include having knowledge of a power structure, the ability to and knowledge of how to assert autonomy when an event takes place, the ability to use that autonomy to work with others, and the recognition of that autonomy by others. The last indicator of that variable particularly applies to adaptive capacity, as a community cannot adapt if it does not have the power to do so, and if others, specifically government entities, do not recognize that power. As the Pointe-au-Chien Indian Tribe applies for federal recognition and continues to fight to be at the mitigation table, the tribe will be able to increase their autonomy, and therefore their adaptive capacity.

**Table 14 - Adaptive Capacity and the Pointe-au-Chien Indian Tribe**

<b>Adaptive Capacity Metric</b>	<b>Historical</b>	<b>As Climate Changes</b>	<b>Local</b>	<b>Regional, State, National</b>
Response Diversity	High	Decreases	High	Low
Connectivity	High	Decreases	High	Low
Abundance/Reserves	High	Decreases	High	Low
Learning Capacity	High	Decreases	High	Low
Collaborative Capacity (Autonomy)	High	Decreases	High	Low

According to Kerner and Thomas, the attributes of adaptive capacity “were developed to characterize human-managed systems,” and were created for a “resilience assessment process” (2014, p. 695). They suggest that communities use these attributes in community emergency plans (2014, p. 698). Kerner and Thomas use aspects of high, medium and low to test adaptive capacity and resilience in their research subjects. I used the same metric when analyzing the Pointe-au-Chien Indian Tribe, but added a measure of time as well, as time will impact the climate change and relative sea level rise in the area. I also measured the capacity

of the tribe on the local vs. the regional, state and national levels. In Table 14, it is clear that the adaptive capacity of the tribe is historically high, but will decrease as the climate changes. Relocation was the dominant code under response diversity. Since relocation is a common response to environmental change, response diversity will decrease as the climate changes. Land loss and erosion/subsidence were the dominant codes under connectivity. This reveals that relative sea level rise, which results in the loss of land, affects the tribe's connectivity as well. Therefore, connectivity will decrease as the climate changes. Sea level rise, widening canals and levees were the dominant codes under abundance/reserves. This reveals that rising water, and response to rising water, affects the tribe's resources. Therefore, the resources will decrease as waters continue to rise. Levees were also a dominant code under learning capacity. While an effective mitigation tool, levees can also alter the environment. The installation of levees and other mitigation projects increases as climate change increases, but severe climate change could make levees and other mitigation projects obsolete. Therefore, learning capacity decreases as the climate changes. The oil and gas industry was the dominant code under collaborative capacity. The oil and gas industry contributed to widening canals and erosion in the tribe's environment, exacerbating the effects of relative sea level rise. In addition, the lack of autonomy for the tribe to contribute to decisions regarding the actions of the oil and gas industry, and government policies put in place to combat environmental changes harms the tribe's collaborative capacity. Again, collaborative capacity weakens as the climate changes. The tribe's adaptive capacity in the community at present is high, as the tribe responds to disaster in multiple ways, is connected, makes use of local resources, learns how to adapt as the environment changes, and collaborates within its community and with other local tribes. Although the tribe's adaptive

capacity at present at the local level is very high, it is lower at the regional, state and national levels. Therefore, as climate change continues to worsen, the tribe may not be able to respond, connect, access resources, continue to learn to adapt, and continue to collaborate. The tribe may be severed from their land and community completely. In addition, without the agency to interact at the regional, state and national level, the tribe may be unable to protect their land through land trusts, mitigation funding, and influence on future mitigation policy. Thus, climate change and the mitigation and policy measures implemented to combat climate change weaken the tribe's adaptive capacity.

### ***Summary***

Historically, the Pointe-au-Chien Indian Tribe has used their response diversity, collaborative capacity, connectivity, reserves, and learning capacity to adapt to changes in their environment, and they can continue to use these traits to adapt to the hazards and disasters, such as relative sea level rise, in their environment in the future. However, improved autonomy, particularly at the regional, state and national level, could also increase their ability to adapt to changes in the environment, as well as the policy responses to those environmental changes. There is opportunity for the regional, state and federal government to interact more with and gain more knowledge from the tribe, particularly on mitigation and adaptation measures. The recognition of the tribe's ability to adapt will be an important element of their adaptation to hazards in the future. The next chapter provides planning and policy recommendations for better integration of local adaptation strategies.

## **Chapter 6: Conclusions – Adaptive Capacity, Climate Change, and Coastal Communities**

The Pointe-au-Chien Indian Tribe resides in an area that experiences one of the highest levels of relative sea level rise in the world. This high level of rise comes from both the subsidence and the rising waters in the area, and renders the physical environment, as well as the social systems in the area, vulnerable. This study examined how climate change, and the mitigation and policy measures implemented to combat it, affects the adaptive capacity of the Pointe-au-Chien Indian Tribe, how climate change and policy responses to climate change affect the tribe's ability to respond, how climate change and policy responses to climate change affect the tribe's connectivity, how climate change and policy responses to climate change affect the tribe's resources, how climate change and policy responses to climate change affect the tribe's capacity to learn, and how climate change and policy responses to climate change affect the tribe's ability to collaborate, both internally and externally.

### ***Adaptive Capacity***

The ability to adapt stems from the ability to mitigate hazards, and effective hazard mitigation addresses both physical and social vulnerabilities, which results in resilient communities. Most resilient communities are resilient based on local knowledge, rather than top down education or enforced planning methods. Therefore, resilience and adaptability emerge from local knowledge of hazardous and disastrous events at the community level. As a historically isolated community of ecosystem users, the Pointe-au-Chien Indian Tribe has



the local knowledge of both the natural and manmade hazards that have plagued Southeast Louisiana for centuries. As the state and parish plan large structural mitigation projects to try to curtail the loss of land in the region, much like the large structural projects that have altered southeast Louisiana's landscape since the 1700s, the local knowledge of how environmental processes in the area have changed over time, and what methods have been effective to mitigate those processes, would be invaluable.

The tribe's local knowledge allows the tribe to flexibly respond to manmade and natural disasters in the area. The tribe elevated their homes, lived off of the land and water, evacuated during storms, and moved up the bayou to avoid hazardous areas. Relative sea level rise caused extreme land loss in the area, and for some members of the tribe, the choice may be to continue living in an aquatic environment, or move further north to more solid land. This will damage the social relationships in the tribe, and therefore reduce the tribe's diversity of response.

Relative sea level rise also damages the tribe's connectivity. The tribe is connected through its historic tribal land and kinship systems. The land and people disappear as relative sea level rise overtakes historic villages and cultural features and landmarks. In addition, the mitigation measures put in place to protect the area from the hazardous effects of relative sea level rise put the community more at risk. As the area becomes more hazardous, the tribe's younger generations move away to higher ground, losing that connection to the land and their people.

The changes in the environment also affect the resources in the area. Throughout time, the reserves of the land have lessened or disappeared altogether. The saltwater intrusion in the area means the tribe no longer possesses large farms, and instead keeps small gardens.

The loss of land also resulted in the loss of the trapping industry. Additionally, oil spills polluted the water and harmed the crabbing, fishing, shrimping and oystering industries for months at a time. Although the tribe has been able to adapt to these environmental changes, extreme environmental change may take away that option. Furthermore, the dependence on the ecosystem can harm the tribe's ability to bounce back from short-term hazards and disasters.

Living in a changing environment strengthened the tribe's learning capacity. The tribe adapted to this environment by altering their houses, installing small dams and levees, working to reduce erosion, and sharing ideas about how to mitigate hazards in the area. The tribe's lessons learned are also passed down through oral histories. This learning capacity allows the tribe to adapt to living in a physically vulnerable environment, and understand how to mitigate the hazards in that environment.

The tribe collaborates in their community effectively, surviving for centuries in an isolated location, self-sufficient and self-governed. The tribe is not always consulted when it comes to regional, state and federal policy. The tribe fights to be at the table when policy decisions are made, but is not always kept in the loop for every decision. The issues with this are twofold – the policymakers do not get access to the local knowledge that the tribe possesses from thriving in a physically vulnerable environment, and the tribe does not receive the opportunity to have mitigation measures implemented that would protect their community, traditions and culture into the future. The involvement of the tribe in policy decisions would benefit both the tribe and the agency implementing the decisions.

When examining the adaptive capacity metric, I found that the autonomy variable, which was placed under the readiness metric, actually fits better under the adaptive capacity

metric for the purposes of this study. The autonomy variable is similar to the collaborative capacity variable, but applies more to power and recognition of that power. This variable encompasses issues the tribe deals with such as bordering parishes, deciding the placement of local levees, fighting to be part of the state Coastal Plan, and striving to be recognized by the federal government. An increase in autonomy would allow the tribe to implement more effective mitigation measures to preserve their cultural sites and traditions, and most importantly, receive funding to do so. The ability to contribute to state and parish planning projects, as well as the ability to protect and conserve their lands and resources, will help the tribe be more resilient. The recognition of the tribe's autonomy will help them adapt to hazards in the future.

Although the literature emphasizes community resilience and adaptation planning, there is something more to being a thriving community, particularly a community in a physically vulnerable environment. Resilience and the ability to adapt stem from power – not just the power to make decisions, but the power to have your decisions and needs recognized by others outside your community, particularly those who make policy decisions. This recognition will allow communities to make changes to continue to adapt to their environments into the future. If planning authorities accessed local knowledge when making plans, the plans would be more effective, and, giving recognition to communities with that knowledge would help the communities' adaptive capacity.

Historically, the Pointe-au-Chien Indian Tribe has had the adaptive capacity to respond, connect, make use of resources, learn, and collaborate to adapt to the changes in their environment. The relative sea level rise in their area decreases all of these capacities, as water rises and land disappears. Additionally, the tribe's historical resilience and adaptive

capacity, as a result of their isolated location and culture, is localized. Although the tribe strives to participate at the regional, state and national level, the participation processes are often logistically difficult, and require large investments of time and resources.

The tribe not only has to adapt to the changes in their environment, but the mitigation and policy measures implemented by others to navigate those changes. Therefore, the inclusion of the tribe in planning processes is paramount to their survival. Additionally, the tribe's innate local knowledge about adapting to these changes historically is important to making these mitigation measures and policy decisions effective. The participation of the tribe in planning measures will help the tribe, the surrounding community and the region mitigate the extreme changes in the coastal environment.

### **Planning Recommendations:**

There are numerous planning efforts at the federal, state, and regional level that could both help improve the adaptive capacity of vulnerable populations, and learn from those populations' adaptive strategies. Comprehensive planning at the federal, state, regional and local level is an effective way to ensure plans address all of the necessary issues. While plans at the federal and state level may be more prescriptive and top down, plans at the local level can include more local knowledge. Through comprehensive planning, this local knowledge could reach all the way up to the federal level, and result in more inclusive and effective plans.

Planning policy starts at the federal level. Burby et al. (1999) point out that federal policy can impede local planning efforts that aim to reduce risks in vulnerable locations, because these policies encourage development, either by the private sector or by government

agencies. Encouraging development without regard to risk or vulnerability results in poor land use decisions (Burby et al., 1999, p. 248). They suggest that the federal government do more to discourage growth in vulnerable areas by identifying the areas that should be protected (1999, p. 248). Burby recommends that federal and local governments work together to make comprehensive mitigation plans in order to better protect vulnerable communities (2006, p. 3). If the Pointe-au-Chien Indian Tribe were federally recognized, they could implement conservation and restoration projects on their tribal lands.

At the state and local level, hazard mitigation plans often steer planning in vulnerable areas. Brody et al. (2007) recommend that planners in vulnerable localities promote development in non-vulnerable areas (2007, p. 343). They point out that hazard mitigation plans do not always stop development in vulnerable areas, and even when they do result in the implementation of hazard mitigation measures, these measures serve to encourage development in vulnerable areas. Thus, the process of mitigating can sometimes make an area more vulnerable. Godschalk, Brody and Burby recommend that hazard mitigation plans be included in the comprehensive planning process, thus guaranteeing more visibility and communication about mitigation plans (2003, p. 751). In addition, they recommend that mitigation planning at the neighborhood level with reference to specific hazards could be the most effective way to prepare for disaster, as this would encourage more participation in the comprehensive planning process (2003, p. 751). If the tribe were able to mitigate hazards at the community level, they would have the ability to make changes to the environment that would best protect their homes as well as their resources.

There are also recommendations for nonstructural mitigation strategies in particular. According to Broome, Dubinin and Jenkins (2015), governments should dedicate mitigation

funding for nonstructural projects, the agencies who develop the projects, such as CPRA and local parishes, need to coordinate, agencies should integrate the plans for the projects, and there should be a lead agency for the nonstructural projects. Gonzales, Kaswan, Verchick, Huang, Bowen and Jamhour (2016) echo the need for nonstructural projects, but point out that “nonstructural adaptation strategies, whether physical such as property buyouts and elevation or nonphysical such as pre-disaster planning, must be tailored to fit local needs and align with local goals for rebuilding” (2016, p.7). Further, they point to the need for a variety of nonstructural strategies, as “no single nonstructural adaptation strategy will likely meet the needs of a community, and nonstructural adaptation strategies should help a community achieve its medium- and long-term goals for growth and development” (Gonzales et al., 2016, p. 7). The tribe has multiple solutions for mitigation and adaptation strategies, all of which are nonstructural and can be implemented at the community level. Nonstructural strategies can be more complicated for coastal locations.

Planners have specific recommendations for coastal locations. Godschalk et al. (1999) agree with mitigation planning at the local level, and recommend that every locality, specifically coastal communities, implement hazard mitigation plans to better protect themselves from disaster. Other scholars recommend the inclusion of nonstructural risk reduction in the coastal planning process (Broome, Dubinin & Jenkins, 2015; Jenkins, 2016). Doussou and Glehouenou-Doussou recommend nonstructural adaptations such as protecting the coast with sediment and rocks, and structural adaptations such as floodwalls. They also point out that industries and homes in vulnerable locations may need to be relocated (p. 77). Accessing local knowledge when planning the location of rocks and floodwalls could help vulnerable communities play a role in the planning process, and help the plans be more

effective by the inclusion of this knowledge. Integrating community knowledge into the funding and plan prioritization process could also help to ensure these plans are implemented effectively.

Additionally, there are specific nonstructural mitigation strategies for coastal locations. Brody, Zahran, Maghelal, Grover, and Highfield (2007) claim that nonstructural measures are more effective than structural measures when mitigating hazards. Jenkins (2016) delves into the complexities of nonstructural projects in coastal Louisiana, and develops recommendations for best practices for these strategies. The first recommendation is to sever climate change from politics, and link land loss and sea level rise solutions to best practices in social and physical sciences (Jenkins, 2016, p. 22). Using local knowledge for planning decisions is a best practice in social science. The second recommendation urges the connection between government officials and local residents in coastal parishes (Jenkins, 2016, p. 23). The Pointe-au-Chien Indian Tribe and government officials could be better connected in order to implement mitigation strategies. The third recommendation speaks specifically to the process of elevating structures, and points to the need to make these processes easier and more comprehensive (Jenkins, p. 25). The tribe has had issues with elevating structures as the rules for elevation height keeps changing, and so making that process easier would help the tribe better protect themselves from environmental risks. Public education is another nonstructural strategy that Jenkins recommends, and she emphasizes that “public education should be designed to be a dialogue between community residents and officials—encouraging an exchange of knowledge and information, and recognizing residents’ expertise and concerns” (2016, p. 29). Gonzales et al. (2016) also stress the need for education and communication during the design of nonstructural

strategies, and recommend “a two-way dialogue in smaller settings, working cooperatively with a community to identify needs” (p. 72). A dialogue between the tribe and planning officials would benefit both the tribe and the plans. Jenkins further points out that relocation, although it is a strategy that many communities shy away from, could be more successful with the input and engagement of the relocating communities in the plan (2016, p. 31). Although the study participants do not want to relocate, they would want to be consulted if there was a plan to do so.

### **Community Recommendations:**

There are adaptive capacities at the community level that communities can improve upon as well. A local, adaptive method of planning over time can be more effective in protecting the environment (Blaikie et al., 2003; Brody & Highfield, 2007). The Economics of Climate Adaptation Working Group recommends localities seek funding and support, and prepare a climate adaptation strategy. Through the mapping project, the tribe is working on a local adaption strategy based on their local knowledge. Mukheiber and Ziervogel recommend consulting local stakeholders, as well as climate change experts, in order to successfully create adaptation measures (p. 148). The tribe could be local stakeholders for the adaptation plans in their community, parish and region. Cutter and Emrich (2006) recommend tailoring preparedness, response, recovery and mitigation methods to different communities, depending on their physical and social vulnerabilities. Wamsler (2007) points out that access to resources and trust affect whether or not vulnerable populations are protected from risks, and recommends improving risk reduction measures, financing, trust, and communication to better reach those populations and assist in their adaptation to climate change. The tribe



could use resources and communication with planning authorities to better protect their ancestral land. Haque (1997) claims that the communication of risk to communities, rather than the production of a planning document, is more effective when implementing hazard mitigation measures. McGranahan, Balk and Anderson, on the other hand, recommend that mitigation come from local needs and knowledge (2007, p. 36). The tribe understands their risks, and could communicate their local knowledge of these risks to those creating planning documents. Burley recommends that coastal residents be involved in coastal restoration processes, such as restoring wetlands, as they have the innate knowledge of loss and what needs to be restored (Burley, 2010). Communities can use this local knowledge, in combination with best practices in social and physical sciences, to enhance their adaptive capacity (Bethel et al., 2014; Jenkins, 2016). Using their knowledge of coastal restoration processes, combined with scientific knowledge, the tribe could create an adaptation plan that would help them adapt far into the future.

### **Policy Implications:**

Therefore, planning at the federal, state, and regional level could have a more effective local impact if localities were included in the planning process. Additionally, nonstructural mitigation strategies are especially effective, particularly in coastal locations. Further, this study indicates that federal, state and regional policies often do not provide agency for indigenous ecosystem users, or provide the tools necessary to successfully adapt to environmental changes. The following recommendations detail how local knowledge can be integrated into planning policy in order to create more effective and comprehensive plans, while also preserving the tradition and culture of indigenous ecosystem users. Government

agencies and communities can work together to improve adaptive capacity at the federal, state and local level through the following recommendations.

### *Federal*

The federal government can improve local adaptive capacity by implementing the following recommendations. The federal government should encourage the reduction of development in vulnerable areas, particularly vulnerable coastal areas. While the federal government currently takes flood insurance away from communities who do not adequately manage their floodplain, and encourages safe floodplain management processes, it could identify more areas that are too vulnerable for development. Furthermore, the construction of structural megaprojects such as levees in vulnerable areas, while protecting those that live in those areas, also encourages others to move to the areas, causing overdevelopment and increased vulnerability. The federal government should communicate the risk that still exists in levee protected areas, even after the levees are built. The federal government should discourage or limit oil and gas extraction activities in vulnerable coastal areas. In addition, the federal government preserves tribal lands for federally recognized tribes, but the federal recognition process can be lengthy. It should be possible to preserve vulnerable tribal lands while the recognition process is underway. The federal government should also encourage cooperation between the entities working on planning and mitigation strategies. The government could provide more funding mechanisms for comprehensive planning that include multiple agencies.

### *State and Regional*

State and regional entities can also better contribute to local adaptive capacity. State and regional entities should also discourage development in vulnerable areas, particularly vulnerable coastal areas. While structures are required to be built to the base flood elevation in areas susceptible to storm surge, it may be safer to prohibit building in those areas altogether. The state should also discourage or limit oil and gas extraction activities in vulnerable coastal areas. Further, the state should make mechanisms available for state recognized tribes to protect their vulnerable tribal lands, especially areas essential to protecting their traditions and culture. State and regional entities should also encourage comprehensive planning and coordination between plans that address mitigation, resilience and land use planning. Currently, many localities have separate mitigation, resilience and land use plans. Combining these processes could result in more robust, inclusive and far-reaching plans. While state and local governments often rely on the federal government for large mitigation projects, some parishes, particularly Terrebonne Parish, use millage rates or sales tax to fund their own structural mitigation projects. Furthermore, state and regional entities should encourage the use of nonstructural adaptation strategies. The 2017 Coastal Master Plan Update addresses nonstructural strategies more than the 2012 update did, but there is room for more encouragement. As funding becomes available, state and parish governments could provide more grants for nonstructural measures, beyond just house elevation. In addition, state and regional entities should work to link adaptive strategies to the physical and social sciences, as well as engineering. Many entities use modeling to plan for sea level rise and other environmental changes, but there is an opportunity to model at the local level. As subsidence continues, each locality will have a different rate of subsidence.

Understanding this rate will help to understand how to plan for it. In addition, considering the social aspects of the community during this planning effort is important as well. Moreover, state and regional entities should coordinate planning efforts with local communities.

Planning meetings should go beyond just checking a box to including all community members that can contribute to the process. Additionally, state and regional entities should encourage dialogue between officials and local communities. Often, local communities have knowledge that officials may not have access to. Finally, state and regional entities should communicate risk and risk reduction strategies to local communities, and local communities should communicate risk and risk reduction strategies to state and regional entities. Enabling local communities to share their knowledge could result in more effective mitigation and adaptation plans, as well as the implementation of those plans.

### *Local Coastal Communities*

There are recommendations for local coastal communities to improve their adaptive capacity as well. Coastal communities should prepare their own adaptation plans. Adaptation strategies could be different for every community, and the community should be able to understand and plan for climate change at the local level. Coastal communities should also consider their physical and social vulnerabilities when preparing these plans. Physical and social vulnerabilities are different for every community, and communities often have more knowledge about their vulnerabilities than entities that create planning strategies from the top down. Finally, coastal communities should work to combine local knowledge with best practices in sciences to enhance adaptive capacity. Combining local knowledge with scientific data can result in more comprehensive, visual and understandable data for future

mitigation and adaptation planning. Local knowledge will help these coastal communities protect their traditions and culture despite climate change and the policy responses to climate change affecting their way of life.

### ***Further Research***

This study could further expand to include other communities tied to their locations through ecosystem and ancestry and experiencing climate change and the policy responses to climate change in their communities. These can include other Native American communities in Louisiana, the United States, and other indigenous communities throughout the world. It could also carry beyond coastal environments, to include riverine or desert communities, all of which will be affected by climate change in the future. As climate change continues to affect coastal environments, these types of communities will be the most impacted by environmental changes. Understanding how communities intricately tied to the ecosystem can adapt to these changes, and the policy measures enacted to combat these changes, will help other communities, even those not as reliant on the environment, to adapt to the environmental changes that affect coastal communities in Louisiana, the United States, and worldwide.

### ***The Point-au-Chien Indian Tribe and the Future***

Over the past four years of this project, the members of the tribe and the researchers (including myself) became more than the subjects and objects of the study. Instead, I had the privilege and the sorrow of watching a community adapt every day to the changes in their environment, and to the policies implemented to combat these conditions that they did not

develop or influence. I observed as the tribal members struggled in conversation to understand the dilemmas that they face currently and in the long term. The elders are burdened with the thought that their way of life may disappear and no one will notice or care. I cannot say for sure what will happen in this community, but this project revealed to me that without immediate intervention, we will one day lose the rich and deep traditions and culture of the Point-au-Chien Indian Tribe.

## References Cited

- Adam, J. (2008). Forced migration, ADAT, and a purified present in Ambon, Indonesia. *Ethnology*, 47(4), 227-238.
- Adger, W. (1999). Social vulnerability to climate change and extremes in coastal Vietnam. *World Development*, 27(2), 249-269.
- Alam M. and Rabbani, M.D.G (2007). Vulnerabilities and responses to climate change for Dhaka. *Environment and Urbanization* 19(1), 81-97.
- Alexander, D. (1997). The study of natural disasters, 1977-1997: Some reflections on a changing field of knowledge. *Disasters*, 21(4), 284-304.
- Alexander, D. (2000). *Confronting Catastrophe*. New York: Oxford University Press.
- Atakapa-Ishak Nation. (2016). History. Retrieved July 1, 2016 from <http://www.atakapa-ishak.org/history/>.
- Babbie, Earl. (2007). *The practice of social research*. Belmont, Ca: Thomson Wadsworth.
- Barton, A.H. (1969). *Communities in Disaster: A Sociological Analysis of Collective Stress Situations*. Garden City, NY: Anchor, Doubleday.
- Beierle, T. C., & Konisky, D. M. (2000). Values, conflict, and trust in participatory environmental planning. *Journal of Policy analysis and Management*, 587-602.
- Bethel, M., L. Brien, M. Esposito, C. Miller, H. Buras, S. Laska, R. Philippe, K. Peterson, and C.P. Richards. (2014). Sci-TEK: A GIS-based multidisciplinary method for incorporating traditional ecological knowledge into Louisiana's coastal restoration decision-making processes. *Journal of Coastal Research*, 30(5), 1081-1099.
- Bianco, H., Alberti, M., Popper, F., Parnell, S., Pieterse, E., Watson, V., et al. (2009). Shaken, shrinking, hot, impoverished and informal: Emerging research agendas in planning. *Progress in Planning*, 72(4), 195-250.
- Blaikie, P., T. Cannon, I. Davis, and B. Wisner. (2003). *At Risk: Natural Hazards People's Vulnerability, and Disasters*. London: Routledge.
- Bogard, W. C. (1988). Bringing Social Theory to Hazards Research Conditions and Consequences of the Mitigation of Environmental Hazards. *Sociological Perspectives*, 31(2), 147-168.
- Brody, S. D., & Highfield, W. E. (2005). Does Planning Work?. *Journal Of The American Planning Association*, 71(2), 159-175.
- Brody, S. D., Zahran, S., Maghelal, P., Grover, H., & Highfield, W. E. (2007). The Rising Costs of Floods. *Journal Of The American Planning Association*, 73(3), 330-345.
- Bronen, R. (2008). Alaskan communities' rights and resilience. *Forced Migration Review*, (31), 30-32.
- Bronen, R. (2014). Choice and necessity: relocations in the Arctic and South Pacific. *Forced Migration Review*, (45), 17-21.
- Bronen, R., & Chapin, I. (2013). Adaptive governance and institutional strategies for climate-induced community relocations in Alaska. *Proceedings Of The National Academy Of Sciences Of The United States Of America*, 110(23), 9320-9325.
- Broome, C. M., Dubinin, J. & Jenkins, P. (2015). *The View from the Coast: Local Perspectives and Policy Recommendations on Flood-Risk Reduction in South Louisiana*. Center for Planning Excellence.
- Burby, R. (2006). Hurricane Katrina and the paradoxes of government disaster policy: Bringing about wise governmental decisions for hazardous areas. *Annals of the American Academy of Political and Social Science*, 604, 171-191.
- Burby, R., Beatley, T., Paterson, R., Platt, R., Berke, P., Deyle, R., et al. (1999). Unleashing the power of planning to create disaster-resistant communities. *Journal of the American Planning Association*, 65(3), 247-258.
- Burley, D. M. (2010). *Losing ground: Identity and land loss in coastal Louisiana*. Univ. Press of Mississippi.

- Burley, D., Jenkins, P., Darlington, J., & Azcona, B. (2005). Loss, attachment, and place: A case study of Grand Isle, Louisiana. *Reconstruction: Studies in Contemporary Culture*, 5, 3.
- Campbell, J. R. (2014). Climate-Change Migration in the Pacific. *Contemporary Pacific*, 26(1), 1-28.
- Campbell, S. (1996). Green cities, growing cities, just cities? Urban planning and the contradictions of sustainable development. *Journal of the American Planning Association*, 62(3), 296-312.
- Carmichael, K. (2008). Language death and stylistic variation: an intergenerational study of the substitution of /h/ FOR /ʒ/ in the French of the Pointe-au-Chien Indians. Tulane University Department of Linguistics.
- Chitimacha Tribe of Louisiana. (2016). Tribal History. Retrieved July 1, 2016 from <http://www.chitimacha.gov/history-culture/tribal-history>.
- Cho, J. Y., & Lee, E. H. (2014). Reducing confusion about grounded theory and qualitative content analysis: Similarities and differences. *The Qualitative Report*, 19(32), 1.
- Comfort, L., Wisner, B., Cutter, S., Pulwarty, R., Hewitt, K., Oliver-Smith, A., ... & Kringold, F. (1999). Reframing disaster policy: the global evolution of vulnerable communities. *Global Environmental Change Part B: Environmental Hazards*, 1(1), 39-44.
- Coastal Protection and Restoration Authority (CPRA). (2012). Louisiana's Comprehensive Master Plan for a Sustainable Coast. Retrieved February 12, 2016 from <http://coastal.la.gov/a-common-vision/2012-coastal-master-plan/>.
- Creswell, J. W. (2009). *Research design: qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, Calif: Sage Publications.
- Creswell, J. W. (2012). *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. SAGE Publications. Kindle Edition.
- Cutter, S., & Emrich, C. (2006). Moral hazard, social catastrophe: The changing face of vulnerability along the hurricane coasts. *Annals of the American Academy of Political and Social Science*, 604, 102-112.
- Cutter, S., Mitchell, J., & Scott, M. (2000). Revealing the vulnerability of people and places: A case study of Georgetown County, South Carolina. *Annals of the Association of American Geographers*, 90(4), 713-737.
- D'Angelo, C. (2016, February 12). A Louisiana Tribe Is Now Officially A Community Of Climate Refugees. Retrieved February 12, 2016, from [http://www.huffingtonpost.com/entry/climate-refugees-louisiana\\_us\\_56bbd5efe4b0c3c550501784](http://www.huffingtonpost.com/entry/climate-refugees-louisiana_us_56bbd5efe4b0c3c550501784).
- Dalbom, C., Hemmerling, S.A., and Lewis, J. 2014. Community Resettlement Prospects in Southeast Louisiana [White Paper]. Tulane Institute on Water Resources Law & Policy. New Orleans, LA.
- Davis, M. (2006). *Planet of slums*. London: Verso.
- Davoudi, S., Brooks, E., & Mehmood, A. (2013). Evolutionary resilience and strategies for climate adaptation. *Planning Practice & Research*, (ahead-of-print), 1-16.
- Dedoose. (2016). About Us. Retrieved July 25, 2016 from <http://www.dedoose.com/about-us>.
- Department of the Interior, Bureau of Indian Affairs. Federal Register 25 CFR Part 83: Federal Acknowledgment of American Indian Tribes, Final Rule. Vol. 80, No. 126. Retrieved June 6, 2016 from <http://www.bia.gov/cs/groups/xofa/documents/text/idc1-031255.pdf>.
- Department of the Interior, Bureau of Indian Affairs. Frequently Asked Questions. Retrieved June 29, 2016 from <http://www.bia.gov/FAQs>.
- De Sherbinin, A., Schiller, A., & Pulsipher, A. (2007). The vulnerability of global cities to climate hazards. *Environment and Urbanization*, 19(1), 39-64.
- De Wet, C. (1988). Stress and environmental change in the analysis of community relocation. *Human Organization*, 47(2), 180-187.
- Dossou, K.M.R and Gléhouenou-Dossou, Bernadette. (2007). The vulnerability to climate change of Cotonou (Benin): the rise in sea level. *Environment and Urbanization* 19, 65-79.
- Duram, L. A., & Brown, K. G. (1999). *Insights and applications assessing public participation in US watershed planning initiatives*. *Society & Natural Resources*, 12(5), 455-467.



- Economics of Climate Adaptation Working Group. (2009). *Shaping Climate-Resilient Development: a framework for decision-making*.
- Elran, M. (2012). Part 1: The Philosophy of Resilience. *The International Symposium on Societal Resilience* (pp. 13-18). Washington, D.C.: Homeland Security Studies and Analysis Institute.
- Erisman, J. W., Brasseur, G., Ciais, P., van Eekeren, N., & Theis, T. L. (2015). Put people at the centre of global risk management. *Nature*, 519(7542), 151-153.
- Fankhauser, S., Smith, J. B., & Tol, R. S. (1999). Weathering climate change: some simple rules to guide adaptation decisions. *Ecological economics*, 30(1), 67-78.
- First People's Conservation Council. (2016). About Us. Retrieved July 1, 2016 from <http://fpccLouisiana.org>.
- Godschalk, D. R. (2003). Urban hazard mitigation: creating resilient cities. *Natural hazards review*, 4(3), 136-143.
- Godschalk, D. R., Beatley, T., Berke, P., Brower, D., & Kaiser, E. (1999). *Natural hazard mitigation: recasting disaster policy and planning*. Washington, D.C.: Island Press.
- Godschalk, D. R., Brody, S., & Burby, R. (2003). Public Participation in Natural Hazard Mitigation Policy Formation: Challenges for Comprehensive Planning. *Journal Of Environmental Planning & Management*, 46(5), 733-754.
- Gonzales, C., Kaswan, A., Verchick, R., Huang, Y., Bowen, S. & Jamhour, N. (2016). *Climate change, resilience, and fairness: how nonstructural adaptation can protect and empower socially vulnerable communities on the Gulf Coast*. Oxfam America.
- Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards*, 38(1-2), 101-120.
- Grzegorzewski, A. S., Cialone, M. A., & Wamsley, T. V. (2011). Interaction of barrier islands and storms: implications for flood risk reduction in Louisiana and Mississippi. *Journal of Coastal Research*, 156-164.
- Hamza, M., & Zetter, R. (1998). Structural adjustment, urban systems, and disaster vulnerability in developing countries. *Cities*, 15(4), 291-299.
- Haque, C. (1997). Atmospheric hazards preparedness in Bangladesh: A study of warning, adjustments and recovery from the April 1991 cyclone. *Natural Hazards*, 16(2-3), 181-202.
- Holub, M., & Fuchs, S. (2009). Mitigating mountain hazards in Austria - legislation, risk transfer, and awareness building. *Natural Hazards and Earth System Sciences*, 9(2), 523-537.
- Huq, S., Kovats, S., Reid, H., and Satterthwaite, D. (2007). Editorial: Reducing risks to cities from disasters and climate change *Environment and Urbanization* 19(1), 3-15.
- Innes, J. (1996). Planning through consensus building - A new view of the comprehensive planning ideal. *Journal of the American Planning Association*, 62(4), 460-472.
- Iwan, W. D., Cluff, L. S., Kimpel, J. F., & Kunreuther, H. (1999). Mitigation emerges as major strategy for reducing losses caused by natural disasters. *Science*, 284(5422), 1943.
- Jenkins, P. (2016). "A sense of place at risk: perspectives of residents of coastal Louisiana on nonstructural risk reduction strategies." Oxfam America.
- Keddy, P. A., Campbell, D., McFalls, T., Shaffer, G. P., Moreau, R., Dranguet, C., & Heleniak, R. (2007). The wetlands of lakes Pontchartrain and Maurepas: Past, present and future. *Environmental Reviews*, 15(NA), 43-77.
- Kerner, D. A., & Thomas, J. S. (2014). Resilience Attributes of Social-Ecological Systems: Framing Metrics for Management. *Resources*, 3(4), 672-702.
- Lafourche Parish Hazard Mitigation Plan Update. (2010). Shaw Environmental & Infrastructure, Inc. Retrieved February 12, 2016 from <http://www.lafourchegov.org/home/showdocument?id=20116>.
- Lafourche Parish Hazard Mitigation Plan Update. (2015). Stevens Disaster Management Institute (SDMI) and Lafourche Parish Government. Retrieved February 12, 2016 from <http://www.lafourchegov.org/home/showdocument?id=22804>.

- Kennedy, C. (2012). Thriving on a sinking landscape. *National Oceanic and Atmospheric Administration*. Retrieved June 30, 2016 from <https://www.climate.gov/news-features/features/thriving-sinking-landscape>.
- Laukkonen, J., Blanco, P. K., Lenhart, J., Keiner, M., Cavric, B., & Kinuthia-Njenga, C. (2009). Combining climate change adaptation and mitigation measures at the local level. *Habitat International*, 33(3), 287-292.
- Lopez, J. A. (2009). The Environmental History of human-induced impacts to the Lake Pontchartrain Basin in Southeastern Louisiana since European settlement-1718 to 2002. *Journal of Coastal Research*, 1-11.
- LSU AgCenter. (2016). Louisiana FloodMaps Portal. Retrieved June 30, 2016 from <http://maps.lsuagcenter.com/floodmaps>.
- Marshall, B., (2013). New research: Louisiana coast faces highest rate of sea-level rise worldwide. *The Lens*. Retrieved June 30, 2016 from <http://thelensnola.org/2013/02/21/new-research-louisiana-coast-faces-highest-rate-of-sea-level-rise-on-the-planet>.
- McGranahan, G., Balk, D., & Anderson, B. (2007). The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones. *Environment and Urbanization*, 19(1), 17-37.
- McLellan, A. B., & Elran, M. (2012). *The International Symposium on Societal Resilience*. Washington, D.C.: Homeland Security Studies and Analysis Institute.
- Mileti, D.S. 1999. *Disasters by Design: A Reassessment of Natural Hazards in the United States*. Washington, DC: Joseph Henry Press.
- Mukheibir, P. and Ziervogel, G. (2007). Developing a Municipal Adaptation Plan (MAP) for climate change: the city of Cape Town. *Environment and Urbanization* 19(1), 143-158.
- Muller, M. (2007). Adapting to climate change water management for urban resilience. *Environment and Urbanization*, 19(1), 99-113.
- National Research Council. (2006). *Facing Hazards and Disasters*. Washington, D.C.: The National Academies Press.
- National Research Council. (2015). *Developing a Framework for Measuring Community Resilience: Summary of a Workshop*. Washington, D.C.: The National Academies Press.
- Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F., & Pfefferbaum, R. L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*, 41(1-2), 127-150.
- O'Rourke, D., & Connolly, S. (2003). Just oil? The distribution of environmental and social impacts of oil production and consumption. *Annual Review of Environment and Resources*, 28(1), 587-617.
- Perry, R. W., & Lindell, M. K. (1997). Principles for Managing Community Relocation as a Hazard Mitigation Measure. *Journal Of Contingencies & Crisis Management*, 5(1), 49.
- Picou, J. S., & Marshall, B. K. (2007). Social impacts of Hurricane Katrina on displaced K-12 students and educational institutions in coastal Alabama counties: some preliminary observations. *Sociological Spectrum*, 27(6), 767-780.
- Picou, J. S., Marshall, B. K., & Gill, D. A. (2004). Disaster, litigation, and the corrosive community. *Social forces*, 82(4), 1493-1522.
- Plyer, A. D., Warren, D., & Bonaguro, J. (2007). FEATURE PAPER: Real-Time Data Dissemination in a Rapidly Changing Environment. *Session 1: emergency preparedness and surveillance*, 3.
- Pointe-au-Chien Indian Tribe. (2016). Accessed February 15, 2016 from <http://pactribe.tripod.com>.
- Quarantelli, E.L. "Ten criteria for evaluating the management of community disasters." *Disasters*. 21.1 (1997): 39-56.
- Quarantelli, E.L. (ed.) 1998. *What Is a Disaster? Perspectives on the Question*. New York: Routledge.
- Robers, J.D. (2016). Evolution of the Levee System Along the Lower Mississippi River. Retrieved June 30, 2016 from

- <http://web.mst.edu/~rogersda/levees/Evolution%20of%20the%20Levee%20System%20Along%20the%20Mississippi.pdf>.
- Rottet, K. J. Language Shift and Language Death in the Cajun French-Speaking Communities of Terrebonne and Lafourche Parishes, Louisiana. [Dissertation]. UMI Company: Ann Arbor, Michigan, 1995.
- Saldaña, J. (2012). *The coding manual for qualitative researchers* (No. 14). Sage.
- Scott, J. C. (1998). *Seeing like a state: How certain schemes to improve the human condition have failed*. Yale University Press.
- Shaw, R., & Sharma, A. (2011). *Climate and disaster resilience in cities*. Bingley, UK: Emerald.
- Sherrieb, K., Norris, F. H., & Galea, S. (2010). Measuring Capacities for Community Resilience. *Social Indicators Research*, 99, 227-247. Retrieved October 29, 2013, from the Springer Science & Business Media B.V. database.
- Soja, E. W. (1989). *Postmodern geographies: The reassertion of space in critical social theory*. Verso.
- South Louisiana Wetlands Discovery Center (2016). Vanishing Points: Pointe-au-Chien Indian Tribe. Retrieved June 6, 2016 from <https://vanishing-points.org/2015/03/26/pointe-au-chien-indian-tribe>.
- Speller, G. M., & Tigger-Ross, C. L. (2009). Cultural and social disconnection in the context of a changed physical environment. *Geografiska Annaler Series B: Human Geography*, 91(4), 355-369.
- Sultzman, L. (2016). Acolapissa History. Retrieved July 1, 2016 from <http://www.dickshovel.com/acol.html>.
- Tang, Z., & Brody, S. D. (2009). Linking planning theories with factors influencing local environmental-plan quality. *Environment & Planning B: Planning & Design*, 36(3), 522-537.
- Terrebonne Parish Hazard Mitigation Plan Update 2014. (2015). Terrebonne Parish Consolidated Government. Retrieved February 12, 2016 from [http://www.tpcg.org/files/flooding/HMPU\\_Approved\\_2014.pdf](http://www.tpcg.org/files/flooding/HMPU_Approved_2014.pdf).
- Terrebonne Parish Hazard Mitigation Plan Update. (2009). Shaw Environmental & Infrastructure, Inc. Retrieved February 12, 2016 from [http://www.tpcg.org/files/flooding/Terrebonne\\_Parish\\_HMPU\\_2010.pdf](http://www.tpcg.org/files/flooding/Terrebonne_Parish_HMPU_2010.pdf)
- The Bureau of Indian Affairs Branch of Acknowledgment and Research. (1997). The Official Guidelines to the Federal Acknowledgment Regulations, 25 CFR 83. Retrieved February 12, 2016 from <http://www.bia.gov/cs/groups/public/documents/text/idc-001214.pdf>.
- Tierney, K. J. 1989. —Improving theory and research on hazard mitigation: Political economy and organizational perspectives. *International Journal of Mass Emergencies and Disasters*, 7:367-396.
- Tseng, C., & Chen, C. (2012). Natural disaster management mechanisms for probabilistic earthquake loss. *Natural Hazards*, 60(3), 1055-1063.
- Tunica-Biloxi Tribe of Louisiana. (2015). Welcome! Retrieved July 1, 2016 from <http://www.tunicabiloxi.org>.
- UNISDR (United Nations International Strategy for Disaster Reduction). 2015. *Sendai Framework for disaster risk reduction 2015-2030*. Accessed August 17, 2015 from <http://www.preventionweb.net/files/resolutions/N1516716.pdf>.
- United States Census Bureau. Grand Isle town, Louisiana population estimates. Retrieved June 30, 2016 from [factfinder.census.gov](http://factfinder.census.gov).
- Victor, D. G. (2015). Climate change: Embed the social sciences in climate policy. *Nature*, 520(7545), 27.
- Wamsler, C. (2007). Bridging the gaps: stakeholder-based strategies for risk reduction and financing for the urban poor. *Environment and Urbanization*, 19(1), 115-142.
- Wendland, T. (2015, December 7). From Paris: Houma Chief Seeks Support For Tribe. Retrieved January 5, 2016, from <http://wwno.org/post/paris-houma-chief-seeks-support-tribe>.

- White, G. F. (Ed.). *Natural hazards: Local, national and global*. New York: Oxford University Press, 1974.
- Whyte, K. P. (2014). Indigenous women, climate change impacts, and collective action. *Hypatia*, 29(3), 599-616.
- Wilk, J., Hjerpe, M., Jonsson, A., André, K., Glaas, E., Rød, J. K., Tomasz, O. & Neset, T. S. (2013). *A Guidebook for Integrated Assessment and Management of Vulnerability to Climate Change*.
- Yin, Robert K. 2009. *Case study research: design and methods*, 4th ed. Applied social research methods series, v. 5. Thousand Oaks, Calif: Sage Publications.

**QUESTIONS FOR INTERVIEWS AND FOCUS GROUPS**

1. Tell me about the community you grew up in.
2. Tell me about your home – then and now.
3. Tell me about your family – then and now.
4. Tell me about your neighbors – then and now.
5. Describe a typical weekday in your life. What do you do for work?
6. Describe a typical weekend in your life. What do you do for fun?
7. From your perspective, how has your community changed?
8. Tell me about any extreme weather events your community has experienced.
9. Tell me about a time you or your community had to make a change due to outside forces.
10. Tell me about a time you have had to fight for your home or community.

## **Vita**

Tara Lambeth received a Master of Science in City and Regional Planning from Pratt Institute in Brooklyn. Immediately after earning her master's degree, she moved to New Orleans to pursue her interests in hazard mitigation planning and disaster studies. She is currently the Assistant Director at UNO's Center for Hazard Assessment, Response and Technology (UNO-CHART), a doctoral candidate in Urban Studies, and a Certified Floodplain Manager. Her addresses issues of community resilience, adaptation and climate change. She plans to finish her doctorate in the summer of 2016.