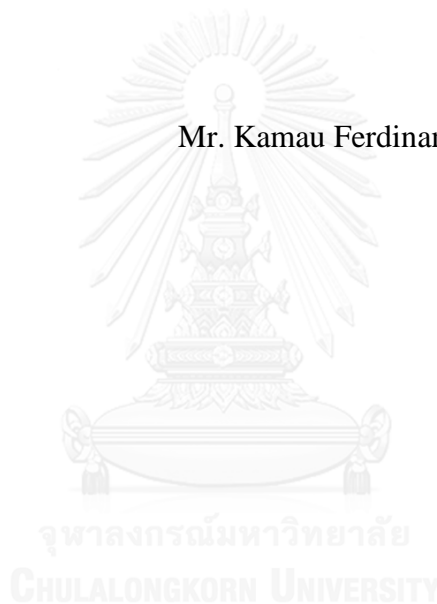


GOVERNANCE CONSIDERATIONS IN FLOOD MANAGEMENT:
A CASE STUDY OF NEW ORLEANS

Mr. Kamau Ferdinand



บทคัดย่อและแฟ้มข้อมูลฉบับเต็มของวิทยานิพนธ์ตั้งแต่ปีการศึกษา 2554 ที่ให้บริการในคลังปัญญาจุฬาฯ (CUIR)
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A Thesis Submitted in Partial Fulfillment of the Requirements
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The socio-economic disparities, cultural practices, and institutional capacities of New Orleans, Louisiana, U.S. impacted the initial response to Hurricane Katrina in August of 2005, as well as the long-term recovery and present-day mitigation efforts by the local, state, and federal governments. Examining the current practices, perceptions, and future plans of flood management strategies for New Orleans, a city considered to be among those most affected by future climate change impacts, the findings of this report contribute to the identification of the key issues of sustainable urban flood disaster management. The primary method of data collection was semi-structured interviews as the scope of this research concerns the relationship between perspectives of different key stakeholders: (1) community organizers, (2) members of governmental organizations, and (3) representatives of NGOs of flood management in New Orleans. A purposive sampling approach was used to locate a small sample cases with productive, in-depth experiential data required by the nature of the research. Data comprised the statements on organizational roles, capacities, and resources the participants used to express their views and involvement with the issues. The findings show that while New Orleans has clearly defined flood management institutions for high-level flood management capacity, interagency and community cooperation is a key driver to towards the city becoming more resilient to flood disaster. Although the primary strategy for managing future flood disaster continues to be the improvement of the levee system, a modern understanding of the risks from hurricane hazards will be a key factor of the city's future flood management approach.

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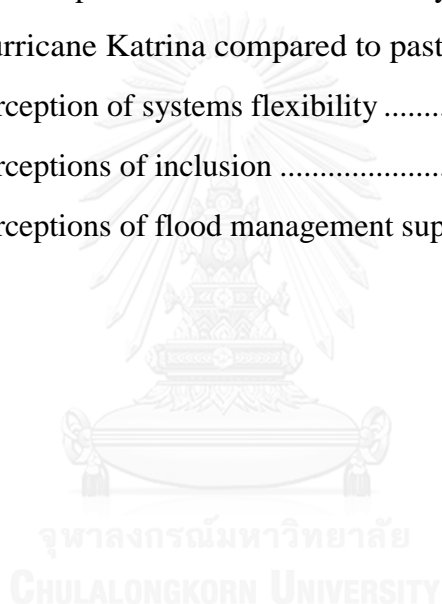
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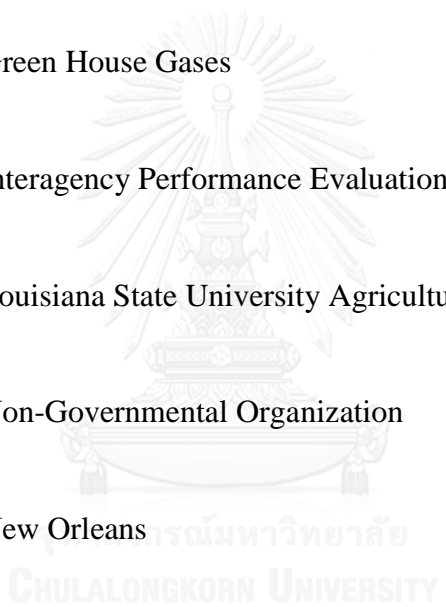


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LIST OF ABBREVIATIONS



DFIRM	Digital Flood Insurance Map
DHS	Department of Homeland Security
FEMA	Federal Emergency Management Agency
GHG	Green House Gases
IPET	Interagency Performance Evaluation Task Force
LSU AgCenter	Louisiana State University Agricultural Center
NGO	Non-Governmental Organization
N.O.	New Orleans
NOHSEP	New Orleans Homeland Security and Emergency Preparedness
NOLA	New Orleans, Louisiana
S&WB	Sewerage & Water Board
U.S	United States
USACE	United States Army Corps of Engineers

CHAPTER 1

INTRODUCTION

The consequences of climate change are a current reality and cannot be regulated to a future problem. Across the globe, natural disasters, correlating with changing climate patterns, are becoming more frequent and with increasing human and economic costs. The impact of climate-induced natural disasters, such as hurricanes, heavy rainfall, and flooding, are likely to increase the vulnerability of coastal and floodplain cities. *The Impacts of Natural Disasters: A Framework for Loss Estimation* states that the United States (U.S.), in congruence with this global trend, has experienced an increase in the costs of natural disasters, mainly as a result of populations gravitating towards these coastal metropolitan areas, as well as an increase in the value of possessions (Litan, 1999). The International Disasters Database lists 7 of the top 10 Natural Disasters in U.S. in terms of total affected people as having occurred in the last decade. In terms of economic damage 8 of the top 10 disasters have occurred in the last decade.

In city governments, mitigating and managing the impacts from extreme floods, through evacuation, information dissemination, and relief, is part of disaster management. Municipal governments are responsible for managing the risks that impact the safety, security, and well-being of their local population and environment. Coastal cities are particularly vulnerable to extreme weather events and climate change related disasters. Preparing for, mitigating, and adapting to these occurrences and associated disasters are critical requirements for coastal city governments to become more resilient. Since 1995, North Atlantic hurricane frequency and intensity has steadily increased. The 2005 hurricane season set new records for both the number of named storms and those reaching hurricane strength (Masozera et al., 2007). Extreme weather and hurricane prediction have improved considerably over the last fifty years. Satellite tracking and weather models provide much greater forecast precision, and television and the Internet present much more

effective dissemination of critical information. Nevertheless, increasing urban development in a number of floodplains has heightened the inundation vulnerability of residents. New Orleans, Louisiana in the United States is among the most prominent cities that share this concern.

The susceptibility of its population to flood disasters indicates an important need to include social considerations in disaster management planning. Although social memory is important in reconstructing past adjustments to climate change, it is often neglected in contemporary contexts (Folke et al., 2005). Plans that acknowledged past floods and emphasized steps to make the areas less susceptible to storms that exceed the levees' design limits would have made New Orleans more resilient to the disaster of Hurricane Katrina. Therefore, considering a coastal area, such as New Orleans, for this research is meaningful in evaluation of the need for ongoing planning for potentially enormous flood disasters as well as significant climate-related risks.

How decision makers participate in public policy problems and solutions to improve conditions can mitigate future disasters. The customary view of an extreme weather event would deem it and the affected population as independent of each other. On the other hand, a systems theory framework diverges from the conventional perspective to identify the reciprocal relationships of individuals, communities, and organizations and their environment (Friedman, 1997). In the case of Hurricane Katrina and New Orleans, using a systems approach to organize the complex components and processes involved could contribute greatly to the understanding of effective disaster preparation for other similarly vulnerable cities world-wide.

1.1 Research Problem

This research has investigated the influence of non-climatic factors such as land-use decisions, disaster warning and response systems, and the types of structures located in vulnerable areas on flood disasters. These multiple factors impact the extent of damage, morbidity, and mortality in locations affected by climate change, which are usually large areas and associated dense populations. The study also examines how resources, capacities, and institutions can affect long-term infrastructure and disaster planning in New Orleans to make the city more prepared for climate change induced disasters.

By identifying the effects of flood disasters on urban systems as well as the resulting structural and non-structural measures taken by the managing institutions, the research herein describes the key governance gaps that contributed to the Hurricane Katrina disaster, and possibly hampered the process of sustainable reconstruction and recovery in New Orleans. Currently there continues to be a gap in experiential research regarding urban flood management. Specifically, what are the perceptions that lead to the responses of flood disasters, the awareness of a particular disaster, the best way to manage them, and what are the observed challenges to effective future flood management?

1.2 Significance of the Study

The study investigates the effective forms of governance for successful flood management. By examining the links between certain social structures, governance, and preparation for extreme events, best practices can be studied, applied, and suggested for other similarly vulnerable areas. The city of New Orleans has experienced a major disaster and has large future risks for calamitous events due to the potential impact on both its large population and economic status. Therefore studies on New Orleans and coastal Louisiana can provide useful information for vulnerable port cities and deltaic systems in the developed and developing world. Also, by evaluating the city's attention toward flood management, we can better understand how other vulnerable cities might adapt to various climate change risks.

Incorporating differing global best practices of governance in flood management will benefit all societies in better application of climate change strategies. The identification of elements of governance, the examination of the selected strategies by various officials, and the gaps in application of urban flood management in the city of New Orleans contribute to the understanding of core issues, and the creation of a framework for better flood disaster management, development, and sustainability.

1.3 Objectives of the Study

1. To evaluate the governance perspectives of New Orleans' key stakeholders concerning flood management before and after an environmental catastrophe, most notably Hurricane Katrina.

2. To determine if flood management perceptions are reflected in resilience building of vulnerable populations.

1.4 Research Questions

The research concentrates on the following questions:

1. What are the governance perspectives of New Orleans' key stakeholders concerning flood management before and after a catastrophe?
2. Are flood management perceptions reflected in resilience building of vulnerable populations?

1.5 Expected Outcomes

These findings determine:

1. The differing perspectives of stakeholders towards sustainable urban flood disaster management.
2. Whether local flood management planning considers the perspectives of different stakeholders in decision-making.

CHAPTER 2

LITERATURE REVIEW

The role of governance in urban flood management has garnered increasing attention in academic literature. In accord with the current urbanization trends, more than half of the world's population today lives in cities. Coastal low-lying cities are particularly high risk areas for climate-related hazards due to their often large populations and complex socio-economic systems (Nicholls et al., 2007). Both climatic and non-climatic factors impact New Orleans' future exposure to flooding. Climatic conditions comprise of excessive heat, heavy precipitation, sea-level rise, and an increase of intense tropical cyclone activity. Non-climatic issues consist of increasing population, expanded land use, and land subsidence. Municipal governments are primarily responsible for urban development, and disaster preparedness and response. Therefore, the quality of their decisions has a significant impact on disaster risks that threaten the safety, security, and well-being of their local populations and environments (Huq et al., 2007). In addition, land-use planning, weather forecasting and response systems, and city infrastructure also affect the impact of extreme weather events.

New Orleans is a critical economic and cultural location of the U.S. Throughout its history, flood management has always been a principal city function to manage the security of its residents. Overall, New Orleans is among the top twenty cities today in terms of exposed population and assets to coastal flooding, and is predicted to be among the top 20 world port cities in danger in terms of climate change flood hazards by 2070 (Nicholls et al., 2008). With its long history of devastating flood disasters due to its geographical location and topography, and as a result of the extensive flood damage from Hurricane Katrina, the levees have continuously been reinforced and rebuilt to protect the city. In consideration of these realities, there is a pressing need for at risk urban areas, such as New Orleans, to create disaster management strategies with a focus on sustainable development. Table 2.1 lists the top 20 world port cities last ranked in 2005 in terms of population and asset exposure.

Table 2. 1 Top 20 World Port Cities with Population Exposure

Country	Urban Agglomeration	Delta	Pop 2005	CURRENT CLIMATE CURRENT POPULATION/ASSETS Scenario C		
				Wind Damage Index	Exposed Population (000)	Exposed Assets (US\$bil)
INDIA	Mumbai (Bombay)		18,196	26	2,787	46.20
CHINA	Guangzhou Guangdong	[D]	8,425	24	2,718	84.17
CHINA	Shanghai	[D]	14,503	41	2,353	72.86
USA	Miami		5,434	0	2,003	416.29
VIETNAM	Ho Chi Minh City	[D]	5,065	7	1,931	26.86
INDIA	Kolkata (Calcutta)	[D]	14,277	41	1,929	31.99
USA	New York-Newark		18,718	3	1,540	320.20
JAPAN	Osaka-Kobe	[D]	11,268	32	1,373	215.62
EGYPT	Alexandria	[D]	3,770	0	1,330	28.46
USA	New Orleans	[D]	1,010	15	1,124	233.69
JAPAN	Tokyo	[D]	35,197	100	1,110	174.29
CHINA	Tianjin	[D]	7,040	0	956	29.62
THAILAND	Bangkok	[D]	6,593	9	907	38.72
BANGLADESH	Dhaka	[D]	12,430	35	844	8.43
NETHERLANDS	Amsterdam	[D]	1,147	3	839	128.33
VIETNAM	Hai Phòng	[D]	1,873	5	794	11.04
NETHERLANDS	Rotterdam	[D]	1,101	3	752	114.89
CHINA	Shenzen		7,233	21	701	21.70
JAPAN	Nagoya	[D]	3,179	9	696	109.22
CÔTE D'IVOIRE	Abidjan		3,577	0	519	3.87

Source: Nicholls et. al. 2008

Urban disaster planning is often linked to a larger number of factors: economic, political, and social development, as well as environmental and geographical issues. The increase in urban development in the New Orleans metropolitan area has intensified the continued destruction of the surrounding protective marshlands and amplified the flood vulnerability of residents. For instance, an artificial channel through the wetlands called the Mississippi River Gulf Outlet (MRGO) is generally attributed the funneling of Katrina's storm surge straight at New Orleans, New Orleans East in particular. The loss of natural protections heightened the impact of Hurricane Katrina and overwhelmed the man-made protections of levees and pump stations in New Orleans (Mooney, 2015).

Cities largely have a clearly defined governance structure, with large municipalities separated into smaller administrative units (da Silva et al., 2012). It is known from studies of neighborhoods destroyed by disaster that communal institutions and social networks often survive, despite the destruction of the physical environment itself. There are gaps in how policy implementation impacts community capacity for

disaster management. These are socio-economic issues heavily influenced by environmental change. Hence, the significance of socioeconomic stratification was observed in New Orleans on August 29th, 2005, in every phase of emergency management during the Hurricane Katrina disaster.

Uncoordinated segmented systems of government create additional complications for low-income residents throughout the post disaster recovery process. Research studies have revealed the disparate consequences of the city's flooding on poor, minority households neighborhoods. Blacks in New Orleans before Katrina comprised of 67 percent of the city's total population. However, these residents suffered higher degrees of poverty and financial instability with 84 percent of its population living below the poverty line. Many poor citizens lacked personal automobiles, or access to one thereby limiting their ability to evacuate the city. The aftermath of the hurricane led to flooding of 80 percent of New Orleans, and the death of over 1500 of its citizens (Katz, 2006). The planning and recovery of New Orleans concentrated primarily on returning the city structures to pre-Katrina conditions.

However, opinions of flood management priorities in New Orleans vary among different groups. As a part of the master planning process, a series of community meetings and a Neighborhood Participation Program for Land Use were organized to provide communities the opportunity to review proposals. Some responses from these meetings indicated a strong desire to adopt the "Dutch system" of water management. Nevertheless, plans to convert vulnerable low lying areas to urban wetlands have been opposed by residents inhabiting these areas. They are more likely to be African-American populations with limited incomes, education, employment, and political access (Finch, Emrich, & Cutter, 2010). In general, there is a lack of trust in government and developers, as well as a conventional belief that funneling water out the city is the best method for flood management. This lack of trust is essentially due to historical, racial, and political based land-use decisions that often resulted in African-American communities being established in the most vulnerable areas. Although Hurricane Katrina flooded the majority of the city, a racial and economic disparity of effective evacuation and emergency services and the

vulnerability of low-income groups were apparent during the response and recovery to the storm.

While human activities and natural occurrences are closely connected, historical records often eschew the human factor of events in favor of environmental ones. Post-Katrina, the African American population in New Orleans has contracted from the aforementioned 67 percent to 59 percent at a loss of approximately 100,000 people. This decline is consistent among predominantly black neighborhoods such as the Lower Ninth Ward and New Orleans East, perhaps signifying the disproportionate impact of Hurricane Katrina on housing loss and recovery (Roig-Franzia, 2015). Figure 2.1 shows the decline in the African American population in the city by neighborhood.

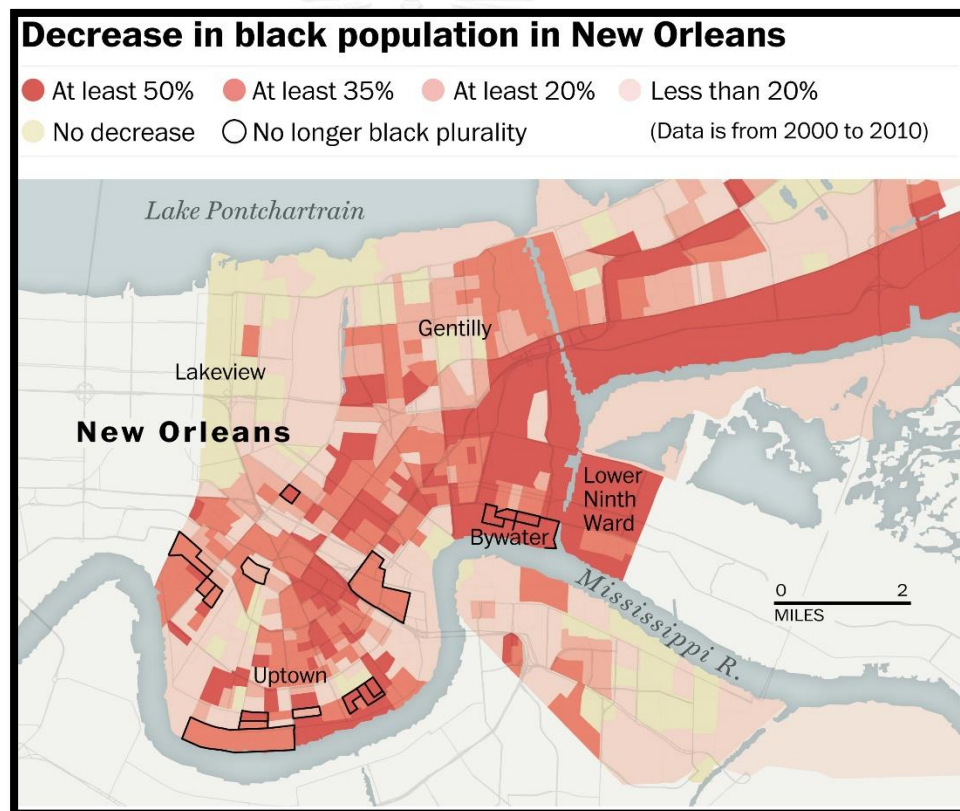


Figure 2. 1 The decrease in black population in New Orleans

Source: Dan Keating/The Washington Post, 2015

Resilience strategies can be unsuccessful partly due to a failure to incorporate historical understanding into hazards management plans. Interestingly, even prior to the major terrorist attack on September 11, 2001 in New York City, The Federal

Emergency Management Agency (FEMA) determined a major hurricane hitting New Orleans as one of the top domestic threats to the country (Gotham, 2007; Boaz, 2005). In view of these expectations, Hurricane Katrina was an exhibition of planning failure at all levels of government —federal, state, and local.

The municipal government lacked foresight and essentially deferred leadership to the state and federal government for preparation and recovery efforts. Inadequate attention was given to updating evacuation strategies and monitoring the condition of, or strengthening the levees, despite federal funds provided to the State of Louisiana for the United States Army Corps of Engineers (USACE) civil projects. One USACE official interviewed for this thesis stated, “We would get pieces and parts of funding, but we were very limited what we could do based on what Congress appropriated to us.” Money was mostly spent on disconnected projects chosen by the State Congress. Additionally, the city government oddly rejected evacuation assistance before Katrina landfall from Amtrak, the U.S. government supported train system (Foreman, 2005).

In the days following Katrina’s landfall, The Louisiana Department of Homeland Security prohibited relief organizations such as the Red Cross and the Salvation Army to enter the city to provide relief supplies to those stranded in flooded areas. FEMA delayed the deployment of hundreds first responders for several days including firefighters and health care providers not licensed to work in the State of Louisiana. President George W. Bush publicly stated on September 13, 2005, approximately two weeks after the Hurricane devastated region that “all levels of government” were inadequate in responding to a well-known and predictable threat to the city of New Orleans (Boaz, 2005). Therefore, in consideration of these issues, this research aims to use a systems perspective to ascertain the systematic role governance plays in successful flood management.

2.1 New Orleans Geographical Context

New Orleans, Louisiana, founded in 1718, is a major U.S. port city and the largest city in the State of Louisiana. New Orleans is situated in the Mississippi Delta approximately 50 miles from the Gulf of Mexico between the Mississippi River to the south and Lake Pontchartrain to the north. Historically, Louisiana has experienced the greatest flood losses per capita and the highest repetitive loss of the same property in the country. The State is comprised of nearly 5,700 square miles of wetlands, which

are being eroded at a rate calculated approximately at an American football field (total size in square meters is $48.768 \times 109.728 = 5,351.215$ sq. m.) per hour. These wetlands serve as the principal buffer between the sea and New Orleans. Between 1932 and 2010, over 1,900 square miles were lost, accounting for up to 90 percent of coastal wetland loss in continental United States (Coastal Protection Restoration Authority of Louisiana, 2007; Mooney, 2015). As noted in the previous section of this text, the loss of the surrounding wetlands was and will be an existential threat to the long-term survival of New Orleans. In the future, the city could conceivably be situated directly alongside the Gulf of Mexico, entirely unprotected to the threats of another natural disaster. Figure 2.2 displays the great land loss of the State as well as expected losses.

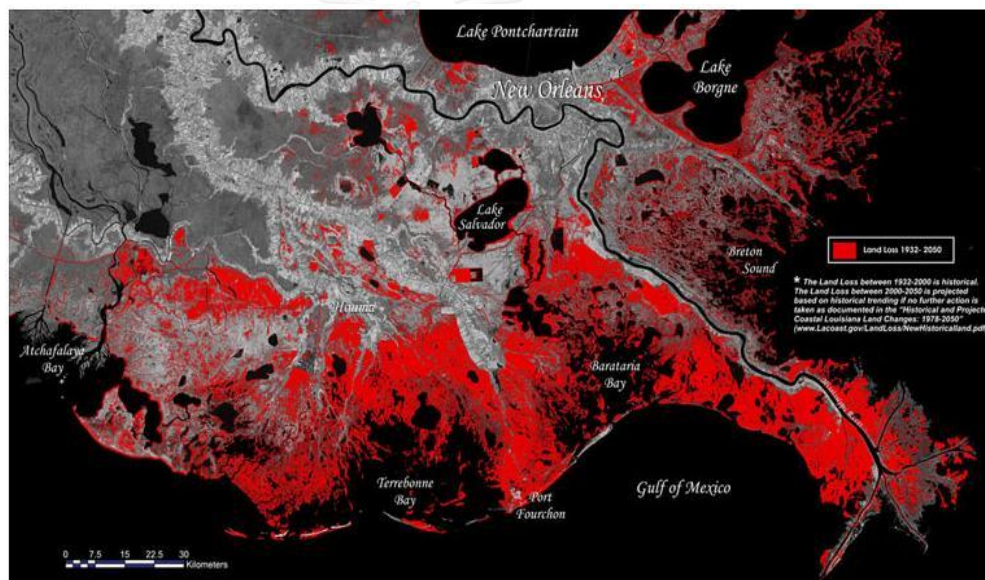


Figure 2. 2 Louisiana land loss historical and projected 1932-2050
Source: www.lacoast.gov, 2004

The Mississippi River floodplain has the highest rate of relative sea-level rise in one of the lowest locations in the U.S. (Masozera et al., 2007). Moreover, major hurricanes occur at a higher rate on the Gulf of Mexico than in other U.S. regions, and flood hazards from heavy rain events, including hurricanes or tropical storms are the most frequent hazard in New Orleans. Coastal erosion in the delta and urban expansion have led to a substantial reduction of the soil volume, and have considerably reduced the natural wetlands that buffer that and protect New Orleans from hurricane storm surges (Yarnal, 2007). Constant land subsidence has put

the city 2-2.3 m below sea level on average, and up to 3.3 m below sea level in some places, essentially shaping the New Orleans area into a bowl. Over the last century, low-lying swamp areas including the Lower Ninth ward and New Orleans East that were drained for residential properties and developments have settled more than 10 ft. Over the next century New Orleans is expected to experience continued land subsidence of about 3 feet, and sea-level rise of 3–6 feet (Rogers, 2008). Although the city has always faced these natural risks of sea-level rise, land sinking, and wetland loss, its growing vulnerability to hurricanes and flooding has been compounded by non-climatic factors such as settlement location decisions, extraction of groundwater, oil and natural gas, canal development. Paradoxically, in consideration of the fact that New Orleans is located below sea level and lacks natural drainage, the construction of protective structures such as levees and drainage canals to reduce vulnerability to river and lake flooding have in fact contributed to its growing vulnerability (Masozera et al., 2007; Colten, 2008b; Costanza, 2006). Subsequently, disaster preparedness for the city is primarily focused on limiting flood damage.

2.2 New Orleans Flood History before Katrina

Since 1559, 177 hurricanes have struck the Louisiana coastline, and since its inception, New Orleans has experienced 27 major climate related disasters (Kates, 2006). As a consequence of being located on land with poor drainage, the area is vulnerable to flooding from hurricanes, Mississippi River overflow, and heavy rains. Historically, the Mississippi River undergoes seasonal flooding, but the river itself has not been a cause of city flooding in over one hundred fifty years. From that time until now, most flood damage had resulted from the storm surges from Lake Pontchartrain (Rogers, 2008). However, unlike the floods that came from Lake Ponchartrain in 1915 and 1947, the most recent flooding of Hurricane Betsy in 1965 and Katrina in 2005, also involved storm surges from the eastern areas, where land loss was profound and the MRGO served as an express way for flood waters, an unintended consequence of attempts to facilitate shipping lanes into the city. Figure 2.3 illustrates the flood damage from hurricane storm surge in New Orleans over the last century. After each event, the city has been repaired, rebuilt, and often expanded, with the levees being reconstructed and often raised.

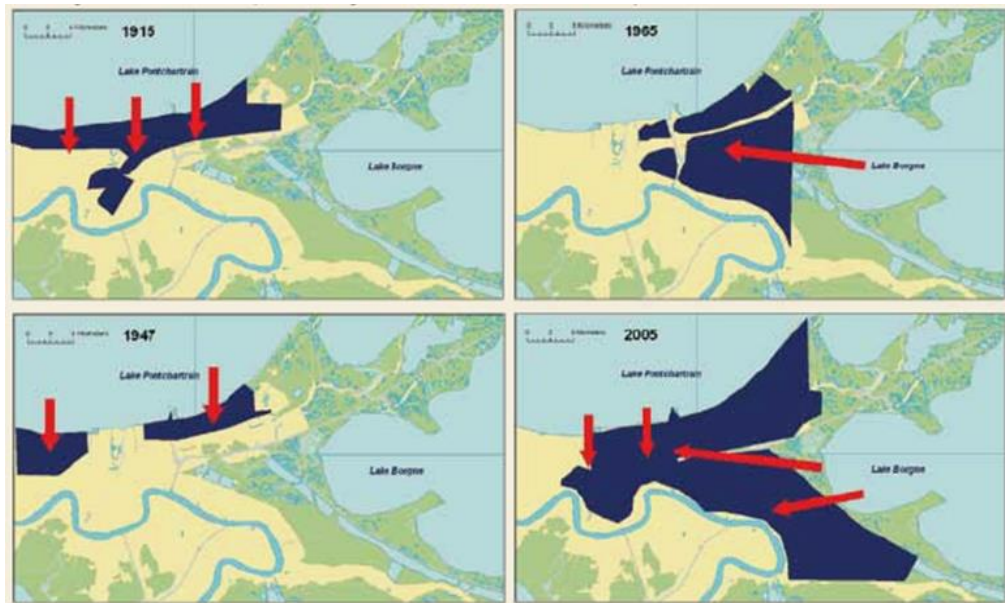


Figure 2. 3 Hurricane flood damage in New Orleans over the last century
Source: Grossi and Muir-Wood, 2006.

2.2.1 Mississippi River Flood Hazards

Throughout history, numerous floods have taken place in the lower Mississippi River Delta. Significant river flooding affected New Orleans in 1859 and flooded one-third of the city for 3 months. The largest ever recorded inundation in the lower Mississippi River floodplain occurred in 1927. A record 46 cm of rain combined with lower valley levee failure caused 6 months of flooding in New Orleans. Unfortunately, 246 people were killed in the New Orleans area (Rogers, 2008).

2.2.2 Flooding from Hurricanes

Hurricanes reach the Louisiana Coast at an average of two every 3 years. Since 1559, out of the 177 hurricanes that made landfall, 38 produced flooding in the city of New Orleans. Prior to Katrina, the hurricane to cause the most destruction in New Orleans was a 1915 category 4 hurricane that caused serious city wide damage and killed 275 people. In 1947, a hurricane flooded the city for two weeks. 51 people drowned and the city sustained \$100 million in damages. Hurricane Betsy flooded New Orleans in 1965, disproportionately devastating the Lower Ninth Ward, the same community essentially destroyed by Hurricane Katrina in 2005. Some members of the predominately, African American community remain concerned the specific Industrial Canal levee holding back flood waters in that area were neglectfully, and even purposefully inadequate since their homes and even lives were less valuable than other neighborhoods.

Like the residents of the Lower Ninth Ward, the poor white population of St. Bernard Parish was greatly affected by Hurricane Betsy flooding and lacked trust in governmental authorities as well. These citizens believed the MRGO transportation channel caused the flooding and filed a lawsuit against the Army Corps of Engineers. These beliefs persist today after the catastrophic flooding in the area caused by Hurricane Katrina.

Hurricane Betsy became the first natural catastrophe in America to exceed a total of \$1 billion in area-wide damages. New Orleans itself suffered \$90 million of losses with eighty one people killed by the storm. This revealed the inadequacy of the city's levee protection. Only 4 years after Hurricane Betsy, Category 5 Hurricane Camille made landfall on the Gulf Coast in August 1969. Damages in Louisiana totaled \$350 million. Surprisingly, these two hurricanes were overstated to have been between a 1-in-200 and 1-in-300 year recurrence frequency event (Rogers, 2008).

2.2.3 Flooding from Rainfall

The yearly average rainfall for the city of New Orleans is approximately 132 centimeters, and severe rainstorms caused major flooding of New Orleans in 1881, 1927, 1978, 1980, and 1995. The 1927 storm exceeded the pump capacity to remove environmental water of the Sewerage & Water Board's (S&WB) pump stations, depositing 35.6 cm of rain in one day. The 1978 storm dropped 5 cm of rain per hour, and again overwhelmed the S&WB pump stations, and inundated most of the city in about 24 hours. In May 1995, almost 40 hours of continuous thunder storms dumped up to 30.5 cm of rain on New Orleans, causing widespread flooding. The S&WB pump stations were inundated and 44,500 homes and businesses damaged at a cost of \$3.1 billion. Outside of a tropical storm or hurricane, this was the single costliest weather event to ever affect the U.S. (Rogers, 2008).

2.3 Flood Management Efforts before Hurricane Katrina

New Orleans foretold catastrophic flood protection failure with only marginal increases in protection from recurrent floods and hurricanes. The initial colony settlement dug drainage ditches around each of the original 14 city blocks. The answer to periodic overflowing by the Mississippi River and the hurricane season was to build levees (Rogers, 2008). By 1728, all residents located near the river were required to

build levees in front of their land. Levee heights were incrementally improved to handle overtopping based on the water increase from the last extreme weather event. In the early 1900s, railroads and public utility companies were responsible for restoring infrastructure after a hurricane while civilians, the National Guard and city workers provided relief efforts (Colten, 2008a). Years later, local levee boards were established to uphold the canals with the S&WB of New Orleans maintaining the pump stations and regulating the discharge in the drainage canals. By 1955 the USACE had become the principal institution for levee and drainage canal maintenance (Rogers, 2008). The premise that levees alone are sufficient for managing Mississippi River floods had been the main basis for the USACE flood control program policies (Link, 2006). This has also been the primary concern of flood management from the perspective of the city residents. In 1960 the USACE New Orleans District office wanted to install tidal gates and pumps to send water from the drainage canals into Lake Pontchartrain to address subsidence around the canals. The plan was emphatically opposed by local residents and officials over concern of the gates reducing storm water pumping capability and causing unwarranted flooding. Subsequently, the USACE adopted the preferred method of the local community, which was to heighten the drainage canal levees using concrete flood walls (Rogers, 2008).

Reactive practices continued up until the 2005 Hurricane Katrina disaster, even as the task of flood management and response transferred from individuals to the state and finally to the federal government. Additional upgrading of the levees, supported by two key spillways to divert surging Mississippi waters, has made the city safer from river floods but not from hurricanes. Consequently, these marginal increases in safety led to more disastrous failures with the arrival more intense storms. One exception to this approach towards flood protection occurred in 1927 when state and federal officials and New Orleans businessmen blew up the levees numerous times to ease Mississippi River flooding endangering New Orleans. However, this intentional action has raised suspicions up until now that in the event of extreme floods, the same solutions will be undertaken to preserve the high income areas of the city (Olshansky, 2008).

There have been differing theories presented for flood hazard management along the Mississippi River. In the mid-19th century, in opposition to the USACE's

levees-only theory, civil engineer Charles Ellet, Jr. presented what are now characteristics of the systems thinking approach. He determined that reservoirs for water retention and natural and artificial outlets, in addition to levees, were necessary for effective and complete flood control (Board, 2004). It was decades later before changing settlement patterns and floodplain evacuation projects were considered as a flood risk management strategy. Improved drainage techniques allowed cities to grow along the river and canals. Traditionally, earth fill had been to use to raise the height of the New Orleans levees. However, this requires the elimination of residences around the canals which city developers have not considered a realistic option. In 1960, the USACE New Orleans District office suggested flood gates and pumps at drainage canal outlets to solve this problem. However, this plan was not accepted by the local community, levee boards, and SW&B due to concerns about gate effectiveness and coordination between local authorities and the USACE (Rogers, 2008).

In 1965, Hurricane Betsy caused multiple levee failures and widespread flooding throughout the city, affecting some neighborhoods much more than others. In response the USACE greatly strengthened the levees and began erecting concrete flood walls along the drainage canals to sustain a Category 3 hurricane. In keeping with the government's failure to factor in historical extreme event precedents, Hurricane Betsy's characteristics were not incorporated into the original levee design calculations. Although the USACE didn't meet its initial completion date of 1978, the improved levees protected the city of New Orleans from three hurricanes in 1985, 1997, and 1998. However, they still were not fully completed and inadequate, leaving New Orleans highly vulnerable, contrary to public perception, by the time Katrina hit.

2.4 Climate Change Adaptation

Good governance includes the capability of addressing climate change risks by governments, communities and non-governmental organizations (NGOs) (Bang & Esmark, 2013). Adger (2008) suggests that effective urban adaptation to climate change is more a matter of governance dependent on societal perceptions and processes rather than hard, infrastructural measures. In the case of New Orleans, the socio-economic conditions, cultural practices, and institutional capacities influence its particular approach to adaptation and governance.

New Orleans has a great vulnerability to the negative impacts of climate change hazards such as increased frequency and intensity of hurricanes, a higher susceptibility to flooding, and a higher rate of infectious diseases and heat-related illnesses and deaths. Recognizing this, New Orleans executed a Climate Action Plan to reduce energy consumption and greenhouse gases (GHGs) emissions in 1999. The climate change efforts of the local government, in response to increased vulnerability to storm and flooding events has up until today relied heavily on structural improvements for adaptation rather than mitigation. However, local and regional government are increasing their focus on mitigation practices, such as wetland creation, to sequester more GHGs, reduced GHG emissions from oil and gas industries, and greater renewable energy investments (Carbonell, 2009). The New Orleans Master Plan created after Hurricane Katrina, appeals to the State of Louisiana and the USACE's "Multiple Lines of Defense" Strategy for the future safety and resilience of the city. This measure calls for the creation and restoration of wetlands, ridges, and barrier islands on the Louisiana Coast as a buffer zone between the sea and the city for greater flood protection. Further detail of the measure is displayed in Figure 2.4. The failure to maintain the wetlands, the inadequacy of the levee system and lack of any coordination for evacuation spelled doom for most of the city.

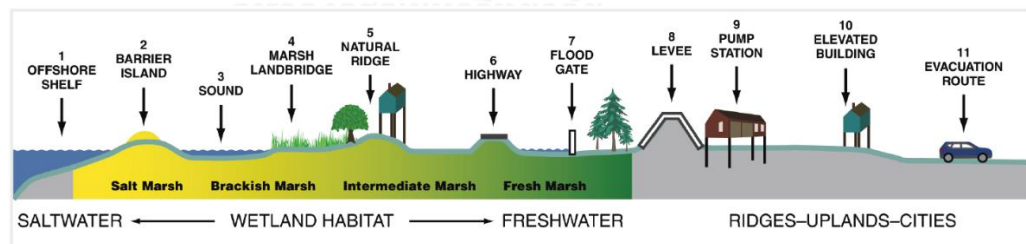


Figure 2. 4 Multiple lines of defense against hurricane storm surge
Source: City of New Orleans Plan for the 21st Century, 2010

Prior to Hurricane Katrina, the municipal government began a flood mitigation plan to address flooding and climate change impacts. New Orleans continued its plan after the storm with the hiring of its first Mitigation Director, and a renewed commitment to sustainable rebuilding, climate change mitigation and carbon emission reduction. Two initiatives in particular, GreenNOLA and the S&WB Wetlands Assimilation Project, address these concerns directly. GreenNOLA is the Office of

Recovery and Development Administration sustainable redevelopment plan for the city's physical and administrative infrastructure. It includes all-hazard mitigation in city planning and specifies population resettlement patterns based flood risk. The S&WB Wetlands Assimilation Project follows the "Multiple Lines of Defense" Strategy focusing on the restoration of wetlands lost to oil and gas development and diverting nutrient-rich municipal effluent to wetlands for restoration, storm surge protection, and carbon sequestration. All of these approaches are a significant change from a singular emphasis on levees and floodgates as the primary method for resisting floods (Kazmierczak, 2010).

Socio-economic considerations are very difficult to separate from climate change adaptation decisions (Adger, 2005). Although New Orleans is located in one of the wealthiest and most developed countries in the world, the metropolitan area has great socio-economic disparity, with associated imbalances in exposures between those most and least affected by disaster. The dissimilar impact of climate change on different individuals and groups is expected to worsen the present socio-economic differences. The anguish of thousands of poor New Orleanians stranded in the Superdome, outside the convention center, and on the roof tops of homes in impoverished neighborhoods, broadcast live across the U.S. and the world, was an accurate portrayal of the governmental failure to protect its citizens who did not have the financial or organizational means to protect themselves. According to Kelly and Adger (2000) an individual's vulnerability is dependent upon their socio-economic conditions rather than the natural hazard itself. Those from a lower socio-economic status are more likely to die, undergo injuries, report emotional stress, have significantly higher financial losses, and encounter more barriers during all stages of a disaster: response, recovery, and reconstruction (Fothergill & Peek, 2004). Researchers have determined that socio-economic status is a major indicator of resilience in the aftermath of a disaster; citizens with the fewest resources and lacking transportation assistance were disproportionately impacted in the recovery period of Hurricane Katrina (Ernstson, 2010; Masozera et al., 2007). For example, The Small Business Administration's Disaster Relief Loans program is the federal government's largest program to help people rebuild after natural disasters. Unfortunately, a large majority of low income families are denied loans on the basis of insufficient income

or low credit ratings. The disaster loan program also functions as a screening device for FEMA grant eligibility (Fothergill & Peek, 2004). Figure 2.5 displays the disparity of returnees to New Orleans five years after Hurricane Katrina.

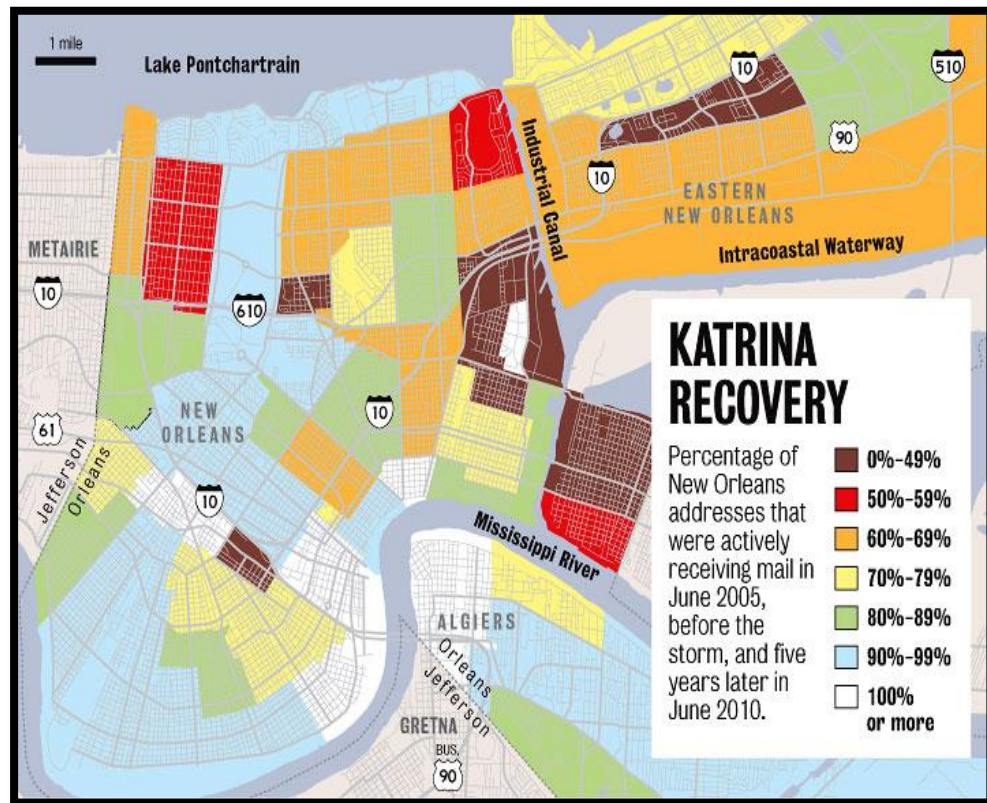


Figure 2. 5 Percentage of active mail addresses 5 years after Katrina
Source: GNO Community Data Center/The Times-Picayune, 2010

The common view of the storm that devastated New Orleans in August 2005 is that of an improbable 1 in a 100 year natural disaster event. However, a number of studies have determined that climate change will likely increase the frequency and severity of impact of natural hazards on the exposure of global coastal cities, culminating in a probable 1 in 100 year coastal flood event for cities by the year 2070. In accordance with this trend, North Atlantic hurricane frequency and intensity has steadily increased since 1995. In addition, the 2005 hurricane season set new records for both the number of named storms and those reaching hurricane strength (Masozera et al., 2007). However, the catastrophic disaster of Katrina considered from a systems perspective appears to be a complex historical progression of a natural event intertwined with immense human error. Using a systems approach couples previously

separate flood protection and coastal restoration programs, and includes social, economic, and cultural perspectives to make a more sustainable and comprehensive strategy for flood management for the city of New Orleans.

2.5 Hurricane Katrina Disaster

Hurricane Katrina struck New Orleans as a category 3 storm in late August 2005. The storm breached the levees and canals protecting the city and flooded approximately 80% of the city at depths of a few inches up to over 15 feet. Figure 2.6 illustrates the range of flood depth in the city in the days following Katrina. The areas closest to the river, also known as the “sliver by the river,” included older, more established housing. To a large extent, uptown St. Charles avenue mansions, the Garden District of venerable homes, and the historic French Quarter were spared heavy flooding.

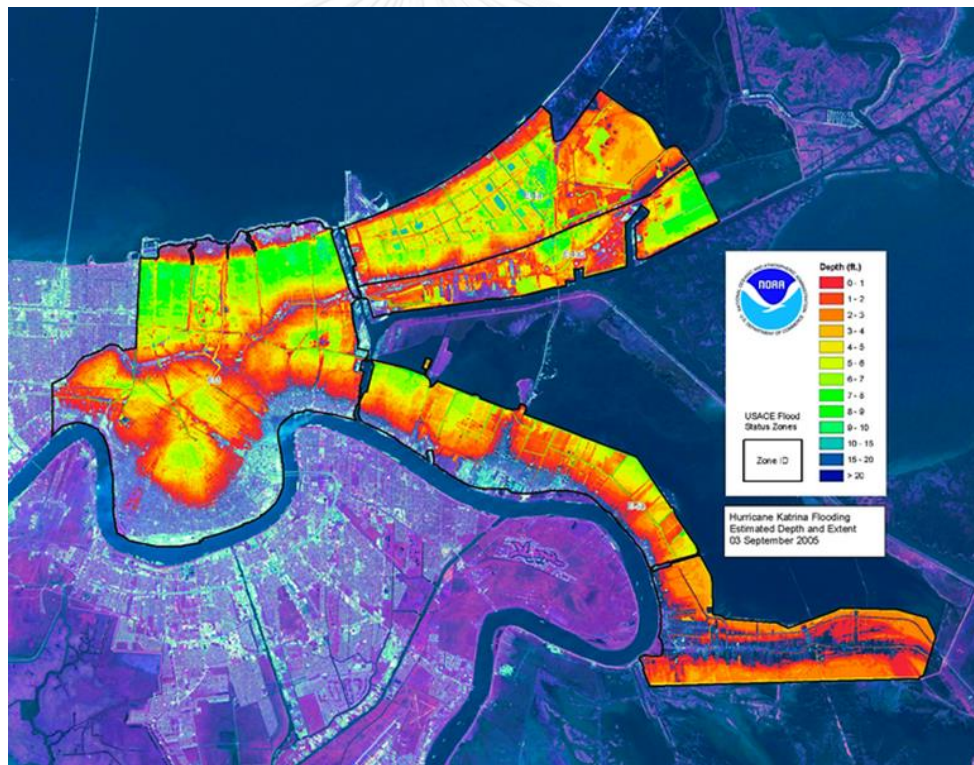


Figure 2. 6 Flood depths in New Orleans five days after Hurricane Katrina
Source: www.katrina.noaa.gov/maps/maps.html, 2005

The National Oceanic and Atmospheric Administration recorded the highest wave height in the Gulf of Mexico and the highest measured coastline surge in North America during the storm. The widespread overtopping of levees and failure of

floodwalls contributed to a majority of the flooding of New Orleans. Tens of thousands of homes became deluged for weeks with water polluted with chemicals and waste after the pumps became overwhelmed (Yarnal, 2007). Nearly two-thirds of the levee protection system had to be reconstructed prior to the next hurricane season (Link, 2010). Katrina is the costliest hurricane in recent US history and the deadliest since 1928, with at least 1,800 fatalities, tens of thousands of displaced residents, and USD 30 billion in direct economic losses in southern Louisiana. Figure 2.7 illustrates how great the impact of Katrina was compared to previous major hurricanes in the U.S.

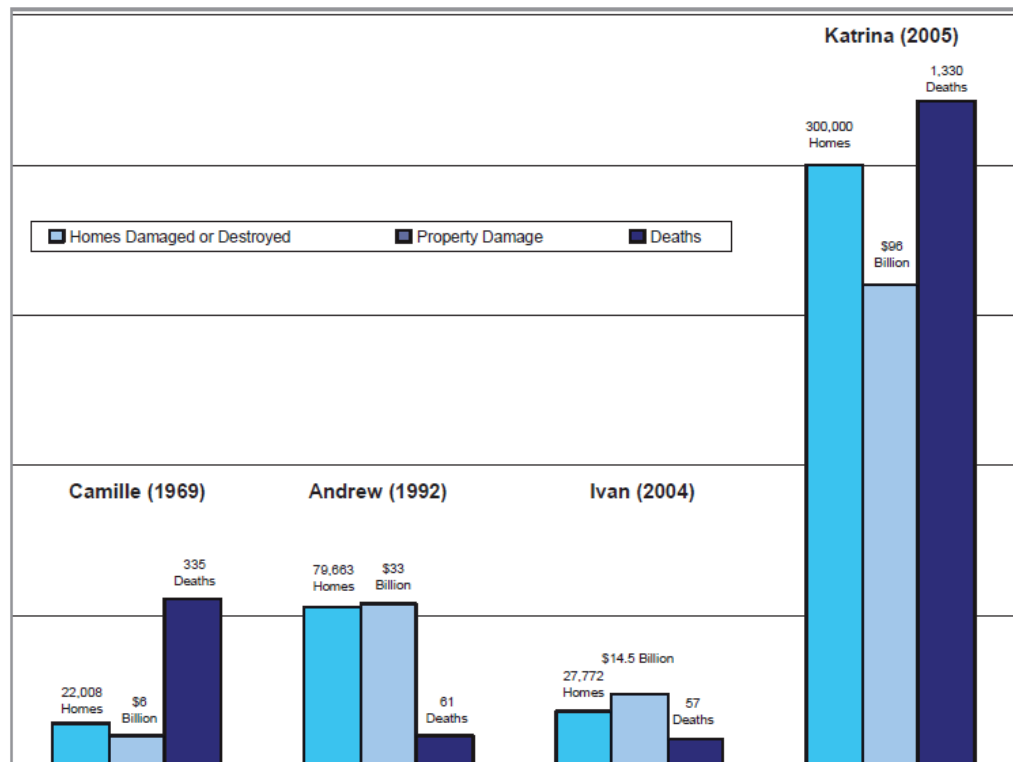


Figure 2. 7 Hurricane Katrina compared to past major hurricanes
Source: White House Report, 2006

28 percent of the approximate 1.3 million people in the New Orleans metropolitan area lived in poverty before Katrina (Shapiro & Sherman, 2005). Although advanced technical and administrative systems have been instituted to avert a similar future catastrophe, the vulnerability of the social structure to disasters remains an issue to consider for authorities.

2.5.1 Hurricane Katrina Warnings

Prior to Hurricane Katrina in August of 2005 academicians, climate researchers, social scientists, emergency managers, and engineers all had documented the risks of a major hurricane striking the New Orleans region. Numerous scientific studies, simulation exercises, media reports and documentaries all issued extensive and repeated warnings for years preceding the Katrina catastrophe. Some well-recognized sources highlighted the likelihood of disaster include National Geographic, the U.S. Public Broadcasting Service program Nova, the daily newspapers including the New Orleans Times-Picayune, and the Houston Chronicle. The *Times-Picayune* printed a five-part front page series in 2002 about the threat of a worst-case disaster. In his feature for *Scientific American*, “Drowning New Orleans,” Mark Fischetti declared, “New Orleans is a disaster waiting to happen.” The threat of such a disaster was synonymous with the city’s name--the New Orleans scenario. Hurricane Katrina developed with sufficient preparation time and warning for the New Orleans metropolitan area to announce it an emergency situation days before landfall. Nonetheless, the city suffered a major social breakdown as government authorities on every level were inadequately prepared to manage a response to meet the scope of the impending disaster.

2.5.1.2 Hurricane Pam

In the summer of 2004, after five years of failed funding, FEMA underwrote a “Hurricane Pam” training exercise intended to simulate and identify the scale of requirements for responding to a catastrophic Gulf Coast hurricane (United States, 2006, Cigler, 2007). The exercise was originally planned in 1999, but failed to secure funding for 5 years. The original planning group comprised of up to 300 Federal, State, and local emergency response officials and nonprofit organizations, including the Red Cross. Exercise scenarios included storm surges that topped levees and a great regional evacuation. In the exercise, State officials could not decipher how to move as many as 100,000 people unable to evacuate on their own (Kiefer, 2006).

The results of this drill were to be used to improve State and Federal plans in the event of such a catastrophe. Although the workshops were derived from planning documents with no historical components, and failed to produce a full, operational

guide in time for Hurricane Katrina, the exercise was determined to have been useful. FEMA distributed copies of a plan resulting from the simulation before Katrina made landfall. Officials regarded it as detailed enough to pinpoint federal tasks and guide hurricane response (Moynihan, 2009). Preparedness and evacuation measures were reasonably successful along stretches of the Gulf Coast. In New Orleans there was a considerable lack of action during the preparedness phase and the emergency management system became overwhelmed and collapsed.

2.5.2 Causes of Hurricane Katrina Disaster

It would be inaccurate to categorize the destruction of New Orleans as the result of a natural disaster. The catastrophic disaster was as much the result of human mismanagement of the environmental region as much as the hurricane itself. As Hurricane Katrina made landfall, an overwhelmed emergency management system left the population lacking resources to evacuate trapped by floodwaters in the city. The city was inadequately prepared, a plan to restore the State's wetlands had not been enacted, and urban development spread into more vulnerable areas to storm hazards (Costanza, 2006). Hundreds of miles of the Mississippi River with thousands of miles of canals, have been managed for commercial transport in the New Orleans area. The levee system built by the Corps of Engineers was designed to primarily for shipping channels (Cigler, 2007). There were severe criticisms of government delays in responding to the plight of the poor (especially to the flooding), and about general public policy issues involving emergency management, environmental policy, poverty, and unemployment. The response to Hurricane Katrina required a highly distributed and collaborative response. In addition to federal, state, and local governments, non-profit, private, and public actors were also involved. One study counted over 1,500 different organizations involved in response activities over the period from storm formation to the first week after landfall in Louisiana (Butts, 2012).

2.5.3 Preparation

In 2003, the National Response Plan (NRP) was introduced to establish a specific national chain of command as part of a comprehensive all-hazards management approach to emergency events. Years in advance of Hurricane Katrina,

the city of New Orleans obtained approval for its disaster management plan through the National Incident Management System in which local governments submit plans to the state for review and FEMA for disaster assistance (United States, 2006). However, funding for these preparedness plans were consistently denied by the Department of Homeland Security (DHS), through the U.S. Department of Justice, as it was intended for responses to major terrorist attacks rather than natural disaster. More than 170 public and private organizations participated in exercises called Purple Crescent from October 2003. However, these exercises and the following meetings between disaster management networks failed to produce significant outcomes. One pertinent example of the ineffectiveness of the Purple Crescent exercises was the failure to test FEMA approved city evacuation procedures even though transportation is a key factor for emergency preparedness (Kiefer, 2006). Although, there appeared to be an operational multi-level governmental emergency management system, the Katrina disaster was compounded by fragmented crisis management responsibilities and interagency knowledge-sharing among various federal departments. More specifically, removing FEMA from preparedness assistance with state and local responders negatively affected state and local mitigation capacity (Cigler, 2007; United States, 2006).

At the time of Hurricane Betsy in 1965, multiple small evacuations shelters were located in or near residents own neighborhoods requiring less movement and time. With approximately two days of warning of the threat of Betsy, government officials at all levels, the local private sector, and NGOs such as the Red Cross, successfully implemented evacuation of an USACE estimated approximately 90 percent of the vulnerable population with public transportation; assisting almost a half a million citizens (Colten & Sumpter, 2008). By the 1990's emergency planners understood the increased risk of the heightened levees that were a response to Betsy's extensive flooding of the city could impact greater flooding rather than prevent it. Therefore, local evacuation was not deemed a feasible choice as it was pre-Betsy. Anticipating greater flooding in the city from future hurricanes, planners revamped evacuation plans to have individual residents be responsible for their safety and well-being. Private automobiles and the interstate highway system were to be used to transport residents out of state or

further in land to avoid the threat of hurricanes (Masozera et al., 2007). The characteristics of evacuations in New Orleans had changed from an urban central city context to a suburban one.

However, evacuations from lower populated suburban areas with lower and housing densities and “special needs” populations are rather uncomplicated compared to inner-city communities. Many urban residents lack the resources of those in the suburbs and rely almost exclusively on public transportation. This was the case in New Orleans as 27 percent of the adult population were not car owners. In addition to this, the City faced issues of decrepit neighborhoods, health and healthcare inequities, and segregation. Although the poor were not regarded as a “special needs” population, they required more planning consideration by the municipal government to be safe from the threats of Katrina (Cutter, 2006). The comparatively uneventful evacuations from suburban coastal Mississippi and Alabama in contrast with New Orleans suggested a difference in evacuation experiences. Because New Orleans is surrounded by water, evacuation over a million people from the Greater New Orleans area is a considerable challenge. For this reason, early evacuation is very important to limit the impacts of disaster. In this regard, the increased levee protection created a swing from a more to less resilient evacuation procedure.

2.5.3.1 Katrina Federal Preparation

FEMA has been the main focus of Katrina inquiries as it was the lead federal agency for the hurricane. Since the 1990's, FEMA has been primarily responsible for working with state actors to coordinate large-scale disaster responses that involve the national government. After the September 11 disaster, FEMA along with more than twenty other departments, agencies, and offices was incorporated into the DHS with the purpose of more effectively coordinating emergency response with State and local governments. However, contradictorily, the DHS moved FEMA personnel, resources and programs from regional offices to DHS headquarters in Washington (United States, 2006).

Ironically, Katrina presented the federal government with a particular opportunity to utilize its new initiatives and create a quick, substantial, proactive response to a crisis. Instead, decision-making was scattered among federal

responders resulting in a failure to respond to early warnings and treat Hurricane Katrina as nationally significant as 9/11. This is particularly relevant as the DHS was unproven in its utilization of its authority and resources. Lacking urgency, federal responders regarded Katrina as if it were a normal storm needing a routine natural disaster response. The extensive delay of a coherent response showed a catastrophic failure to completely comprehend the totality of the risk and the vastness of the network of Katrina responders involved, the skills they offered, and how to use their capacities. For example, there was uncertainty among the States regarding the use of active military and the National Guard during the vital first days. The Weapons of Mass Destruction Civil Support Teams were an all-hazards response unit composed of National Guard personnel. Some states mistakenly understood them to be used only for weapons of mass destruction events and postponed deploying the teams to areas in need (Cigler, 2007).

2.5.3.2 Katrina State Preparation

Recognizing the sovereignty of the States, the federal government has traditionally deferred to the States to enact emergency management plans involving disaster mitigation, preparedness, response, and recovery activities (United States, 2006). In the near certainty that federal assistance will be necessary after an event such as a hurricane, states may make these requests before disasters strike. Despite the 2004 Hurricane Pam drill, state preparation for Hurricane Katrina remained deficient. This failed crisis planning appeared to have little relevance to the operational challenges and capacity the responders faced when Hurricane Katrina developed as a potential crisis (Boin, 2007). A 2004 revision to the NRP assigned the U.S. Department of Transportation with evacuation planning. Similarly at the state level, state plans were revised putting the Louisiana Department of Transportation and Development in charge of evacuation planning with the governor continuing to be responsible for disaster declarations and evacuation orders.

In 1998, interstate gridlock and a close call with Hurricane Georges compelled the State of Louisiana to make improvements in its evacuation system. Hundreds of thousands of people were stranded on the outbound interstate lanes; livid that the clear inbound lanes remained unused. The result was the addition of a “contra-flow” plan to be used for the next major hurricane. This plan would use the

inbound lanes or “reverse the flow” to expedite the evacuation of the New Orleans metropolitan area. Although New Orleans and the surrounding parishes failed to follow the script exactly, the contra-flow was largely successful before Katrina landed, with approximately 90% of the city residents evacuating the region far quicker than during in 2004. However, historical social lessons still had not been considered. Although State and local emergency planners were well aware that tens of thousands of residents either could not or would not evacuate, the city did not have significant plans for this population (United States, 2006). The USACE’s and FEMA’s 1994 evacuation report determined that a sizable population would be likely to remain in the city in the onset of another dangerous hurricane. It was only until the July 2004 Hurricane Pam exercise predicted Katrina’s impact, that state and federal officials even began to contend with the issue of a large potentially trapped population (Kiefer, 2006). Still, the State continued with inadequate preparedness and the emergency plan remained incomplete without effective steps to reduce the concluded impacts (Colten, 2008a). There was no particular plan to organize those still residing and resistant to leave from the historically most flood-prone areas.

As Katrina’s strength increased in the Gulf of Mexico, based on the National Weather Service’s severe warnings and projections three days before landfall, Louisiana Governor Kathleen Blanco declared a state of emergency (Colten, 2008b). Louisiana State policy requires that emergency preparedness agencies procure and preposition supplies in the event of an emergency. Even so, food and water stockpiles were deplorably in short supply compared to Betsy. The National Guard delivered an obviously insufficient 9,000 meals to the Superdome before Katrina made landfall (United States, 2006). To compensate for this glaring oversight, authorities had suggested those evacuating to the dome before Katrina to store food for 3 days (Colten & Sumpter, 2008). Agencies did not anticipate the instability of communications systems, flooding that would interrupt the emergency response for New Orleans, or the social breakdown when the inadequate food and water supplies in the city were depleted (Colten, 2008b).

2.5.3.3 Katrina Local Preparation

The New Orleans Office of Homeland Security and Emergency Preparedness (NOHSEP) coordinates the local, state and federal agencies for disaster planning, response and recovery for the City. State and local emergency plans such as the city of New Orleans Comprehensive Emergency Management Plan follow federal government guidelines. At the time the city lacked a comprehensive plan, the zoning ordinance was outdated, and it had not adequately prepared an emergency response including timely early warnings and temporary evacuations of vulnerable locations for Hurricane Katrina (Costa, 2005; Yarnal, 2007). In 2004, the New Orleans Police Department had issued a detailed hurricane response plan but no training exercises had been done. The useful results of FEMA's 2004 Hurricane Pam workshop did not appear produce preparation activity by the city government (Westrum, 2006).

As states above, more than 27 percent of the adult population did not have dependable private transportation or a place to go (Cutter, 2006). 1 in 5 families or up to 130,000 people were dependent on relatives, neighbors, charitable organizations, or entirely on public transportation. In addition, special needs populations such as the elderly or disabled, and their caregivers or often confronted with the dilemma of choosing between a potentially dangerous evacuations or trying to "ride out" the hurricane (United States, 2006). Still, in contrast to Betsy planning, the city did not give specific directions to the Regional Transit Authority as to where to the position buses or assemble drivers. In addition, there was no specified location for evacuees to gather to be picked up, or pre-determined places to evacuate. There were also no plans to use Orleans Parish School Board buses. The city, state, and FEMA, approved evacuation plan was devoid in details and precautions for errors (Kiefer, 2006).

2.5.4 Katrina Response

After landfall, FEMA's preparation and response continued to be neither comprehensive nor quick enough to match the size of the disaster. The knowledge of federal officials seemed to be constantly slower than the media reports of the situation. Levee breaches were reported the day of landfall, but the DHS did not confirm the extent of the flooding with the New Orleans Coast Guard. Neither Michael Brown nor Michael Chertoff were up to date on the fact that thousands

evacuees were seeking refuge at the New Orleans Convention Center until made aware by reporters (Moynihan, 2009). Even worse, FEMA obstructed many valuable relief efforts of other states responding to the crisis in Louisiana. The agency repeatedly stopped or diverted other states' in transit or ready to go response teams away from their destinations for reasons unclear. In many cases food, water, and medical supplies were held up while FEMA tried to figure out what to do with them. Some of the more egregious of the dozens of incidents include:

- Two trucks carrying thousands of bottles of water stopped ten miles out for lack of a tasker number
- Refusing repeated offers from the State of Arkansas to send buses and planes to evacuate people
- Turning back the USS Bataan, a 844-foot ship, with had helicopters, water supplies, six operating rooms and beds for six hundred patients
- Turning back a dispatched 135-foot landing craft stacked with food and water 40 miles from New Orleans
- Buses to evacuate the Superdome and the Convention Center did not become available until a week after landfall

Katrina prompted the largest evacuation of a city in the history of the United States in a short period of time. Extraordinary efforts to shelter and provide provisions to almost 150,000 homeless saw some of the largest mobilizations in U.S. history. Still it was severely insufficient for people's needs (Moynihan, 2009). The city of New Orleans was expected to begin evacuations 30 hours before Katrina landfall. Mayor Ray Nagin decided on a voluntary evacuation 27 hours before and delayed ordering a mandatory evacuation until 10 hours before landfall (Kiefer, 2006). Despite the delay, the city successfully evacuated 80 percent of its population before Katrina hit. In accord with the Hurricane Pam exercise, about 130,000 residents and visitors to the city, primarily the poor, African-American, elderly or those simply without resources, stayed through the storm (Colten 2008; Cutter, 2006). The same day, after calling for a mandatory evacuation, Mayor Nagin declared the Superdome as the refuge of last resort. Previous hurricane usage of the Louisiana Superdome as a short-term emergency sanctuary had shown that criminal activity was likely to occur (Kiefer, 2006). When it became full and conditions deteriorated,

people were sent to the Convention Center. The Convention Center however had not been intended as a place of refuge. There were no provisions and little security. When Katrina crashed into the city, and the flooding began, the police lost communications and law enforcement broke down. Many officers were among the remaining residents trapped in the rising floodwaters with twenty-five percent of all police vehicles destroyed when the levees were breached. Criminal activities interfered with local response operations. The police were too disorganized to maintain public order, and many deserted the city (Westrum, 2006).

2.5.5 Socio-Economic Factors

The social vulnerability disparity was just as great, if not greater than the physical vulnerability difference in the city. A number of academics have asserted that racial preference and inequality are more responsible for the impacts of Katrina and the disaster response and recovery operations rather than the storm itself (Cutter, 2006). There was obviously a preexisting social architecture that led to one of the deadliest disasters in over a century. The victims of the Katrina disaster were overwhelmingly poor African Americans residing in highly vulnerable areas of New Orleans such as the Lower Ninth Ward. The poor are likely to reside on the cheapest land, or un-developed floodplain areas leaving them more exposed to the impacts of climate change (Yarnal, 2007).

A number of historical socio-demographic disparities in New Orleans contributed to the Katrina crisis. Pre-Katrina social patterns, economics, and psychology influenced how residents decided to evacuate (Cigler, 2007). For instance, in addition to those who required assistance to evacuate, there was a substantial population of New Orleans residents accustomed to the annual threat of major storms, and were evacuation weary or even evacuation-resistant. This factor of the evacuation planning was disregarded by local and regional authorities. Although a survey of Katrina evacuees concluded that race and class were key factors of the evacuation process, additional factors such as age, disability or preservation of materials were also important.

Just as pre-existing social conditions determine the vulnerability of a population, the capacity to recover is a function of those same conditions. Poorer residents, who are more likely to rent or live in public housing, have no control over

their residential status after a disaster. In the initial periods of recovery, African Americans who remained close to the city had praise worthy access to public services. As the recovery wears on, however, there is less political will to focus on poor African American rebuilding issues who lived in the some of the city's most flood-prone areas. For example, despite equal levels of devastation, wealthy Caucasian districts were more likely to return to the pre-Katrina status than poor, African American areas (Yarnal, 2007).

2.6 Katrina Recovery

In the wake of Katrina, city and state emergency operation plans included no procedures for archiving records of past responses, let alone ensuring lessons learned will be passed to the next generation of planners. Even the Corps of Engineers which formerly prepared sizable reports on each hurricane, no longer assembles storm response summaries. Although the long-distance evacuation saved many lives, it was not designed to serve the entire population, nor could it protect property and the city's economy. Plans that acknowledged past floods and emphasized steps to make them less susceptible to storms that exceed the levees' design limits would have made New Orleans more resilient (Colten, 2008). The effectiveness of a recovery plan is dependent on a number of things: the scope and data that comprise the plan, the equity of the planning process, and the integrity of those creating it (Olshansky, 2008). As observed and documented in New Orleans after Katrina, it is possible for a city to be reconstructed without fully recovering. In other words, resilience is not synonymous with rebuilding.

There are no single governance solutions for all conditions as developing resilient urban systems is more a local governance issue (Adger, 2008). However, transference of decision making to local urban authorities in the context of climate change is only effective with a governance system that focuses on the well-being of low-income and special-needs citizens. This in turn is dependent on their awareness of climate related hazards and their capacity to influence political authorities. This suggests that inflexible centralized governance is generally ineffective to deal with sudden crisis.

In accordance, many small local initiatives such as the NOLA Homeboys and the Cajun Navy outperformed the federal government in rescue operations immediately after Katrina, but were entirely left out of the post-Katrina planning

(Westrum, 2006). When local planning authorities create adaptation policies, a bottom-up outlook tends to be greater emphasized. It took approximately 1 year after Katrina for city and state leaders to begin the process of formalizing a citywide infrastructure plan. Some neighborhoods began their own planning process, while other neighborhoods were granted professional assistance from the mayor and the city council. Planning documents from groups such as the City's Bring New Orleans Back Commission and the State's Louisiana Recovery Authority showed differences in planning objectives by the different levels of government. Both plans propositioned the federal government to improve levee protection to withstand future category 5 hurricanes, green spaces, and selective neighborhood building. The Bring New Orleans Back Commission, called for a smaller city of 250,000 to be planned with the residents of New Orleans create jobs and stimulate the economy. However, although unified, equitable recovery and citizen participation was emphasized in the planning process ultimately it was not a major focus of the plans.

In order to appropriately involve communities in increasing their resilience to global climate change, people must be enabled to impact applicable public policy. Therefore, it can be argued that urban resilience is largely a function of resilient and resourceful citizens. "Urban recovery occurs network by network, district by district, not just building by building; it is about reconstructing the myriad social relations embedded in schools, workplaces, childcare arrangements, shops, places of worship, and places of play and recreation" (Vale & Campanella, 2005). There were inspirational recovery stories of citizen resilience in New Orleans after Hurricane Katrina. For example, the working-class Vietnamese American residents of east New Orleans were also hard hit and thoroughly flooded by Katrina. However, their common heritage and tight-knit communities helped them to a stronger post-Katrina recovery than their Caucasian or African- Americans in counterparts (Vanlandingham, 2015).

Despite the large role of communication and organizational failures in the disaster following Katrina, planning for future storms focuses largely on compelling the federal government to build levees to withstand category 5 hurricanes, or a 100-year storm event that has only a 1 percent probability of occurring in any year. (Kates, 2006). The Louisiana Recovery Authority issued a report that includes a combination of coastal restoration and improved levee protection to protect against future

hurricanes. A plan to restore the wetlands surrounding New Orleans called the Louisiana Coastal Area Project could have reversed the trend of continuing wetland loss. However, the allocation of funds for continual reliance on civil engineering solutions to restore the city to its pre-Katrina appearance, will jeopardize the necessary ecological solutions to better protect the City from expected more intense future storms and sea level rise due to climate change. Even though the report recommends sustainable development, it supports economic development, using increasingly costly fossil fuel resources that contribute to the problem of climate change issues. Ironically, coastal Louisiana, which may be the most vulnerable region, provides a large fraction of these resources.

The investments the city of New Orleans made after Hurricane Katrina are believed to have reduced the present and future vulnerability of the city. However, a more recent study conducted by The World Bank and The Organization for Economic Co-operation and Development concurred with Nicholls' findings. Accounting for existing and future flood defenses, New Orleans will continue to rank among the most vulnerable cities as measured by annual average losses due to floods today and projected in 2050 (Hallegatte et. al., 2013). New Orleans has a history of making quick short-term political and economic decisions without a focus on long-term sustainability. Plans that acknowledged past floods would have made New Orleans more resilient to the disastrous impact of Hurricane Katrina. In light of this, it appears that the culture and socioeconomics of the area have more influence on its disaster management than the impact of climatic hazards.

2.7 Key Governance Roles and Responsibilities

The role of urban governance includes not only, formal institutions but also networks of informal, interconnected actors (Kemp et. al., 2005). In the framework of flood disaster management, where reducing social vulnerability is a priority, governance extends further than formal planning and state regulation by emphasizing learning, collective action, participation, societal improvements and the overall needs of the marginalized populations (Tanner et. al., 2009). Therefore, plans to rebuild the physical infrastructure of the city must be accompanied by a commitment to rehabilitate its social fabric and communal networks. Folke et. al. (2005) state, "A

resilient social-ecological system may make use of crisis as an opportunity to transform into a more desired state.” The following sections will analyze the governance structure of New Orleans in terms of institutional responsibilities of flood prevention, flood detection and warning, flood management, and flood management. In most American cities, policy-making systems involve private advisors, contractors and institutions in assistance of city, state, and federal government agencies responsible for disaster risk assessment and infrastructure. In the case of New Orleans, flood management has been designed by U.S. congressional subcommittees, the USACE, and private corporate lobbyists in conjunction with different local levee boards and port authorities. FEMA is the lead federal agency for large-scale disaster responses and was responsible for coordinating the Hurricane Katrina response.

2.7.1 Flood Prevention Responsibilities

Disaster management in America traditionally has been handled by State and local governments, with the federal government playing a facilitating role. State governors direct activities with local governments initiates requests for federal help when the disaster beyond their capabilities for an effective response. However, in instances of anticipated certain disaster, such as a hurricanes, federal assistance can be provided without waiting for specific requests from the state or local governments. Hurricane Katrina presented a need for a larger, more proactive Federal involvement in catastrophic contingency planning.

2.7.1.1 Federal Emergency Management Agency (FEMA)

Decisions concerning flood management infrastructure in New Orleans are largely made by FEMA. The Mitigation Division of FEMA uses the National Flood Insurance Program and Flood Insurance Rate Maps, updated to Digital Flood Insurance Maps (DFIRMs) in 2008, in conjunction with the USACE and local officials to create a flood management system that strengthens the areas susceptible to the three main types of flooding in New Orleans: storm surge, river overflow, and heavy rainfall. DFIRMs also allow New Orleans residents to view flood hazard areas prone to coastal storm surge and river flooding from a 1-percent-annual-chance storm event. This enables communities to make informed decisions about

federally-backed flood insurance policies and create mitigation plans that reduce their flood risk. For a community to participate in the National Flood Insurance Program, it must meet at least the minimum standards based on DFIRMs and FEMA flood hazard data for its particular area. However, a community may use other data approved by FEMA, such as maps produced by the Interagency Performance Evaluation Task Force (IPET) and National Hurricane Center, to build to Base Flood Elevations higher than that shown on the DFIRMS. A 2015 FEMA report specifically declared “The community always has a say in what the latest maps and data should be.” Additionally, as a result of the impact of Hurricanes Katrina and Rita, the Louisiana State University Agricultural Center (LSU AgCenter) with FEMA created a flood map web portal that enables the public to determine ground elevation anywhere in the State of Louisiana.

2.7.1.2 United States Army Corps of Engineers (USACE)

The federal government funds and executes large infrastructural projects such as levees. The primary responsibility for managing threats to the New Orleans metropolitan area, in addition to limiting further damage to coastal wetlands that act as a protective barrier to storm surges, would appear to be that of the federal government via the USACE. The USACE is also responsible for the protection measures of Mississippi River control, and the Southeastern Louisiana Urban Flood Damage Reduction Project which focuses on regional drainage for flood risk reduction. However, although the greater New Orleans area is burdened with the totality of all of these threats, the USACE prioritizes protection for the City as part of the greater region rather than a focus on the City itself.

Since 2006, the USACE has been building the largest civil works project in Corps’ history restoring the Hurricane and Storm Damage Risk Reduction System (HSDRRS) resulting from lessons learned during and immediately after Hurricane Katrina in August 2005. The HSDRRS is a large-scale infrastructure project designed to reduce the effects of a 100 year level storm surge or a one percent chance of such a storm occurring in any given year. It is an integrated system composed of 133 perimeter miles of levees, numerous floodwalls, flood gates and storm proofing drainage pumping stations. Historically, levee requirements have been determined by rebuilding and fortifying protections as a response to previous

hurricanes. The new system has been designed by considering a range of scenarios and events, such as different sizes, intensities and paths of storms from the from a likely 50 year event to a highly unusual 5000 year event. Researchers also looked at the issue of land subsidence and the impact of climate change on sea level rise and the makings for stronger storms to affect the region. The assortment of levees, floodwalls, flood gates and pumping stations is now regarded as a risk-reduction system instead of a hurricane protection system. This updated viewpoint assumes shared risk from hazards with residents of the city. Hence, non-structural measures, such as home elevation and fortification, and evacuation, should still be considered. Also, the recognition that even with the new, modern construction, levee system failure is still a possibility (Schleifstein, 2011). A continuous systems approach in funding, design, and policy for risk reduction in New Orleans was not apparent before Hurricane Katrina. The IPET studies, a partnership of government, academic, private sector scientists and engineers, conducted an investigation of the root causes of failure of the New Orleans hurricane protection system during Hurricane Katrina. Their final report determined the collection of individual levee projects surrounding the metropolitan area “did not perform as a system: the hurricane protection in New Orleans and Southeast Louisiana was a system in name only (Link, 2006).”

2.7.1.3 Sewerage and Water Board and Department of Public Works

Even though the City, with the assistance of the USACE, considers its flood management levels achieved with a stronger system of hurricane and storm damage risk reduction, there continue to be projections of substantial flood risk in post-Katrina New Orleans. The city is responsible for small-scale infrastructural projects such as catch basins and small drainage lines, as well as non-infrastructural measures such as early warning and information communication systems. Drainage has always been an issue for the metropolis, with land subsidence due to a decline in permeable surfaces and development in low-lying areas presenting a constant challenge to flood management efforts. The city of New Orleans itself is concerned with improving drainage capacity and evacuation strategies to manage the potential increase of localized heavy rain due to climate change. Specifically, the Department of Public Works and the S&WB are concerned with engineering and maintenance of the drainage pumping system and drain lines. Even with major improvements, the SW&B

continues the process of enhancing its flood protection systems with the development of zoning and building policy to meet the requirements of the United States Environmental Protection Agency and Department of Justice. The Third Modified Consent Decree with these agencies require incorporating stormwater best management practices in the development and implementation of a green infrastructure plan for the city. Green infrastructure refers to the networks of parks, river and stream corridors, bioswales, rain gardens and permeable pavement as a part of a long term plan for living with water. This approach could provide multiple number of social, economic, and environmental benefits such as energy and GHG reduction, green jobs, and improved habitats and recreational opportunities.

Furthermore, the S&WB contracts with nonprofit organizations such as Global Green USA, a national environmental organization, for awareness of issues and education among residents about green infrastructure, sustainability and resiliency. Although, there is no widespread policy yet implemented for green infrastructure, Global Green helps communities use techniques to increase the use of renewable resources, sustainable land use, and environmental protection, and in turn mitigate the effects of climate change. Even though there still is more of a grey infrastructure focus of pumping water out, Global Green coordinators have seen a change from business as usual after Hurricane Katrina. Additionally, social-ecological benefits can be found in collaboration with residents and communities to green neighborhoods and urban areas in the form of improved flood mitigation, air quality, energy consumption, human well-being and perspective on the interdependence of humans and the natural environment.

Overall, the goal is to enable natural floodplains along the existing canals in low lying areas to reduce subsidence by storing water rather than seeking to remove it as quickly as possible. This method aims to protect residents from extreme floods by allowing the river to flood periodically and incorporating water into long-term flood management strategies. Studies have shown that communities that are adapted to living with water, rather than being insulated from it, are continuously stable (Liao, 2012). In this regard, the S&WB's green infrastructure commitments and collaborations apply systems thinking as part of an integrated flood management solution.

2.8 Flood Preparation

In addition to the clear targets of the hard, infrastructural measures of flood management, New Orleans residents also acknowledged the need for future improvement in its non-infrastructural measures such as retrofitting existing buildings to be elevated, floatable, or wet-proofed to mitigate flood impacts. Evacuation and disaster mitigation procedures involve public, private, and non-profit sectors to better manage the potential variations in storm activity. City officials lacked an efficient system of distributing and updating information to residents during response efforts. Initiatives to support the public to become more empowered with their security have been refined with the NOLA Ready campaign. This campaign is overseen by NOHSEP and coordinated with local and state government agencies, non-profit agencies, and the public for citywide preparedness both in and out of hurricane season.

The NOLA Ready program provides the public with comprehensive information for emergency preparedness with features such as immediate emergency notifications, special needs registration, city assisted evacuation, emergency and evacuation training, and preparedness measures before, during, and after a storm. Furthermore, NOHSEP functions as the coordinating public safety agency for the city of New Orleans. The agency conducts trainings in communities to heighten their disaster awareness, preparedness, and evacuation capacity. In addition, the New Orleans Fire Department and the non-profit organization, Evacuateer.org, trains individuals interested in volunteering during a city-wide hurricane evacuation. This emphasizes the importance of city-wide coordinated response and recovery to emergency events. These are products of lessons learned after Hurricane Katrina to serve populations previously overlooked prior to the disaster. In this regard, the city is putting emphasis on enhancing the capacity of citizens to safeguard their lives and their communities in the event of another possible flood disaster.

Community organizations and NGOs supplement the formal efforts for flood management and disaster preparation in the city. Academic institutions are also major contributors to New Orleans' disaster preparedness strategies with their expert knowledge on the ways the city can understand and implement flood management plans and policies. Public-private partnership projects involve

university research centers such as the Center for Hazards Assessment, Response & Technology at The University of New Orleans, Tulane-Xavier University Center for Bioenvironmental Research, and the LSU AgCenter to work on social, environmental and hazard risk reduction.

In addition, the city of New Orleans is now collaborating with planners from the Netherlands to study ways to use the canals and open areas to store rain water and become accessible water habitats for communities. This plan is in the model of the 2006 Dutch “Room for the River” program. The approach of the Netherlands extends further than an engineering solution. It is thought to be an international example for integrated flood risk, multi-level governance, and flexibility towards to new ways of thinking. Ironically, in the early twentieth century it was the Netherlands that looked to New Orleans for drainage assistance to help spur urban development. At this time, many river cities around the globe saw New Orleans as an example of modern water management (American Society of Mechanical Engineers, 1997). These collaborations indicate the importance of information exchange between cities and countries for effective future disaster preparation. Marc Walraven, a district head in the Dutch ministry of transport, public works and water management, toured the built protections of the city and determined them to be “adequate to defend New Orleans” (Schwartz, 2012). This view was supported during Hurricane Isaac as the levees effectively protected New Orleans from 14-foot storm surges. The long established outlook is that a system of levees is necessary and sufficient for flood protection. However, strong winds and sustained rainfall still cause difficulties for the storm water infrastructure and power grid of the city. Hurricane Katrina showed that a dependence on conventional preparations actually made New Orleans more vulnerable, and simply delayed the risk for a great disaster.

2.9 Context for Research

A number of studies project a continuous increase of climate change impacts and heightened future flood exposure in coastal cities such as New Orleans. In New Orleans, planning for evacuation from Hurricane Katrina omitted significant numbers of residents and illustrated the state of the city’s exposure despite the technological advances of the United States. Despite a call from the mayor for mandatory evacuation one day prior to hurricane Katrina landfall, forty percent of

citizens, most of them socioeconomically disadvantaged, lacked personal automobiles and no mass transit was available. Furthermore, unconnected government agencies differed in their funding streams and disaster management efforts. For instance, U.S. Department of Housing and Urban Development response and recovery efforts concentrated on long-term housing issues while FEMA's response centered on temporary housing matters. Although a lack of cohesion among governmental agencies was normal prior to Hurricane Katrina, the perception persists after supposed lessons learned.

2.10 Urban Governance Framework

The Institute of Development Studies at the University of Sussex Brighton created an analytical framework for good urban governance to measure developing Asian cities' aptitude to apply a cohesive climate change resilience plan (Tanner et al., 2009). This framework identifies five main categories that can be used in an urban setting to assess good urban governance and risk reduction of climate hazards for vulnerable populations. These characteristics include (1) decentralization and autonomy, (2) accountability and transparency, (3) responsiveness and flexibility, (4) participation and inclusion and (5) experience and support.

1. Decentralization and autonomy: Climate resilient cities effectively collaborate with state and national government to execute policies and programs. Although decentralization can produce conflict among agencies, hierarchically arranged decision-making can exclude the participation of those most vulnerable.
2. Transparency and accountability: A municipal government committed to maintaining open information and funding access to the public, along with an independent media must be present to ensure fair and equitable grievance claims of residents to ensure the accountability of political decision makers.
3. Responsiveness and flexibility: Local institutions need to be flexible in their response and management of the unpredictable impacts of climate change which are likely to increase in the future. In order for residents to become more resilient, preparation, response, and recovery planning should be continuously reevaluated.

4. Participation and inclusion: Future climate induced flooding will likely disproportionately impact the poor and most vulnerable groups. Good urban governance practices require meaningful involvement of these populations in policy decisions.
5. Experience and support: Resilient cities utilize a diverse network of institutional knowledge for extreme weather management: community organizations, academia, NGOs and different levels of government are all instrumental to support efficient system operations.



CHAPTER 3

METHODOLOGY

To understand if and how lessons learned are applied for effective flood management after an extreme weather catastrophe, this qualitative research utilized explorative methods that include perspectives in the findings, in addition to the secondary data acquired from academic journals, periodicals and local planning documents that provide the background of the research. This chapter discusses how the research was conducted, and how the data were collected and analyzed.

3.1 Data Collection

As the research questions concerned the relationships between perspectives, the primary method of data collection was an interview using a semi-structured questionnaire. This method allowed the interviewer to simultaneously maintain conversation structure through open-ended questions by using a questionnaire that served as an interview guide to obtain in-depth experiential data from a small sample of individuals. The interview guide provides a systematic framework to assist with the sequence questions, and the elaboration of information when interviewing various people (Esterberg, 2002). Prior to the interviews being conducted, an extensive literature review was completed. The insights gained from these data were used to develop questions focused on the concepts of flood management. The questions functioned as a conversational guide (see Appendix) and were not especially standardized so that data could be collected with greater relevance from the different key stakeholders including: community organizers, members of governmental organizations, and representatives of NGOs. By questioning different organizations about their share in these issues, data were obtained on organizational roles, capacities, and resources. Data comprised the statements informants used to express their views and involvement with the issues.

For the purpose of reliability, pre-interview testing was conducted with individuals who met the sampling criteria to clarify or eliminate possible repetitive

questions, as well as determine suitable length of time for initiating the interview. Informants interviewed were either personal contacts of the sole interviewer or referred by a personal contact. A purposive sampling approach was used to locate cases with productive data required by the nature of the research. Purposive sampling can be more efficient than random sampling when an expert informant can provide greater knowledge on a particular subject (Tongco, 2008). To begin the interview process, the participants were informed of the purpose of the study, their right to withdraw from the study at any time, and promised anonymity. The fact that the interviewer is a native of New Orleans may have supported the possibility for the subjects to speak freely about their personal reflections and opinions on flood management in the city.

3.2 Interviewee Demographics

Interviews were conducted with ten informants from fifteen respondents. Five current local government officials who are working on issues related to flood management were interviewed from different departments in New Orleans. Participating organizations included FEMA, the USACE, the NOHSEP and the SW&B. A local citizen, an activist, a community leader, and representatives from an NGO, who are or have been involved in disaster response and flood management issues in New Orleans, comprised the remainder of the consultants. Ultimately the sample size, split between 5 men and 5 women, was defined by the number of agreeable responses to the invitation to participate. All informants were between 32 and 71 years of age. Some interviewees were natives of New Orleans, others were longtime residents, and some were recent transplants. All informants have at minimum a university degree.

Table 3. 1 Study Informants and Roles

Institutions Represented	Flood Management Role
Federal Emergency Management Agency	Conducted meetings with communities for disaster recovery and mitigation Reviewed plans for elevation, acquisition and floodplain management programs
New Orleans Office of Homeland Security and Emergency Preparedness	Maintains framework for preparation, response, and recovery to emergency Responsible for long-term risk reduction to avoid damage rather than respond to it
The U.S. Army Corps of Engineers	Provides storm surge or risk reduction measures for the New Orleans region
Sewerage and Water Board	Responsible for the drainage system over 36” and the drainage pumping system
Nonprofit and Volunteer Organizations	Provides assistance to weather homes for water management and green infrastructure Educates for awareness and resiliency

3.3 Conducting the Interviews

Members of the local government, community, and an NGO were interviewed by Skype and/or email between August, 2014, and March, 2015, at a time and date of the informants choosing to maximize their participation comfort in the study. The interviews focused on the ways in which New Orleans is currently managing flood hazards, what changes have been made to policies after Hurricane Katrina, and what are the expected future difficulties concerning flood management. Participants granted permission to electronically record the interviews, which entailed between 30 and 60 minutes, and were carefully transcribed to ensure accurate data collection. Recoding the interviews and triple-checking transcripts against the original audio recordings limited errors and assure the accuracy of the recordings, thereby enhancing

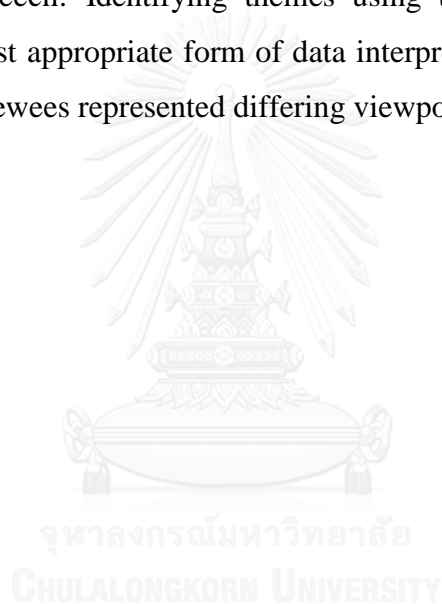
the of the research findings. Note taking was used to support the recordings and document silences or reactions that may have added meaning to the interview. All interviews were conducted separately, except for those with the NOHSEP and the NGO. Officials representing NOHSEP, and the Department of Hazard Mitigation, which is a division of NOHSEP, were interviewed together. Two individuals from the NGO were interviewed together as well. The interviewees were informed of the interviewer's background to establish a rapport and facilitate a more free-flowing interview. Moreover, participants were not hindered from responding to questions in a free and honest conversational manner. The participants were interviewed for their perspectives, insights, and experiences on how the differing worlds of government, community, and non-profit initiatives interact. Follow-up and probing questions, when applicable, were used to advance the conversation or for clarification of a response. Questioning and discussions by Skype were recorded with the permission of the interviewees.

3.4 Analysis Methods

Upon completion, the audio recordings were reviewed three times for an accurate account of the transcription as well as to increase the understanding of the intent of the interviewees' statements and opinions. Therefore, the report focused specifically on what the informants stated to articulate their insights of their experiences accurately. Mayring (2014) suggests that qualitative content analysis has three fundamental of interpretation: summary--the reduction of the material, explication--the finding of additional material to increase understanding, and structuring-- sorting out significant aspects of the data.

The structuring interpretation form of qualitative content analysis was used with the pertinent content filtered out of the complete material as a whole. The data were then organized, and analyzed according specified pre-determined categories. The categories utilized were determined by an urban governance framework developed by the Institute of Development Studies at the University of Sussex Brighton (Tanner et. al., 2009). This framework identifies attributes of good urban governance that support effective climate change resilience. These attributes include: decentralization and autonomy--the capacity of government to implement decisions and the relationship, between different levels of

government, transparency and accountability—government accountability to citizens, and openness with information and decision making, responsiveness and flexibility--rapid response and communication to various citizen needs, participation and inclusion--consideration of the most vulnerable citizens in decision-making, experience and support--successful experience in planning and implementation of climate-related adaptation strategies for vulnerable groups (Tanner et. al., 2009). Several direct quotes from these transcripts were included as part of the data analysis. Other quotes were paraphrased for brevity, or eliminated as conversation or filler words commonly found in spoken speech. Identifying themes using this deductive approach was deemed to be the most appropriate form of data interpretation for this thesis as there were different interviewees represented differing viewpoints on the topics.



CHAPTER 4

RESEARCH FINDINGS AND DISCUSSION

The study examined how New Orleans is currently managing potential flood disasters and incorporating new methods in their flood management efforts. This study also examines challenges and opportunities for more effective disaster preparation and mitigation. The following section uses data collected from the interviewees and literature search to construct an accurate, comprehensive description of New Orleans disaster responses and planning focused through the urban governance framework developed by the Institute of Development Studies at the University of Sussex Brighton.

4.1 Decentralization and Autonomy

Cities that shun political standoffs and collaborate with national and state governments to implement climate change policies and programs are more resilient. Although the decentralization of decision-making can create delays between different agencies, top-down political structures often forsake the participation of vulnerable citizens.

4.1.1 Agency Collaboration for Flood Management

New Orleans does have an extended history of collaboration among various levels of governments and institutions for strategic flood management. The following responses illustrate how these organizations interact. For example, “...*the Board is a partner of the city’s storm water task force.... (SW&B official).*” In addition, “...*there are a few meetings formally scheduled in elected city council meetings.... (NOHSEP official).*” However, this research found that federal and local governments did not communicate closely. This view is supported the statement of a FEMA official:

“I don’t think the city of New Orleans had been in close communication with FEMA for floodplain management because they did not

have an approved hazard mitigation plan on file with the government.”(FEMA official)

The city’s reliance on hierarchical governmental structures, and the lack of a federally approved hazard mitigation plan, indicated the municipality had a continued dependence on the traditional structural method of levees to abate potential disaster for prior to Katrina. A hazard mitigation officer with NOHSEP supports this finding stating, “...*the concept of not waiting rather than responding to threats and disasters, had not happened in City Hall at that point.*” However, collaborative flood management efforts appear to have increased among the different governmental agencies and departments following the disaster. The same NOHSEP official addressed the necessity of being proactive post-Katrina stating:

“The health department has been very good in being a partner in actually going out to hospitals, nursing homes and help conveying information and get everybody registered.” (NOHSEP official)

One of the lessons learned from Hurricane Katrina was to utilize the resources of partner agencies to effectively implement features of fresh programs, such as the special needs registry of NOHSEP’s NOLA Ready program.

4.2 Transparency and Accountability

Cities must not only be accountable for their management of public services, but also completely transparent in informing the public of the municipal risks and vulnerability to climate change. In addition, local media and journalists who report on the threats of climate change, should keep these issues in the public consciousness. One of the most named aspects associated with flood management concerns in New Orleans was funding and how it was being managed.

4.2.1 Funding for Preparation and Response

According to all government informants, funding is the main driver of both hard and soft measures in all phases of disaster planning indicated by the following responses:

“Now we are fully funded to get the entire system constructed...just from the funding standpoint, we are much more aligned with a system approach.” (USACE official)

The USACE official in essence is stating that if only partial funding is available, then only a partial system can be completed. This lack of complete funding is alluded to as one of the primary culprits for the failure of the protective structures throughout the city. However, there are particular bureaucratic measures that must be met prior to receiving funding as explained by a FEMA official:

“...one of the requirements for that funding is to have that approved hazard mitigation plan in place prior to the disaster hitting, and that's something that the city of New Orleans didn't have...(FEMA official)

The dependence on levees and limited system coordination marked the neglect of the city to institute the necessary procedures to be properly prepared for potential disaster.

4.2.2 Funding for Recovery

In addition to the New Orleans municipality securing appropriate federal funding for recovery, how to manage the funds became an arduous task on its own according to a NOHSEP official:

“...implementation of those plans really does get completed or prioritized based heavily on what money is available.” (Hazard Mitigation officer, NOHSEP)

The amount of funding secured can determine what projects are completed or even attempted. Struggles with communication and cooperation could benefit from systems thinking based approaches. A FEMA official indicated to the lack of transparency and accountability between authorities and the public resulted in confusion and inertia for recovery solutions:

“...to not be able push those button on locals applications because the government didn't inform the people, or they didn't follow the program or they changed their certificate, or whatever it is, so now we can approve the grant. It's heartbreaking.” (FEMA official)

Additionally as the following statements indicate, informants both from the government and public declared a proper use of funds is just as relevant as, if not more than, the funding itself.

“...the federal government negotiates federal rates. And those don't become available to people where they have an evacuation at home in America.....”(Community leader)

This statement suggests, there is little funding appropriated to the public, who may have special needs, or simply be in need, to assist their ability to adequately manage an immediate disaster scenario. Having such a provision included in the disaster management system could do much to alleviate stress and discomfort for evacuees. A FEMA official concurs that many people are not able to access funding:

“...funding is really not designed to say make a community whole after a disaster. It's designed to work with a specific group of applicants...”
(FEMA official)

“...people see a pot of disaster recovery funds and they have their own plan on what they want to do with that...” (FEMA official)

Regardless if funding is secured, if it is not disseminated appropriately, the widespread beneficial impact of the funding will be unlikely felt by all. A particular point of confusion and disappointment from the public is the difficulty in comprehending by what arrangement funding is allocated as the benefits as a similar level of recovery has not been realized for all residents of the city.

4.3 Responsiveness and Flexibility

A resilient governance system should exhibit flexible and adaptive decision-making processes in the face of uncertain climate shocks and stresses in order to respond to different citizen needs. In the case of New Orleans' recovery and response to Hurricane Katrina, the term “system” can be attributed different definitions such as infrastructure, integrated action, or private stakeholder services, all dependent on the perspective of the defining agency. This research found that in applying systems thinking towards disaster response and preparation, the different connotations of the term “system” all allow various degrees of flexibility and responsiveness by participating groups. Figure 4.1 highlights the perceptions of a flood management system as a responsive and flexible entity.

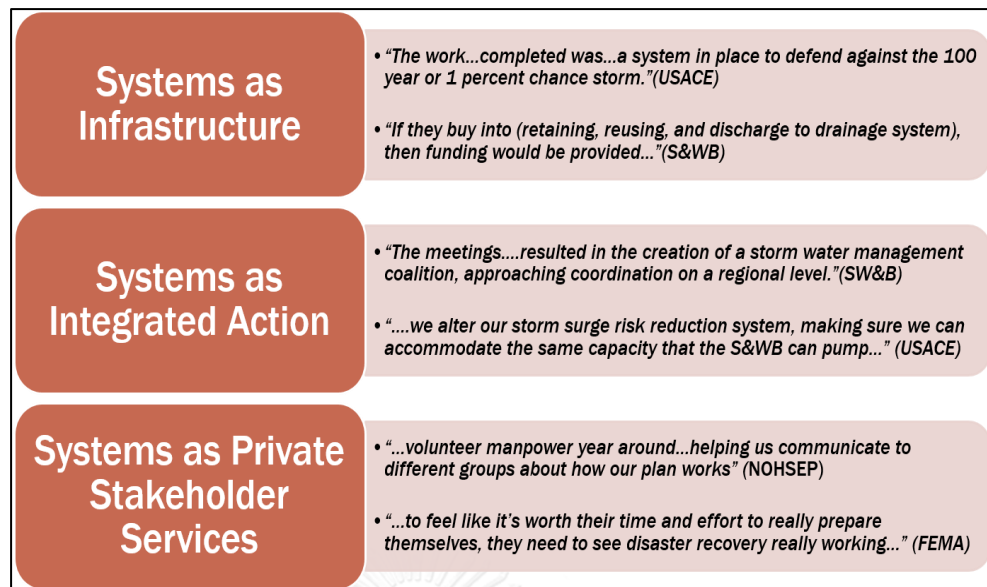


Figure 4. 1 Perception of systems flexibility

4.3.1 Systems as Infrastructure

Organizations such as the USACE and the S&WB, who are concerned with civil engineering matters, often referred to “system” as physical infrastructure that can be completed by a set date, as the following statements indicate:

“The work that we just recently completed was fully funded by Congress to get a system in place to defend against the 100 year or 1 percent chance storm.”(USACE official)

In this regard, the levee system is now considered to be completely constructed and properly fortified to withstand a potential extreme weather event such as a major hurricane. The S&WB, seeking to align a systems approach with how its physical infrastructure is utilized, remains in conflict with cultural practices of stormwater management:

“If they buy into this concept (retaining, reusing, and discharge to drainage system), then funding would be provided to maintain the small drainage system, the replacement and maintenance.”(S&WB official)

Generally, after each extreme weather event, the levee infrastructure has been expanded as a method of increasing protections. This method has in fact fostered a

sense of complacency and decreased the flexibility of the city and agencies to respond to disaster. As Katrina demonstrated, relying on inflexible physical structures for protection leaves little options when those structures fail as a response to potential disasters.

4.3.2. Systems as Integrated Action

A resilient system cannot be solely dependent on inflexible infrastructure for protection from extreme weather events. In recognition of the potential threats facing the region following the Katrina disaster, the USACE, as indicated by the following statement, has begun to use systems thinking to extend definition of “system” beyond static infrastructure:

“We are now truly looking at these risk reduction measures as a system through how one affects the other and how it affects the overall system.”
(USACE official)

However, although the USACE considers “*numerous alternatives in greater depth than during Hurricane Katrina (USACE official),*” the Corps does not limit systems thinking to simply assessing the impacts of different initiatives.

A systems approach for resilience suggests a more concerted effort of collaboration to be more than discussions and reflected by integrated activities. The experience of the Hurricane Katrina disaster compelled different governmental organizations to move quickly to rectify their system coordination shortcomings with each other for New Orleans’ flood management. For example, the same USACE official stated “*...we got alternative arrangements to do environmental clearances a little quicker...*” A number of organizations that operated independently before Hurricane Katrina, including the USACE and S&WB, recognize the value in aligning their respective departments for holistic flood management. Speaking to a direct utilization of a systems approach between the two above mentioned agencies concerning the USACE’s risk reduction system, a USACE official states:

“...we alter our storm surge risk reduction system, making sure we can accommodate the same capacity that the S&WB can pump into those canals.” (USACE official)

This is consistent with the USACE's previous statement of how it modernizes its "system" definition, regarding isolating incidents as potentially impacting entire systems. The S&WB also revealed a commitment to more integrated activities on a greater scale rather than being limited to an isolated, local discussion phase:

"The meetings....resulted in the creation of a storm water management coalition, approaching coordination on a regional level." (SW&B official)

The increase in agency collaboration has been recognized by other flood management stakeholders in the city such as non-governmental organizations:

"There is more seen collaboration among authorities such as S&WB and Department of Public Works working together whereas previously they were separate." (NGO representative)

The statements all demonstrate a more resolute movement towards an expansive, inclusive and flexible systems approach of governance.

4.3.3 Systems as Private Stakeholder Services

Nevertheless, limited follow through actions among different government organizations, particularly from the perspective of the public, continued to persist throughout the storm recovery. A local community advocate highlighted as much stating, *"Every echelon has different plans of varying degrees of quality, mostly low."* While New Orleans is improving its response flexibility and capability to disaster, major vulnerabilities will continue to persist without more sustained holistic collaboration among the different sectors of city flood management. Furthermore, a resilient governance system is not limited to public-private partnerships, or assessing the impacts of initiatives. There is also an emphasis on characterizing responsiveness as proactive rather than reactive to particular events. This is clearly indicated by a NOHSEP official remarking:

"We have volunteer manpower year around when we don't have a storm, helping us communicate to different groups about how our plan works"

As it follows, cooperative actions would demonstrate the flexibility a city needs in order to heighten its response capability to potential disaster. Communities

tend to view a “system” more in this vein, as a continuous relationship between authorities and private citizens that is measured by degrees of success, rather than a fixed completion date. The following statement from a FEMA official reflects this perspective:

“In order for people to feel like it’s worth their time and effort to really prepare themselves, they need to see disaster recovery really working...” (FEMA official)

This is a powerful statement from the FEMA official. The ultimate success of disaster recovery efforts will be realized by the degree of confidence and quality of private stakeholder services. This means there should be a consistent emphasis on improvements which would in turn ensure and greater system responsiveness, and by necessity, greater system flexibility. Citizens are reluctant to participate, and become highly distrusting of a less than complete system of governance.

4.4 Participation and Inclusion

Citizens most vulnerable to climate shocks and stresses should participate and be included in the governance decision-making arrangements. In accordance, different organizations in New Orleans acknowledged non-infrastructure measures, in addition to the clear infrastructure targets for flood management, as an area of improvement to serve populations previously overlooked prior to disaster. These non-infrastructure measures primarily consisted of the various organizations involving local communities in decision-making processes through public meetings. Figure 4.2 highlights the difference in perception of community inclusion between the public and authorities for flood management decision-making. Primary perceptions impact future actions which in turn then solidifies the understandings of the respective flood management priorities.

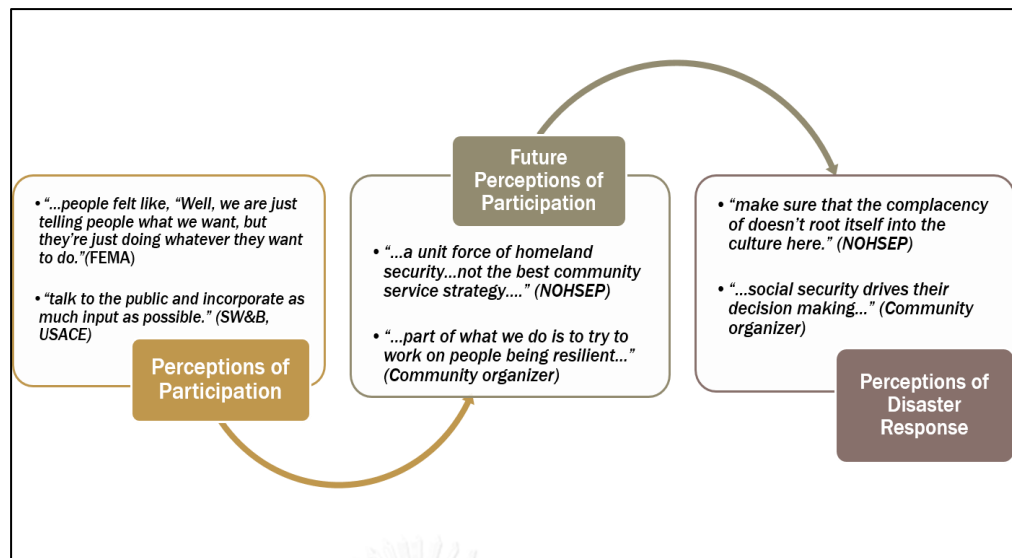


Figure 4. 2 Perceptions of inclusion

4.4.1 Perceptions of Participation

Officials from the S&WB and the USACE both stated that public meetings, which were the forums for issues such as zoning ordinances, and budget hearings on capital programs, should allow officials to “*talk to the public and incorporate as much input as possible.*” One representative for a local NGO stressed proactive participation and inclusion asserting, “*We meet regularly with the neighborhood associations and ask how to get people involved?*” These statements indicate that following Katrina, there was a concerted effort among different organizations for greater engagement with public stakeholders through formal meetings.

Nonetheless, these planning sessions did not appear to invoke the same sense of purpose among private citizens as it did for the organizations. Accordingly, a FEMA official stated, “*I think people felt like, “Well, we are just telling people what we want, but they’re just doing whatever they want to do.”* Events such as these continued to belie the sincerity of local officials from the public perspective. Although citizens, were included in proceedings, their participation appeared to be more of a formality in contrast to complete inclusion. One community activist remarked “*Formal citizen participation is improving in budgeting but not in policy making.*” These statements indicate a divergent perspective regarding public participation in city response meetings.

Still, although citizen participation has been greater emphasized now than prior to Katrina, the *“inability to team and collaborate across political boundaries”* (Community activist), failed to significantly improve the public perception of a change from “business as usual” in the event of another possible flood disaster. A citizen activist summarizes this sentiment stating, *“It in fact, reflects a massively unshared vision.”* In keeping with and further extending this perspective, a FEMA official declared *“the (planning) efforts weren’t coordinated (and) the meetings lost a lot of credibility...”* Consequently, despite the systems approach efforts on community engagement, the public and authorities remain somewhat disconnected regarding how the public responds to disaster.

4.4.2 Post-Katrina Perceptions of Participation

The importance of establishing a constant and active relationship with community members rather than for an isolated response to a crisis event is demonstrated by both of the following statements by the same NOHSEP official and community organizer:

“...going out as a unit force of homeland security, that’s really not the best community service strategy....” (NOHSEP official)

One of the lessons learned from Katrina, exemplified by the NOHSEP official’s statement, is that communities can become more resilient by functioning as a partner with local officials, instead of being dependent on them for their well-being. The increased interaction of local government with communities is more aligned with system principles, and the goals of the communities themselves as indicated by the following statement:

“...part of what we do is to try to work on people being resilient so that they are able to get through disaster.” (Community organizer)

In some instances, particularly from those organizations whose work is built upon healthy community interaction, the importance of participation and inclusion manifests in personal and community empowerment to make self-guided decisions.

4.4.3 Perceptions of Disaster Response

The reasons of how and why local citizens reacted in a certain manner are not entirely shared and understood between the authorities and the community. The following statements between a NOHSEP official and a leading community organizer

highlight these differences. The NOHSEP official sees residents' failure to heed evacuation warnings in the onset of an extreme event as the result of personal and individual choices:

"That's been part of our outreach strategy to make sure that the complacency of doesn't root itself into the culture here." (NOHSEP official)

In contrast, a leading community organizer sees these choices as dictated by greater social circumstances:

"...some of the people did not leave in terms of how much social security drives their decision making..." (Community organizer)

The differences in these responses reflect a different understanding of risk between authorities and communities. Private citizens calculate risk not simply based on safety from the hazard event itself, but also on the lifestyle impacts after the event has passed.

4.5 Experience and Support

A resilient urban system will engage the NGO and civil society sector, as well as technical and academic institutions, to build on existing experiences in planning and successful implementation of adaptation strategies for climate-related risks. Effective planning especially targets vulnerable groups such as the poor or elderly. Including, the perspectives of flood management are fundamental to the planning and implementation practices of different organizations. To accurately grasp the informants' perceptions of flood management, they were asked for their opinions on the primary flood management concerns for the city of New Orleans. The responses below indicated that different priorities of flood management were dependent on the subjects' employment positions and their core responsibilities in the city of New Orleans. Figure 4.3 illustrates the perceptions key stakeholders hold of institutional flood management support.

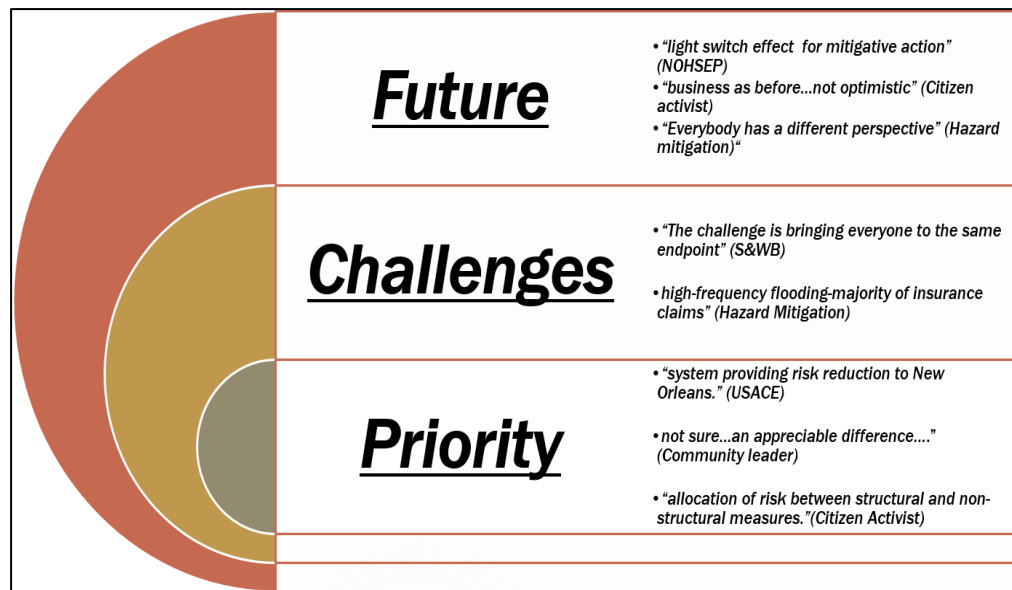


Figure 4. 3 Perceptions of flood management support

4.5.1 Perceptions of Flood Management Priorities

The main public concerns are, predictably, personal security and protection of property:

"There has not been an appropriate allocation of risk between structural and non-structural measures." (Citizen Activist)

Private citizens have suggested there is an overall lack of trust in continuing to view the levees as the primary method for protecting the public and their property from the impact of a potential future disaster.

This directly contrasts with the view of USACE, responsible for building the said levees:

"...we now do have a continuous system protecting or providing risk reduction to the metropolitan area of New Orleans." (USACE official)

The USACE officials were confident that the newly termed "risk-reduction system" would be effective at protecting the metropolitan area from future hurricane-related flooding. The usage of the term "risk-reduction" rather than protection indicates that the Corps recognizes the importance of incorporating non-structural measures to mitigate disaster. Moreover, the Corps

also appeared to appreciate the faultiness of relying solely on improved fortification of levees for hurricane protection.

While most citizens and the Corps are concerned with the larger structural defenses of the city and hurricane protection, local officials may appear to be more concerned with regular occurrences of flooding:

“...changing of culture of removing the rainwater as fast as we can to retaining, reusing, and discharge to drainage system.” (SW&B official)

There is a belief and culture in New Orleans that pumping rainwater out of the city is the most effective way to protect property and lives. Furthermore, other means of flood management that may interfere with this practice have been met with resistance from the public and local officials.

... very high probability high-frequency flooding is the majority of flood insurance claims in the city” (NOHSEP Hazard Mitigation official)

This belief and cultural perspective results from centuries of living in opposition to water rather than living in harmony with it.

4.5.2 Perceptions of Flood Management Challenges

All of the informants acknowledged the various challenges of moving forward towards a successful, holistic system of flood management. Coordination among the different agencies and interest groups for a unified vision remained the greatest challenge.

“Everybody has a different perspective....It takes a while to coordinate that.” (Hazard mitigation officer, NOHSEP)

“The challenge is bringing everyone to the same endpoint....Lots of ideas but little follow through to date.”(S&WB official)

The large number of New Orleans municipal groups struggled with communication and cooperation. For example, the determination of the optimal means to appropriately manage the federal funds secured for recovery was an issue. This prohibited a prompt, clear, unified vision for the recovery of the city.

4.5.3 Perceptions of Future Flood Management

Consistently, a divide remains in perception between local authorities and the local population. The responses of government officials are optimistic regarding the changes the municipality has made and what it means for the future disaster preparation of New Orleans.

“There was an almost a light switch effect pre- and post-Katrina as far as undertaking mitigative action.” (NOHSEP official)

Katrina could not have illuminated more among local officials the priority of being proactive towards disaster preparation. After all, it was an event that had been long predicted. Community members, who have long adopted the position that preparing for a disaster is “out of their hands,” are more reserved in their optimism for future changes in the city.

“If another Hurricane came at the end of the month, I'm not sure that there would be an appreciable difference....” (Community leader)

The fatalistic tone stems from the previously mentioned absence of trust in local government, lack of wide recovery in many communities, and an overall perception that recovery in the city is prioritized by economic interests in contrast to the well-being and security of residents.

“All institutions have continued to do business as before....I am hopeful but not optimistic.” (Citizen activist)

The FEMA official, who is also a native of New Orleans, seems to share the perspective of the local citizens. Without assurances of comprehensive flood management for the city, local residents generally remain, to a large extent, in their thought processes prior to Katrina. The sensibility of many citizens is best described as the idea that fate will decide if their properties are spared or not.

“...it's just every individual for himself...when the flood comes back, some homes will flood, some won't.” (FEMA official)

Although the public remains pessimistic on the overall appreciable impact on their lives, the tone of future outlooks for the city remained largely positive. A recurring theme was that the destruction from Katrina allowed the city to seriously address the issues that led up to the catastrophe.

“...most of what we do here when it comes to hurricane preparedness and flood mitigation....came out of lessons learned in 2005.”
(NOHSEP official)

“There is no more poignant proof for Katrina’s impact than the fact our office didn’t even exist until 2006.”(Hazard mitigation official, NOHSEP)

Homeland Security, in particular, has been able to develop a more comprehensive approach for resident security and preparedness.



CHAPTER 5

CONCLUSION

5.1 Present State of Flood Management

Data collected through literature review and interviews demonstrated that New Orleans has clearly defined flood management institutions that enable it to have high-level flood management capacity. Interview responses also indicated that interagency and community cooperation is a key driver to propel New Orleans towards becoming a more resilient city to flood disaster. The city's historical experiences and challenges related to flood management shape understanding on how future flood management efforts should be handled. There are various flood management strengths and challenges to be considered to make the city of New Orleans more resilient to flood disaster. Consequently, the primary strategy for managing future flood disaster continues to be the improvement of existing methods, primarily the levee system, as a suitable fix. It is uncertain if the major flood infrastructure upgrades will continue to be effective with possibly entirely different climatic, social, and environmental conditions in 100 years' time. In order to effectively adapt to the long-term, gradual impacts of climate change, a radically different methodology from the current infrastructure planning of flood management may be required. One of the key factors to shape how the Corps manages projects after Hurricane Katrina is the modernization of its understanding of the risks the city faces from hurricane hazards.

Opinions of flood management priorities in New Orleans vary among different groups. In general, there is a lack of trust in government and developers, as well as a conventional belief that funneling water out the city is the best method for flood management. This lack of trust is essentially due to historical, racial, and political based land-use decisions that often resulted in African-American communities being established in the most vulnerable areas. The findings show that city officials are aware of the public expectation and history of man-made structures to protect the city from disaster.

A lack of institutional coordination and local resident capacity are key challenges for effective disaster management strategy. Although New Orleans is a vulnerable city with the resources to reduce flood risk, the poor residing in low-lying areas disparately bear the costs of flooding while the wealthy and corporations face little of the same risk (Huq et al., 2007). This suggests that the perceived economic risk for the city is not congruent with the increasing climate change risks the city faces. In order to effectively address vulnerability to the long-term, gradual impacts of climate change, as well as the non-climate factors of flooding, river cities like New Orleans require an alternative long-term mitigation approach to flood management (Liao, 2012). Building strong community resilience is often linked to local customs that at times may influence decision-making outside of state policies. New Orleans is poised to become a model of urban resilience and climate change adaptation for deltaic cities worldwide. In order to have effective flood management, many coastal cities throughout the world must use new approaches to planning and implementation that surpasses building greater flood management infrastructure. Conventional measures may enhance adaptive capacity in the short-term, but not build the long-term capacities to address future climate impacts.

5.2 Gaps in Flood Management Strategies

Public and private sector policy-makers are essential actors in increasing a community's resilience to the impacts of environmental changes. However, successful implementation of these policies cannot occur without the support or active participation of the public. The gaps identified in the local authority awareness of the disaster preparation and recovery attitudes and motivations of communities, as well as a sense of efficacy of programs geared towards public participation for disaster preparation and recovery efforts after Hurricane Katrina, signify a noteworthy systematic unease of policy applicability. The city has shown an increase in transparency by including the public in meetings regarding the future development of the city. However, inclusion has not translated into a greater sharing of decision-making, resulting in a perception and meaning difference of participation between the authorities and communities. A perception of token participation accelerates an attitude of apathy and complacency in residents that authorities desire to avoid when preparing for another potential

disaster. Furthermore, a lack of true integrated participation fails to deeply recognize the core issues and motivations of vulnerable populations as they pertain to flood and disaster management.

In top-heavy systems, early-warning signals observed at the bottom reach higher levels too slowly due to long or complex/noisy lines. When decision-authority lies at these higher levels, decision-power and reaction-capacity are severely limited. In the context of social–ecological systems, this would involve overly complex procedures for decision making, bureaucracy, and a limited influence of local actors on policy. When local planning authorities create adaptation policies, a bottom-up outlook tends to receive greater emphasis. Governance interventions, as a social issue, can have a powerful effect on the resiliency to flooding of vulnerable populations lacking alternatives. Unfortunately, the city’s ineffectiveness at handling the diverse dynamics of flooding through sound urban planning and local coordination has hampered its attention to long-term flood disaster management as the quintessential future challenge. New governance approaches are required to improve resilience of those negatively affected by environmental change.

5.3 Recommendations

New Orleans will become more effective at implementing strategies for flood management, not only in the short term, but for future generations as well, by instituting a number of practices. First, the population should be allocated the competence and power to respond to possible problems. “It should be made more self-reliant, self-sufficient, self-regulating, and self-organizing” (Wardekker et. al., 2010). These findings show that flood management efforts must include coordinated and committed planning with a greater focus on enhancing the capacities of citizens and communities to prevent, mitigate, and manage flood disasters themselves. Furthermore, understanding the how the cultural aspects of communities intertwine with their perception of disaster risk, reduces that said risk, as well as their vulnerability. As previously mentioned, the Vietnamese community’s value of cohesiveness was an important factor in determining their resilience towards Hurricane Katrina. Therefore, citizens must be enabled to influence applicable public policy aligned with cultural practices to enhance participation and strengthen community spirit and positive attitudes towards their role in flood and disaster management. Although local authorities have

recognized the importance of ongoing community outreach, these practices should be normalized into policy for truly effective disaster response. Flood management policies must support community leadership and communicate the public benefit of preparation beyond temporary programs.

Secondly, although the various local, state, and federal agencies have diverse objectives, they must have consistent and continuous coordination to optimize citizen resilience. The local context of disaster is essential for reducing vulnerability, enhancing resilience, coping capacity and overall effective disaster management. The local authorities appear to recognize the benefits and needs of greater collaboration between agencies. However, individual agencies must have increased autonomy for decision-making in case of disaster. This would augment the flexibility, adequacy, and response capability of the city to disturbances. Disaster management has undergone a philosophical shift from large infrastructure projects as a response to a single disaster event, to building the coping capacity of communities to withstand multiple disaster events (Shaw et al., 2010). Therefore, municipal leaders continue to incorporate city operations and precise policies to address post disaster recovery for vulnerable communities. One means of integrating agency functions is to create a joint information database on vulnerable populations, including the hazards, risks and losses associated with their exposure.

Thirdly, municipal officials should continue to engage and learn from other global cities that share their concerns. One major challenge to the long-term planning of New Orleans is the difficulty to precisely forecast the status of the future climate. New Orleans has recognized climate change induced disaster hazards as a significant issue that will impact their disaster management capability. Climate change and the likely increase of extreme weather events will make major flood infrastructure upgrades expensive, and perhaps ineffective, considering entirely different climatic, social, and environmental conditions in 100 years' time. However, if authorities fail to recognize the threats of climate change impacts on city flood and disaster management, the local population cannot be expected to be adequately prepared for a climate impacted event. The case of Hurricane Katrina witnessed a portion of the population incapable of imagining a doomsday scenario despite governmental warnings. A public poorly

educated on the risks of climate change will have great difficulty changing their perception of future extreme events regardless of the warnings. This realization, as well as the destruction suffered from Hurricane Katrina, should facilitate a more modern outlook on sharing good practices in climate change interventions for disaster preparation and recovery beyond strengthening infrastructure or providing simple services for vulnerable citizens.

In conclusion, New Orleans' overall flood management efforts should not be limited to shifting from a grey to green infrastructure solution-based approach. They should be the result of coordinated planning that not only includes innovative city design strategies, integrated water management, coastal restoration, but also concentrating on continuously enhancing of the capacities and social welfare of residents and communities. Therefore, greater collaboration of different stakeholders, in addition to adequate funding of a range of processes, will assist New Orleans' residents to become more adaptable.

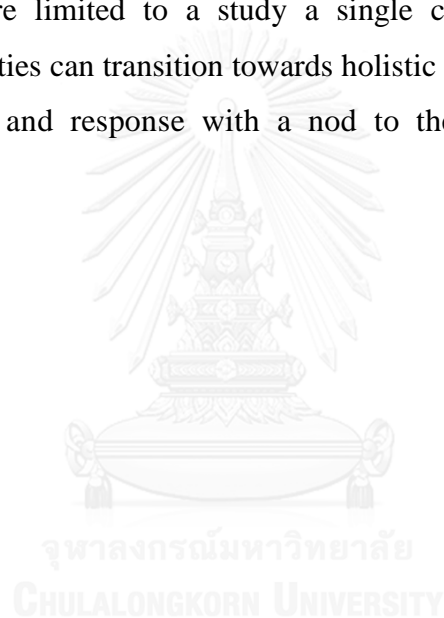
5.4 Limitations and Opportunities for Future Research

Despite the importance of several recommendations developed from this research, several limitations should be recognized. The applicability of the findings of this study is limited due to the restricted sample of informants. Further research could include additional officials or private residents to study additional perspectives on the topic. Furthermore, this thesis focused on New Orleans as a single case study as the impact of disasters is primarily felt at the local scale. As every city has a somewhat unique social, cultural and geographical identity, it is necessary for its efforts to meet the conditions of its locality. An urban area can continue to be exposed and simultaneously reduce its disaster risk with certain measures, such as enhancing infrastructure, updated planning, and increasing public access to resources and information. New Orleans was chosen because of its current and future exposure to flood as well as its emphasis on transitioning from conventional methods to a systems thinking focus for flood management.

For greater insight on how New Orleans' distinct characteristics influences city policies and resident perceptions, the research could significantly extend further comparing New Orleans disaster preparation measures with other cities of similar

environmental circumstance, but different cultural and political settings. For example, the same research in a city such as Bangkok with comparable development history, but different urban cultures and social systems are likely to have dissimilar concepts of the best way to prepare for, respond to and recover from disaster.

Although climate change is not specifically referenced as the reason for building a stronger flood management system in the New Orleans metropolitan area, the city is factoring the potential impacts of climate change in its approach to flood management. In a broader perspective, while there is yet to be widespread climate change policy implementation in the U.S., adaptation planning has occurred in some states and cities. Albeit the results are limited to a study a single city, the findings add to the perspective of how cities can transition towards holistic systems on the issues of flood disaster preparation and response with a nod to the future impacts of climate change.



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APPENDICES

Flood Management Local Authority Questionnaire

1. Introductory information

Possible follow up questions:

- What is your experience and areas of responsibility with flood management?
- What is your knowledge and involvement with the 2005 Hurricane Katrina disaster?
- What was your position in 2005 at the time of Hurricane Katrina?

2. What are the roles & responsibilities of your organization in dealing with flood management in New Orleans?

Possible follow up questions:

- Tell me more about how:
 - any mandates or policies determine your role?
 - you allocate staff/resources to deal with issues?
- How do the different organizations co-ordinate for flood management?

3. In your view, what is the main concern of flood management for the city of New Orleans?

Possible follow up questions:

- How vulnerable is the city to flood?
- What makes some areas more susceptible than others?
- How should people best protect their homes from flooding and respond to flooding?

4. How does your organization involve local communities in decision-making processes?

Possible follow up questions:

- Who do you meet with and how often?
- Do you have an opinion regarding public participation in decision making?
- What are some challenges?

- What are the main flood management priorities of the local communities?

5. What are the existing mechanisms used for flood management?

Possible follow up questions:

- How are decisions made?
- Who is involved in the decision making process?

6. In your view, how effective are the responses by New Orleans authorities and residents to floods?

Possible follow up questions:

- What issues impede sustainable flood management? Why?
- In your opinion, how can the flood management process be improved?
- How can the process be more collaborative?

7. What developments have occurred in New Orleans flood management after Hurricane Katrina?

Possible follow up questions:

- Has the role of your agency changed after Hurricane Katrina? How?
- What are your views on FEMA policy changes? E.g. FEMAStat and the refocusing of resources on individual and community preparedness programs.
- What are your views on the recommendations on community preparedness from *The Federal Response to Hurricane Katrina: Lessons Learned* report (2006)? E.g. combining various preparedness programs into a single national plan.

VITA

Kamau Ferdinand was born in Washington D.C. and raised in New Orleans, Louisiana, USA. In 1996, he received his Bachelor of Arts degree in psychology at Simpson College in Indianola, Iowa, United States. Thereafter, he worked as a counselor for adjudicated youth and with a non-profit for mobilizing and educating community members about health care services and practices in the New Orleans area. Following this he taught at Options Charter Middle School in Washington D.C. He lived in New Orleans in August 2005 at the time when Hurricane Katrina landed, and in Yokohama, Japan in March 2011, experiencing the Great East Japan Earthquake. While in Japan, he achieved a condensed MBA with the Japan Market Exchange Competition (JMEC) in 2007. In addition he resided in central Bangkok as the November 2011 floodwaters approached the city. Being present in local regions at the time of three major historical disasters inspired him to further investigate the concepts of resilience and preparedness, and led to his decision to enter graduate school with the Environment, Development, and Sustainability (EDS) Program at Chulalongkorn University. He will receive his master's degree in August 2016 and plans to begin work on social welfare and environmental issues upon graduation.



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