Quantifying Differential Access to FEMA Disaster Funding and Showcasing Good Mitigation Strategies to Inform Local Decision Makers

By

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Abstract:

Socially vulnerable communities experience the adverse effects of a natural disaster to a greater degree, including more frequent impact, more significant impact, and longer recovery periods. Federal grant funding helps enable communities to prepare for, respond to, and recover from disasters. This research first examines who has historically received funding from the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Assistance (HMA), Public Assistance (PA), and Individuals and Households Program (IHP) programs at the county-level in Florida, Georgia, and North Carolina. Ordinary Least Squares (OLS) regression analysis is utilized to identify relationships between social vulnerability factors (i.e., poverty, race, housing, and Social Vulnerability Index (SoVI)) and FEMA funding receipts. All mitigation projects with program fiscal year (FY) between 2005 and 2020 are included in the analysis; all funding allocations for PA and IHP correspond to Hurricanes Matthew (2016), Irma (2017), Michael (2018), and Florence (2018), respectively. Control variables include population density and hazard level (i.e., percent of properties in a FEMA Special Flood Hazard Area (SFHA), proximity to coast, and total rainfall). Results indicate that both poverty rate and proportion of black residents had negative relationships to HMA and IHP funding; counties with higher proportions of black residents typically received less IHP funding than the value of damage assessed by FEMA during inspection when compared to counties with lower proportions of black residents; counties with a higher SoVI received more HMA funding for emergency management and property protection projects and less HMA funding for land acquisition projects when compared to counties with a lower SoVI. These results advance understanding of how inequities are being exacerbated by a combination of a lack of access to federal disaster funding and such funding being put towards continued development in high-risk areas thus hindering advancements in community resilience for socially vulnerable communities.

The second stage of this research takes a closer look at a sample of 10 counties across Florida, Georgia, and North Carolina to assess mitigation expensing at the local level and how it affects community resilience while considering each county’s social vulnerability, hazard level, and mitigation and recovery plan quality. The results point to disproportionate amounts of HMA funding being allocated to emergency management projects, particularly in socially vulnerable communities, and counties with high mitigation plan quality not necessarily having good mitigation strategies implying that many counties may be simply going through the motions of mitigation planning to secure access to post-disaster funding. Within the sample, counties that showcased the best mitigation strategies emphasized land acquisition, private elevation of structures, building retrofit, and/or stormwater management projects over generators, warning systems, and/or mitigation plan updates. These results can assist local decision makers by showcasing good mitigation strategies and identifying which types of mitigation projects should be pursued given local community characteristics.

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Chapter 1: Introduction

Data shows that direct financial losses from natural hazards are on the rise with inflation-adjusted damage costs for flooding, coastal hazards, and hurricanes averaging $31.6B annually which accounts for approximately 60% of total disaster costs from 1980 through 2021 (NOAA, 2022). Pre-disaster hazard mitigation is the primary avenue to countering this rising trend. The total national benefits of FEMA hazard mitigation grants between mid-1993 and mid-2003, in terms of avoided future losses, were estimated to be $14B in year 2004 dollars compared to $3.5B in costs yielding an overall Benefit Cost Ratio (BCR) of 4.0 with flood mitigation yielding the highest BCR of all hazards at 5.0 (Rose et al., 2007). Recently the National Institute of Building Sciences (2020) cited that mitigation can save up to $13 in disaster losses for every $1 invested with grants from federal programs including FEMA's Hazard Mitigation Assistance (HMA) program yielding a BCR of 6.0.

Mitigation is the first of four stages in the disaster cycle followed by preparedness, response, and recovery. Mitigation and preparedness take place pre-disaster with response and recovery taking place post-disaster. The primary difference between mitigation and preparedness is that mitigation takes place long before a disaster event occurs while preparedness consists of the immediate emergency management actions leading up to a disaster event and often occurs after meteorological warnings have been issued. Mitigation can be classified into two general types, structural and non-structural. As the name implies, structural mitigation involves either the strengthening of a structure to better resist forces (or damage) from natural hazards or the construction of structural protective measures such as dams, levee, and seawalls. Non-structural mitigation involves the managing and overseeing of development procedures such as land acquisition, relocation, and land use planning. Both types are included in the analyses of this study with mitigation projects being classified into five different mitigation actions: acquisition & elevation, development regulation, emergency management, property protection, and structural controls. Emergency management is typically considered as part of the preparedness and/or response stage of the disaster timeline but is included in the five types of mitigation actions here because the FEMA HMA program has historically funded all of these five classifications.

Recovery, the only other long-term stage of the disaster cycle, often evolves into mitigation given that recovering from the previous disaster evolves into preparing for the next disaster. Although mitigation transitions after recovery, there is a gap in knowledge as to how mitigation influences recovery; this research intends to help fill this gap in knowledge by analyzing how mitigation advances community resilience. Community resilience is the ability of a community to prepare for, respond to, and recover from a disaster event (Cutter et al., 2008). Therefore, knowing which types of mitigation (acquisition & elevation, development regulation, etc.) will best advance community resilience and therefore improve recovery at the local level is vital for building resilient communities. In order to accurately assess the influence of various types of mitigation on recovery at the local level, a variety of local characteristics need to be accounted for including hazard level and social vulnerability.

Hazard level refers to the likelihood of a hazard event occurring and the natural geography (e.g., proximity to coast, proportion of area in floodplain, etc.) of the location. Social vulnerability refers to the characteristics of population groups that have historically made them more (or less) at risk when they are exposed to the impacts of a hazard event (Cutter, 2009; Cutter et al., 2003; Flanagan et al., 2011; Roundtable & National Research Council, 2015; Peacock et al., 2014; Van Zandt et al., 2012). Certain characteristics have been identified that allows for certain individuals to be more successful in navigating bureaucratic channels to receive compensation including language, social connectedness, financial resources, and familiarity and trust with local governance (Fotovvat, 2013; Ganapati, 2012; Rivera, 2017; Tierney et al., 2001). Additionally, the absence of procedural equity, defined as the degree to which fair treatment characterizes policies and programs (Bullard, 2005), and the ensuing disparate distribution of resources and capabilities produced, disproportionally affect racial and ethnic minorities and lower income and working-class communities (Bullard, 2008; Cole & Foster, 2001; Harrison, 2014; Mohai et al., 2009; Muller et al., 2018; Pellow, 2017; Schlosberg, 1999, 2009; Shrader-Frechette, 2002). However, Flavelle (2021) concludes that the problem is not intentional discrimination but rather the differences come from realities such as a real estate market that often places higher values on properties in communities with large proportion of white residents, and the difficulty of navigating the federal bureaucracy which tends to favor communities with more resources. Importantly, when federal aid programs only evaluate total cost in damage, as opposed to understanding the impact that creates on the disaster victims or the victim's capacity to recover, then inequities are inherently built into these governing policies and programs. The degree to which social vulnerability influences access to pre- and post-disaster federal funding is investigated in this study to identify inequities resulting from the complex systemic factors mentioned.

Hazard mitigation planning has been proven to be a vital component in the effort to build resilient communities. Planning programs reduce disaster losses by affecting both the location and design of urban development (Godschalk et al., 1998). Since the passage of the Disaster Mitigation Act (DMA) of 2000, local governments are required to adopt hazard mitigation plans to be eligible for certain types of federal disaster funding. Lyles (2012) defines the quality of a plan as the degree to which the contents of a plan serve the purposes for which a plan is intended. Plan quality is assessed for the sample counties in this study using established procedures and the influence of plan quality on county-level mitigation strategies is assessed. It is hypothesized that jurisdictions with higher plan quality scores will secure more mitigation funding, particularly for non-structural mitigation projects such as land acquisition that move development away from high-risk areas and as a result advance long-term risk reduction and build community resilience.

This project takes advantage of a dataset collected in the late 2000s and early 2010s as part of a Department of Homeland Security (DHS) funded study. This original study had a national scope that included six states – Florida, Georgia, North Carolina, Texas, California, and Washington. These six states were chosen to provide variation in planning context with California and Florida historically demonstrating the strongest planning laws followed by North Carolina and Washington, then Georgia and Texas. This current study prioritizes federal funding as it relates to coastal storms and includes data for Hurricanes Matthew (2016), Irma (2017), Michael (2018), and Florence (2018) all of which tracked over the southeastern region of the US and occurred later in the chosen 2005-2020 timeframe so that effectiveness of mitigation can be assessed. Thus, the geographic region chosen was narrowed to include only the states of

Florida, Georgia, and North Carolina while still providing an opportunity for longitudinal analysis. Within the range of counties, a sample of 10 counties was selected for a closer look at how social vulnerability and plan quality impacts community resilience and mitigation expensing; state planning context and hazard level are also considered.

Chapter 1 introduces the foundation of knowledge that this research will build upon and the importance of this research with respect to the community resilience research space. Chapter 2 summarizes relevant existing literature providing the foundation of knowledge on which the present work rests on and advances. Chapter 3 demonstrates how Ordinary Least Squares (OLS) regression analysis was used to identify differences in access to pre- and post-disaster federal funding and presents the results. Chapter 4 first, demonstrates the general trends in mitigation expensing across all counties with varying levels of community resilience and how mitigation expensing is impacted by social vulnerability; second, takes a closer look at the sample of 10 counties to pinpoint preferred mitigation strategies while considering each county's social vulnerability, hazard level, and mitigation and recovery plan quality. Chapter 5 draws conclusions from the results and offers recommendations for future research. Figure 1-1 provides a visual flowchart of this research paper.

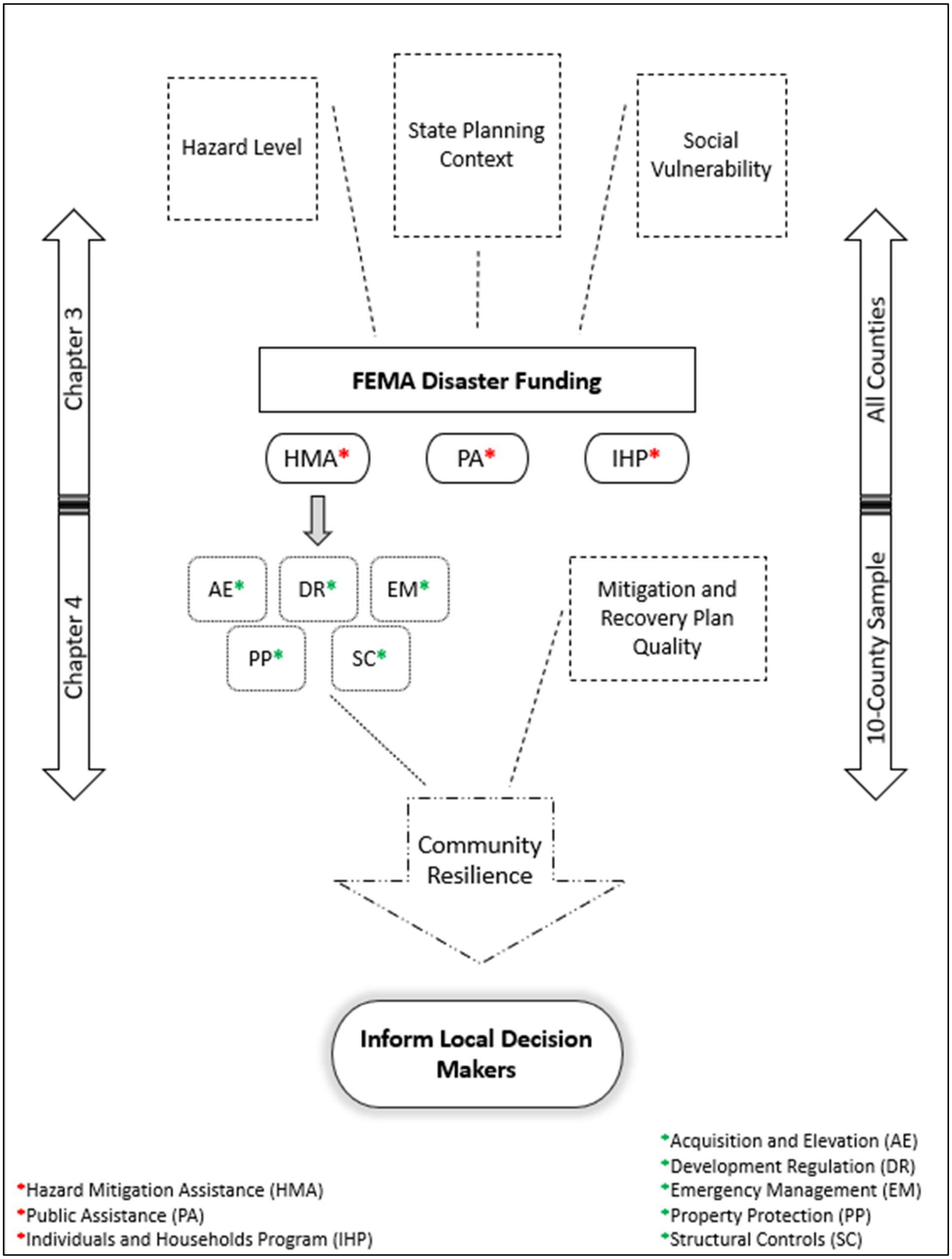


Figure 1-1: Process Flowchart

Chapter 2: Literature Review

This chapter presents the foundation of knowledge from existing research to which the present thesis research builds upon and enables evaluation of the relationship between pre-disaster mitigation and post-disaster recovery and the influence of social vulnerability on access to pre- and post- disaster federal funding.

2.1 Mitigation

Both mitigation and preparedness take place prior to a disaster event. Preparedness includes all of the short-term actions that intend to prepare a community for an eminent disaster event such as disaster warnings, planned evacuations, and weather forecasts. In general, mitigation is aimed at long-term risk reduction. Mitigation takes place both in the long-term pre-disaster phase and long-term post-disaster phase in anticipation of the next disaster. Mitigation includes long-term actions to prevent, avoid, or reduce disaster impacts (Godschalk et al., 1989). Considering that mitigation is the only stage of the disaster cycle that occurs long before a disaster strikes, it is most beneficial in preparing communities to better resist the destructive nature of disasters and therefore reduce economic losses. The National Institute of Building Sciences (2020) cited that mitigation can save up to $13 in disaster losses for every $1 invested. This is even more compelling when considering the mental and emotional toll on disaster victims and contributions to climate change through damage and rebuilding that is avoided.

2.1.1 Hazard Mitigation: Common Examples

Hazard mitigation practices, such as land-use planning, protect passively against damage while emergency preparedness and response, such as more ambulances, protect and restore actively (Lindell, 2019). The active protective and restorative nature of preparedness and response is easily recognized, however it does nothing to mitigate future harm. On the other hand, the passive protective nature of mitigation is typically not realized until the next disaster event which may be years into the future.

Mitigation can be public or private depending on the existence of government intervention. Commonly, public mitigation takes the form of publicly funded disaster prevention infrastructure, such as dams, levees, and flood control basins, and is intended to protect many people. Considering the 4-year nature of political cycles and the infrequency of destructive disaster events, political prioritization at the local and state levels is often very low with the majority of mitigation funding being granted at the federal level. Private mitigation is often used by a single household or business at a time and may include relocating to a less risk-prone area; investing in structural retrofits like hurricane tie-down straps or elevating the home above the floodplain; or purchasing insurance. Research has identified the 'Risk Perception Paradox' which describes how even individuals with high-risk perception seldom take appropriate preparedness actions (Wachinger et al., 2013). Without incentive programs, costly private mitigation is often not adopted (Iwata & Managi, 2014). When mitigation is regulated and coupled with incentive programs, substantial adoption has followed, including building to

Fortified Home standards in the Southeast (*Fortified Home Building Standards,* n.d.) and retrofitting soft-story buildings in California (Islam, 2017).

Not all private mitigation is expensive or disruptive. As observed in Lumberton, NC after flooding caused by Hurricane Matthew, homeowners (a) elevated air condensing units above ground on concrete piers; (b) rerouted duct work from crawlspaces to attics; and (c) evacuated and elevated belongings to shelves or higher floods in preparation for a second flood that occurred just two years later (Helgeson et al., 2021). Collectively these actions reduced impacts, including loss of life and property.

A variety of mitigation approaches exist that have all been proven to decrease disaster losses. Some of these approaches that are available at the local level include property protection, structural controls, public information, natural resource protection, and land-use policies (Lyles, 2012). Property protection policies do not alter the location of existing structures or proposed developmental areas but rather intend to reduce vulnerability of both buildings and infrastructure by strengthening the design and construction processes in ways such as retrofitting, elevation, and reconstruction. During these processes, it is appropriate that national and local level building codes be enforced. Structural control policies implement the use of engineered structures to reduce hazard vulnerability, often taking the form of storm water management approaches such as culverts and diversions or larger scale flood protection such as dams, levees, and seawalls. Public information policies seek to inform people as well as public officials in regard to the potential dangers disasters impose on the community by way of strategies such as brochures, seminars, and social media initiatives. Natural resource protection seeks to preserve delicate environmental areas such as wetlands and dunes; common examples include beach and forest restoration. Land use policies intend to alter existing developmental strategies by moving development away from hazardous areas to areas where vulnerability to the impacts of a disaster event is much lower. The main goal is to reduce and if possible, eliminate development in high-risk areas. The use of hazardous areas does not only degrade public safety, but it also decreases the environmental value of the area. Hazard avoidance plus environmental gains justify low-intensity land uses that eliminate risk to both humans, plants, and animals (Burby et al., 1999).

Generally speaking, mitigation can be classified into two broad categories, structural (e.g., taming nature) and non-structural (e.g., working with nature). As the name implies, structural mitigation approaches focus on the strengthening of the structure itself to better resist forces from a disaster event while non-structural mitigation approaches focus primarily on the management and overseeing of development procedures. Historically, structural approaches have encouraged unsafe development in hazardous areas while non-structural approaches, in particular land-use planning and development management, have been proven to significantly reduce the risk and damages from hazards (Burby et al., 1998; Olshansky, 2001; Nelson & French, 2002; Burby, 2005). Burby (2006) describes the 'safe development paradox' of governmental mitigation efforts prior to Hurricane Katrina (2005) in the city of New Orleans. The paradox is that in trying to make hazardous areas safer, primarily through federally funded construction of new levees and strengthening of existing levees, the federal government, in fact, substantially increased the potential for catastrophic property damages and economic losses. While trying to make hazardous areas safer, public mitigation efforts paradoxically contributed directly to the devastation caused by Hurricane Katrina by increasing development in flood prone areas. Practically, structural mitigation approaches still have advantages, especially as it relates to the development of desirous coastal areas which stimulate local economies. Analysis of the initial and potential future costs and long-term benefits of mitigation projects is necessary in order for local officials to decide whether development in hazardous areas, when done strategically and with good planning, is worth the associated risks.

2.1.2 Hazard Mitigation Planning

Hazard mitigation planning programs reduce losses by affecting both the location and design of urban development (Godschalk et al., 1998) and by creating a knowledgeable constituency of citizens who support hazard mitigation programs (Burby & May, 1998). Additionally, communities with a legacy of strong, engaged planning recover more quickly than those with weak planning regimes (Berke et al., 1993). Theoretically, there are three components of hazard mitigation planning: outputs, outcomes, and processes (Lyles, 2012). Planning outputs are the intermediate planning products and actions, such as plans, agreements, and implementation of plan provisions. Planning outputs result in planning outcomes which are the long-term changes to underlying environmental, social, and economic conditions of a community. Planning processes are coordinated activities taken by stakeholders to develop and implement the planning outputs to achieve desired planning outcomes. Hazard mitigation planning can be quite complex considering not only that the plans themselves typically encompass detailed description of mitigation strategies but also the process of plan implementation and enforcement involve many procedural actions.

The Disaster Mitigation Act (DMA) of 2000 was a milestone in the advancement of hazard mitigation planning procedures. Since the passage of the DMA, local governments are now required to adopt hazard mitigation plans to be eligible for certain types of federal funding. Specifically, the DMA requires local plans to include four main components, (1) documentation of the planning process, (2) risk assessment, (3) mitigation strategy, and (4) plan maintenance process, with the intention of not only requiring local governments to adopt plans but to ensure the contents of the plan are appropriate for the given locale and that the plans are adopted and maintained over time (Lyles, 2012). Skepticism has risen related to the quality of hazard mitigation plans being developed and implemented at the local level, considering that it is possible for local jurisdictions to simply go through the motions of planning in order to secure grant funding. Importantly, therein lies the question, is having a low-quality hazard mitigation plan better than not having one at all?

2.1.3 Measuring the Effectiveness of Mitigation Strategies

There are many different strategies that have been shown to be appropriate for measuring the effectiveness of mitigation, several of these strategies will be discussed in this section, the first of which being the analysis of hazard mitigation plan quality. Lyles (2012) defines plan quality as referring to the degree to which the contents of a plan serve its intended purposes. Burby et al. (2000) defines the primary standards for plan quality which include elements such as clarity of purpose and understandable definitions of procedural actions, linkage of land-use and emergency management efforts, and assigned responsibility for implementation and monitoring. Building off the understanding of plan quality, Berke et al.

(2012) completed a study evaluating state hazard mitigation plans under the DMA. The conclusions drawn were that overall states do not have well organized, technically sound, and thoroughly prepared plans that reflect a strong commitment to mitigation. This conclusion reinforces the wide skepticism that local jurisdictions are simply going through the motions of planning in order to secure desirable public grant funding.

Rose et al. (2007) reported on a Benefit Cost Analysis of FEMA Hazard Mitigation grants that were granted from 1993 to 2003. Within the analysis, benefits were defined as avoided losses, i.e., losses that would have occurred without the mitigation activity. Note that losses from future disasters can only be estimated and quantified in a probabilistic sense. As such, benefits are long-term and more complicated to assess when compared to mitigation costs which are short-term and easy to assess. To make assessment easier, hazard mitigation benefits were categorized. Some of these categories were reduced direct property damage (e.g., buildings, bridges, pipelines), reduced direct business interruption loss (e.g., factory shutdown from direct damage or lifeline interruption), reduced environmental damage (e.g., wetlands, parks, wildlife), and reduced societal losses (e.g., deaths, injuries). A large number of the FEMA Hazard Mitigation Grants were provided through two different programs, the Hazard Mitigation Grant Program (HMGP) and the Flood Mitigation Assistance Program (FMA). The HMGP was created in 1988 to assist states and communities in implementing long-term hazard mitigation measures following presidentially declared disasters. The FMA was created as part of the National Flood Insurance Reform Act of 1994 with the specific purpose of reducing or eliminating claims under the National Flood Insurance Program (NFIP). The overall Benefit Cost Ratio (BCR) for grants analyzed was 4.0. The BCR varied by grant type (i.e., 1.5 for earthquake mitigation to 5.1 for flood mitigation) with all types achieving a BCR above 1.0. Notably, the BCRs for federal grants have increased to 6.0 as identified by the National Institute of Building Sciences (2020) which proves the significant benefits of hazard mitigation funding at the federal level.

Bouwer et al. (2014) completed a study specifically focusing on the cost of mitigation measures in Europe. The adopted cost classification was followed (Meyer et al., 2013) which separates costs into: direct, indirect, and intangible. Direct costs are any costs attributed to research and design, the set-up, and the operation and maintenance of mitigation measures and related infrastructure. Indirect costs are related to secondary costs to economic activities that are not directly linked to the original mitigation intervention. Intangible costs refer to any additional impacts for which no market price exists such as costs stemming from health, cultural, or environmental impacts. An example of the cost classification can be applied to a hypothetical reconstruction of a single-family residential building. Material and labor costs would be direct while an increased use of lumber would create an increased market cost (indirect) and an environmental impact if the lumber was locally sourced (intangible). Within the report itself, costing aspects are broken down for each of the nine comprehensive categories of mitigation measures such as hazard modification, infrastructure development, and emergency response. For all types of mitigation, direct costs are easiest to quantify and therefore have been emphasized over indirect and intangible costs. Nonetheless, the authors conclude that greater attention should be given to the analysis of indirect and intangible costs in order to better assess the overall value of mitigation measures by considering the full range of associated costs.

Shreve and Kelman (2014) reviewed Cost-Benefit Analyses (CBA) of Disaster Risk Reduction. Within the analysis, vulnerability was generalized into four broad categories: economic, environmental, physical, and social. Economic vulnerability relates to the financial capacity to return to a previous path after a disaster; environmental vulnerability is a function of factors such as land and water use, biodiversity, and ecosystem stability; physical vulnerability relates to susceptibility of damage to engineered structures such as houses, dams, and roads; social vulnerability is the ability to cope with disaster at the individual level as well as capacity of institutions to cope and respond (Mechler et al., 2008). Social and environmental impacts are more qualitative in nature and therefore more difficult to measure and as such receive less emphasis than physical and economic impacts. One limitation, noted by the authors, of using Benefit Cost Ratios, which are calculated within a CBA, is that they are often calculated under the assumption that a future disaster event will occur. If a disaster event does not occur within the life of any mitigation project, the project costs will not produce any notable benefits. Therefore, it is beneficial to include in any analysis of mitigation benefits the probability of a disaster event occurring in the specific location of interest. Other limitations noted by the authors include the lack of consideration of potential impacts of climate change, the evaluation of the duration of benefits, and the broader consideration of the process of vulnerability.

Iwata et al. (2014) derived an empirical model that divided the benefits of public mitigation into three components: reductions in human capital loss, physical capital loss, and psychological loss. Human capital loss refers to the number of deaths as well as missing and injured persons. Physical capital loss referred to primary and secondary damage based on the duration of the disaster event. Primary economic damage is direct destruction of public or private infrastructure such as roads, buildings, and products that may include crops or goods; secondary economic damage represents the indirect economic loss arising from primary economic damage, such as stagnation in logistics. Because of the lack of data, only primary economic damage was considered in the study. Psychological loss refers to human anxiety that results from disaster occurrences which is difficult to measure and therefore excluded from the study. Following along with the methodology of Rose et al. (2007), mitigation benefits were generally defined as avoided losses. This study highlighted how people may not recognize the natural disaster risks in the places in which they live considering the scarcity of self-protective measures (i.e., private mitigation measures). It was also found that income levels did not significantly affect whether an individual chose to invest in private mitigation further proving that natural disaster risk perception is low amongst the general public.

Highfield and Brody (2013) completed a study evaluating the effectiveness of local mitigation activities in reducing flood losses. In 1990, FEMA introduced the Community Rating System (CRS) encouraging local jurisdictions to exceed NFIP minimum standards for floodplain management. This program has grown over time, but there is still little understanding of the effectiveness of flood mitigation projects. This effectiveness gap was addressed in their study through longitudinal statistical analysis of 450 CRS-participating communities. The CRS program is heavily weighted toward non-structural mitigation techniques. Mitigation activities were categorized into four series: public information, mapping and regulation, damage reduction, and flood preparedness. Public information includes mitigation activities such as elevation certificates, flood protection information and assistance, and hazard disclosure; mapping and regulation includes activities such as open space preservation, flood data maintenance, and storm water management; damage reduction includes mitigation activities such as floodplain management planning, acquisition & relocation, and drainage system maintenance; flood preparedness includes activities such as a flood warning program, and levee and dam safety. Flood impacts were measured based on NFIP-insured loss claim payments aggregated to the jurisdiction, while property damage was evaluated as total insured damage and divided by FEMA 1% flood zones (A and V) and out of 1% flood zones (B, C, and X zones). 1% flood zones, often referred to as the 100-year flood zone, are areas that will be inundated by a flood event with >1% chance of occurrence in any year. Results showed that only three CRS activities, freeboard requirements (i.e., adding extra height above the base flood elevation), open space protection, and flood protection, significantly reduced flood damage with freeboard requirements being most beneficial.

Kim & Marcouiller (2017) evaluated local hazard mitigation plans to determine how well they support disaster risk reduction. The framework included two phases: (1) evaluating local plan quality within disaster prone counties damaged by flood events across Mississippi River Basin over the last 20 years and (2) examining the effectiveness of plan quality and community capacity in mitigating flood losses. Risk was considered to be the multiplication of vulnerability and exposure. The authors identify that high quality plans are a function of community resilience and community resilience can be a result of high-quality plans. Further results indicate that structural mitigation measures failed to play an important role in reducing physical losses and in multiple models, social capital attributes, educational attainment, social service assets, and economic level were inversely correlated with flood losses. The conclusion is that high quality plans associated with hazard mitigation can contribute to mitigate disaster losses and foster community resilience.

Historically, the short-term stages of preparedness and response are considered by the general public to be more important when compared to the long-term stages of mitigation and recovery (Birkland, 2006; Berke et al., 2014a). One of the reasons for this uneven prioritization is that the costs involved with the implementation of hazard mitigation tools and techniques, whether it be in the pre-disaster mitigation or post-disaster recovery stage, are upfront while the benefits are delayed until after the next disaster strikes, if it strikes at all. Additionally, response operations occur in the immediate aftermath, where political pressure to act is highest, while recovery takes place over years easing immediate political pressure. Furthermore, many mitigation techniques involve moving development away from desirable coastlines and floodplains, where land is cheapest, which collectively decreases developmental funding opportunities for investors and can ultimately reduce incoming tax revenue for the community. From both ethical and long-term perspectives, pre-disaster mitigation is justified as it mitigates hazard impacts and protects quality of life and well-being. Mitigation is necessary to build resilient and sustainable communities that can respond and recover quickly when disaster strikes.

All across the board, mitigation, in particular non-structural mitigation approaches, have proven to be effective in countering the ever-increasing upward trend of disaster losses. When considering the imposing impacts of a changing climate that is exacerbating the risk of future catastrophic events, appropriate mitigation tools and techniques need to be implemented now more than ever before if the upward trend in disaster losses is ever to be reversed. Yet, it is an uphill battle for researchers to encourage the implementation and enforcement of appropriate mitigation tools and techniques considering some of the impeding obstacles such as high up-front costs and delayed benefits, low planner involvement within the framework of local stakeholder networks, pressure to increase development in desirous coastal areas, and complex funding application processes.

2.2 Recovery

Recovery is the final stage of the disaster cycle and is the only other long-term stage besides mitigation. Recovery differs from mitigation due to the fact that recovery takes place in the wake of a disaster event when people tend to be more retroactive. The short timeframe following a disaster event is referred to as the 'window of opportunity'. During this short-term recovery stage, typically at the local level there is increased commitment to vulnerability reduction when compared to a more stable time (Birkland, 1997, 2006). As such, this window is most conducive for the successful implementation of long-term recovery and mitigation strategies.

2.2.1 Recovery Definition

Early literature attempted to define recovery as a consistent stage of the disaster cycle with the end goal being a return to normalcy, e.g., to return to pre-disaster conditions (Haas et al., 1977; Quarantelli, 1982). Developmental strategies and enforcement of structural building codes were to remain the same and no relocation or retrofit of existing structures was to be necessary. This insufficient definition excludes consideration of community resilience; simply going back to pre-disaster conditions means going back to the pre-disaster state of vulnerability that led to the destruction. Disasters are a result of the interaction between the physical, built, and human environment. Therefore, it is necessary to incorporate all three of these components into the recovery process (Jordan & Javernick-Will, 2013).

Recovery is both a process and an end goal (Sutley & Hamideh, 2020). The process includes assessing impacts, rebuilding, and returning to normalcy; the end goal is to be 'recovered' at a level of function equivalent or better than before the disrupting event. Recovery is studied as an interdisciplinary endeavor from a variety of perspectives, including sociology, policy implementation, decision making, engineering, geography, and urban planning (Jordan & Javernick-Will, 2013). As such, a comprehensive definition and theory of recovery has yet to be formed and widely accepted (Smith & Wenger, 2006). One of the main factors that leads to this ambiguity is the scope of recovery being considered, which often follows disciplinary lines. For example, a social scientist may be most interested in studying the recovery of social processes and institutions, such as measuring posttraumatic stress and depression symptoms in children (Kronenberg et al., 2010), or how households go through housing recovery (Sutley & Hamideh, 2020). An engineer, on the other hand, may be more interested in studying the recovery of engineered systems, such as water and power distribution networks (Najafi et al., 2020), or incorporating costs of disaster losses into life cycle-cost estimation techniques (Yum et al., 2020). Indeed, there are many aspects to post-disaster recovery of a community; the duration of recovery and how one might characterize it varies based on the event, the impacted area, socio-political norms, and resources available. Olshansky et al. (2012) goes as far as to say, "it is unreasonable to devise a grand theory of post-disaster recovery, because recovery is just real life, in all its complexities, on fast forward."

2.2.2 Recovery Measurement Strategies

Although there is no consensus on how recovery should be measured or ideal recovery metrics, many studies have proposed and used recovery metrics. Olshansky et al. (2006) used a case study methodology to compare reconstruction strategies in districts that were affected by the 1994 Northridge and 1995 Kobe earthquakes. In their study, successful recovery was a function of many factors. Several of these factors included reduction of risks that threaten housing by enforcing stricter building code standards during the repair and retrofit of existing houses and in the construction of new residences and improved property values to align more with safe development practices.

Aldrich (2012) discovered that the social networks present in a local jurisdiction factor in significantly to the recovery process. Social networks can have a big effect on the distribution of information amongst decision makers and the level of expertise that is input into the decision-making processes. Two key measurements were incorporated into the study which were the retention of people (e.g., how many people left and did not come back) and resources (e.g., efforts put toward the revitalization of damaged environmental areas).

Similar to Aldrich (2012), Li et al. (2010) and Finch et al. (2010) studied post-Katrina recovery using population return as the main source of measurement. Kuhn (2010) went into greater social detail, by focusing on indicators such as living standards, housing construction, and children's academic achievement in schools.

Considering the wide range of recovery metric comparison, it would be highly beneficial if a consensus can be reached regarding how community recovery outcomes should be measured both qualitatively and quantitatively and what specific recovery-related goals are most important at the local community level. Jordan & Javernick-Will (2013) completed a study with the goal of creating a consensus of indicators that express the success of recovery. This was done by conducting content analysis of related literature and, using the Delphi approach, a panel of experts were surveyed to determine what indicators are most important to defining successful recovery. The panel of experts included individuals with a variety of disciplinary backgrounds including sociology, engineering, policy, and response practitioners. All panelists had (1) a Ph.D. in a relevant field, (2) at least 5 years of experience in disaster response or recovery, (3) authorized at least five relevant journal articles, and (4) field experience in at least one post-disaster or preparedness study. Four general classifications of indicators were used: economic, environmental, infrastructure, and social. Economic indicators were cited the most from social science or interdisciplinary literature when compared to the other three indicators. The most cited economic indicators from the literature were employment rates, income levels, and number of surviving businesses. The Delphi panel rated employment and income levels as very important economic indicators with the largest range of responses being related to government revenue. This range in response likely stems from differing disaster experiences in which some relied on government assistance while others relied heavily on private industry to produce substantial revenue streams (Jordan & Javernick-Will, 2013). Environmental indicators were rarely cited within the reviewed literature. A consensus was not achieved amongst the Delphi panelists, but debris removal and water quality were rated by all panelists between 'important' and 'most important'. Infrastructure indicators were cited the most from engineering-related literature when compared to the other three indicators. Panelists agreed that infrastructure recovery is ‘very important’; the measurable elements of which being facility and lifeline repair, housing reconstruction, and transportation systems operation. Amongst social indicators, population return was cited the most amongst the reviewed literature and panelists reached consensus that this metric is ‘very important’. However social service availability was highest-rated category by the panelists. For clarification, social recovery is dependent on environmental, economic, and infrastructural recovery. Therefore, out of the four indicators used, it is the most difficult to measure. The results of the content analysis showed that, likely due to ease of measurement, infrastructure metrics were cited most frequently by authors assessing recovery even though social and economic indicators were also deemed important by the Delphi panel. This study conducted by Jordan & Javernick-Will (2013) does not provide means to create an all-inclusive definition and theory of recovery. But it does provide grounds to build off of in future research; in particular, it provides a general recovery metric framework of indicators prioritized by proven experts in the field, and clear conclusion that social processes are an important part of recovery.

The ability to measure resilience is increasingly being identified as a key step toward disaster risk reduction. As such, Burton (2015) validated resilience metrics using Hurricane Katrina recovery in the Mississippi Gulf Coast as a case study. The article defines resilience as the ability of social systems to prepare for, respond to, and recover from damaging hazard events (Cutter et al., 2008) and defines recovery as the process of reconstructing communities to return life, livelihoods, and the built environment to their preimpact states (Burton et al., 2011). The assessment of recovery was done by taking photos in all cardinal directions in the locations of interest every six months following Hurricane Katrina. The photos were scored subjectively in accordance with six recovery and reconstruction categories that range from no recovery to full recovery. Ordinal logistic regression was used to analyze influence of selected indicators on recovery. Results showed that forty-one proxy variables might be significantly suitable for measuring resilience including indicators such as educational attainment, employment status, homeownership, housing density, schools, the presence of religious organizations, and land-use change.

Cutter et al. (2014) created an empirically based resilience metric called the Baseline Resilience Indicators for Communities (BRIC) which has been input into the FEMA National Risk Index Map. The spatial unit of analysis is the county considering counties are the smallest level of aggregation for which a wide range of human and physical data are consistently collected and archived. Furthermore, county governments are heavily involved in emergency management activities. The chosen 5-year time step began in 2010 with 2015 being the most current release. Data was collected from thirty different sources while being transformed to percentages, rates, averages, etc. to account for varying county sizes and characteristics. All variables were normalized using min-max scaling which allows for relative comparison across counties rather than an applicable measurement for each particular county. The values for all indicators within each capital of resilience were first averaged to create an index for each capital and then the six indexes were summed to result in a final resilience value; thus, the range of scores theoretically range from 0 to 6. The six capitals of resilience include social, economic, community, institutional, housing/infrastructure, and environmental. Additionally, the final resilience value was separated into five categories (very low, relatively low, relatively moderate, relatively high, and very high) based on standard deviation. Forty-nine indicators were chosen to correspond to specific resilience concepts that represent each of the six capitals of resilience. Several of the institutional resilience concepts were mitigation spending (ten-year average per capita spending for mitigation projects), flood insurance coverage (% housing units covered by NFIP), disaster aid experience (presidential disaster declarations divided by number of loss-causing hazard events during past ten years), and local disaster training (%population in communities with Citizen Corps program). Note that for mitigation spending only projects completed as a part of the Hazard Mitigation Grant Program were included with high average mitigation spending being shown as a strong predictor of the most resilient counties in terms of institutional capital. The authors also quantified the relationship between social vulnerability and disaster resilience proving that the two are not simply inverses of one another even though several resilience concepts included relate to social vulnerability such as educational attainment, English language competency, homeownership, and race/ethnic income equality. While there is statistical overlap between the two (~25%), the two are distinct quantitative measurements.

2.2.3 Influence of Social Vulnerability on Recovery

Social factors, including race, ethnicity, income and poverty, tenure status, and education level, critically shape the human, social, cultural, and financial capacities of a community and thereby its recovery (Enderami et al., 2021; Daniel et al., 2022). For example, Hamideh & Sutley (2020) demonstrate how a household’s social vulnerability influences the duration and sequence of a household’s housing recovery trajectory, where households with higher social vulnerability more often experience regressive steps in the recovery process and overall longer recovery times. Importantly, their model demonstrated how the most socially vulnerable households may not ever recover.

Social vulnerability is the pre-existing condition that makes a person more susceptible to adverse events (Sutley & Hamideh, 2020). Socially vulnerable communities often have lower owner-occupied housing rates and lower median household incomes. Tenure status is a critical factor influencing social vulnerability given that renters typically have lower access to resources and many incentive programs are designed around the needs of homeowners. Comerio (1997) suggested that the focus of housing recovery policy in the US on single-family owner-occupied housing plays an important role in shaping inequalities, particularly with respect to rental and multifamily housing. Socially vulnerable households have fewer financial resources and often times live in government assisted housing, sometimes of poorer quality (City and County of San Francisco, California, 2016). Importantly, renters also have less decision-making power in adopting structural mitigation to their homes, deciding when to dislocate, and if ever they are allowed to return to their pre-disaster home (Sutley & Hamideh, 2020). Social vulnerability is not to be a variable confined to housing recovery; it is important for overall community recovery and to ensure social and economic equity (Kim & Sutley, 2021).

Similar to the research presented in Chapter 3, several studies have examined how social vulnerability influences access to federal disaster funding. Domingue & Emrich (2019) explored the distribution of disaster aid across counties in the United States through the lens of social vulnerability and procedural equity. They inquire as to whether FEMA's public assistance program is characterized by procedural inequities, or disparate outcomes for counties with more socially vulnerable populations. The view of procedural equity is as just distributive processes and outcomes (Gooden, 2015), defining an inequity as a case when highly socially vulnerable counties receive a lesser benefit from federal disaster relief than other counties experiencing similar impact. Procedural inequities and the ensuing disparate distribution of resources and capabilities they produce, disproportionally affect racial and ethnic minorities and lower income and working-class communities. Scholars stress that although outward bias and discriminatory intent are still relevant features of society, procedural inequity is part of the commonplace bureaucratic proceedings that privilege certain members of society (Morello-Frosch, 2002; Pellow, 2000; Pulido, 2015). Domingue & Emrich note that, surprisingly, throughout past research efforts, little attention has been paid specifically to Public Assistance (PA) funding which comprises one of the largest portions of national disaster spending (Platt, 1999). This could be partly due to the fact that FEMA PA data has only recently become publicly accessible through OpenFEMA.gov. The PA data that was included in the study was the federally obligated share granted to counties from 2012 through 2015. A per capita federal spending variable was calculated using the total population of counties and because of the variable being positively skewed, it was transformed by logging to base 10 and recoded into a three-category variable based on standard deviation. The number of declared disasters, total county population, and total number of housing units in each county were included as control variables. Multinomial logistic regression (MLR) was employed to identify influential relationships between government spending, social vulnerability variables, and control variables. The models identified a range of demographic, environmental, and socioeconomic conditions as being significantly related to aid distribution, signaling factors above and beyond total losses influence funding which results in disparate levels of recovery across counties. Of the identified 60 different drivers of per capita PA receipt, many are consistent with environmental disaster research that links race, socioeconomic status, gender, and age with disparities in recovery (Bullard & Wright, 2012; Thomas et al., 2013). However, out of the 60 different drivers, only eight variables were significant in more than one year implying that inequities may manifest themselves in dissimilar ways across disasters.

Wilson et al. (2021) synthesizes empirical knowledge of population disparities in access to flood disaster assistance and outcomes during disaster recovery. Four federal program sources were analyzed including NFIP, FEMA IA, SBA Disaster Loan Program, and HUD CDBG-DR. It is noted that following disasters, FEMA receives far more applications than are approved with around a 25% approval rate since 2010 (VMAP, 2021). Billings et al. (2022) identified that applicants in lower-income areas had less likelihood of FEMA assistance per registrant after controlling for flood insurance, property values, and property damages. Analyses of FEMA application data from Hurricanes Harvey and Katrina report that areas with high percentages of minority populations generally receive less assistance (Kamel, 2012; Billings et al., 2022). Furthermore, black households had larger repair costs in Hurricane Katrina compared to similar white households, despite lower home values (Gotham, 2014) and administrative and inspection-related rejections were more often reported in minority communities (Sloan & Fowler, 2015). Overall, renters, low-income households, and racial minorities face barriers not faced by less socially vulnerable populations in accessing federal assistance and as such experience adverse recovery outcomes.

Adding to the body of research that has assessed how social vulnerability influences access to federal disaster funding, Berke et al. (2019) studied social equity within hazard mitigation planning. The authors point out that although over the past century, the most socially vulnerable are increasingly concentrated in hazard-prone areas after major disaster events considering the less vulnerable are more likely to relocate (Boustan et al., 2017), social equity is not prioritized in plans adopted by all six communities included in the study. Some communities have equity policies that increase hazard risk while other counties have policies that decrease risk. A paradox arises similar to that of Hurricane Katrina (Burby 2006); if social equity policies do not consider hazard risk in socially vulnerable communities (which are often in hazard prone areas), then corresponding development will escalate potential for greater future hazard losses and erase developmental progress. There is a clear connection between socially vulnerable populations and hazard prone areas, therefore greater attention needs to be given to implementing policies that reduce risk in these communities.

2.3 Linking Mitigation to Recovery

Both mitigation and recovery are dynamic stages of the disaster cycle. Even though mitigation occurs before a disaster event and recovery occurs afterwards, the two are related in that recovery efforts evolve into mitigation efforts. Additionally, how prepared a community is for a future disaster, considering the community's framework of local stakeholders, quality of mitigation plans, density of development in hazardous areas, and more, can affect how a community recovers from a recent disaster event, including the capability of public officials to apply for disaster funding, mitigation plans being updated, whether damaged buildings in hazardous areas are strengthened/rebuilt or moved to a less vulnerable locale. To date there has been very little research quantifying the relationships between mitigation and recovery.

Researchers have consistently emphasized the importance of integrating mitigation with disaster recovery (Smith, 2010), yet Berke et al. (2012) evaluation of state hazard mitigation plans showed that this policy received the lowest score among all policies. The following research intends to bridge the gap in understanding of the dynamic interplay between mitigation and recovery and how both stages influence one another by first investigating how social vulnerability affects access to federal disaster-related mitigation and recovery funding and second assess how mitigation expensing can advance community resilience and thus increase a community's capacity to both prepare for and recover from a disaster event.

Chapter 3: Quantifying Differential Access to FEMA Disaster Funding

As shown in Figure 1-1, the first stage of this research analyzes the effect of social vulnerability on FEMA funding distribution while controlling for hazard level and state planning context by utilizing Ordinary Least Squares (OLS) regression to identify significant relationships and pinpoint inequities. The three FEMA funding programs assessed are Hazard Mitigation, Public Assistance, and Individual Assistance. This chapter first provides an overview of each of these FEMA programs. It then introduces the datasets used for regression analysis, explains the numerical methodology, and presents and interprets the results.

3.1 FEMA Program Overview

FEMA's Hazard Mitigation Assistance (HMA) provides funding for eligible mitigation measures intended to reduce disaster losses. Projects funded by HMA should reduce the vulnerability of communities to hazardous effects, promote individual and community safety and advance community resilience, lessen response and recovery resource requirements post-disaster, and result in safer communities that are less reliant on external financial assistance following future hazard events (FEMA, n.d.-a). FEMA's HMA grant programs include the Hazard Mitigation Grant Program (HMGP), Flood Mitigation Assistance (FMA), Pre-Disaster Mitigation (PDM), and Building Resilient Infrastructure and Communities (BRIC) (FEMA, n.d.-b). HMGP and FMA are most common with nearly 90% of the projects assessed in this study being assigned to one of the two programs and thus are described in greater detail. BRIC, on the other hand, is a newer program developed in 2018, and thus was not captured as much in this research.

HMGP provides funding for state, local, tribal, and territorial governments for post-disaster rebuilding efforts that will reduce or mitigate future disaster losses. The application must go through the local government on behalf of local businesses and citizens; individuals cannot apply directly. In order to be eligible for HMGP funding, a state must receive a Presidential Disaster Declaration, an approved hazard mitigation plan must be in place at the state and local level, and all communities located within a Special Flood Hazard Area must be a member in good standing of the National Flood Insurance Program (NFIP) (FEMA, 2021). Notably, a disaster declaration triggers availability of HMGP funds in every county in an affected state regardless of whether there was significant damage in the particular locale. HMGP can fund a variety of projects including land acquisition, structural approaches (i.e., levees, floodwalls, etc.), structural retrofits, and building elevations (FEMA, 2021). FMA funding is available to states, local communities, and federally recognized tribes and territories in which funding can be used to reduce or eliminate risk of repetitive flood damage. In order to be eligible, an approved hazard mitigation plan must be in place at the respective governmental level and the funding can only be granted for buildings insured by the NFIP (FEMA, n.d.-c). FMA can fund a variety of projects including land acquisition, elevation of existing structures, and dry floodproofing of historic structures (FEMA, 2021).

FEMA’s Public Assistance (PA) is a reimbursement program that aids communities in responding and recovering from disaster events. Reimbursement can be granted to both state and local governments for disaster-related costs including debris removal, emergency protective measures, and permanent repair work to damaged or destroyed infrastructure. In order to be eligible, the applicant must be in a FEMA designated area and a disaster declaration must have been issued within the past 30 days. PA funding can only be granted to jurisdictions, and not individuals. In addition to covering response and recovery efforts, PA provides additional funding assistance for hazard mitigation efforts (FEMA, n.d.-d).

FEMA's Individual and Households Program (IHP) is the only source of Individual Assistance (IA) funding provided by FEMA. IHP funding is granted to eligible individuals and households affected by a disaster who have uninsured or under-insured necessary expenses. IHP assistance may include: funds for temporary housing while the resident is unable to live in their home, a temporary housing unit when rental assistance is not available due to lack of available housing resources, funds to support the repair or replacement of owner-occupied homes that serve as the household's primary residence, funds for hazard mitigation assistance to help eligible homeowners repair or rebuild, and funds for other uninsured or under-insured disaster-caused expenses and serious needs such as repair or replacement of personal property and vehicles (FEMA, n.d.-e). Applicants must be in a FEMA declared designated area and must verify citizenship, identity, ownership and/or occupancy, and unmet need after insurance (FEMA, n.d.-f). Landlords and tenants are unable to apply for assistance to fund rental unit repairs. When pairing this with the fact that many of the funds are reserved for property owners, the IHP program is designed to support the recovery of homeowners although limited resources are made available to renters.

Of note, there are no FEMA funding programs that directly support mitigation or recovery of businesses.

3.2 Description of Datasets

For each of the three FEMA funding programs, associated datasets have been accessed through OpenFEMA (FEMA, n.d.-g). For HMA, the *Hazard Mitigation Assistance Projects* dataset was adopted and modified as follows for use in this research. The original dataset lists all HMA projects across all grant programs from approximately the past 30 years in all US States and territories. The timeline chosen for this study was from 2005 to 2020 to coincide with the time frame from Hurricane Katrina to the present. As such, only HMA projects assigned to Fiscal Years from 2005 to 2020 were considered. Furthermore, only projects funded to counties located in the states of North Carolina, Georgia, and Florida were included to align with overarching project goals described in Chapter 1. Projects with multiple counties and no designated county and statewide projects were excluded to align with county-level analysis. The initial dataset included 29,196 projects; the final dataset used in this research consisted of 1,876 projects. The 1,876 HMA projects were classified into five mitigation action categories (i.e., acquisition & elevation, development regulation, emergency management, property protection, and structural controls) to allow for longitudinal analysis and to understand how different project types may differentially contribute to resilience and recovery.

For PA, the *Public Assistance Funded Project Details* dataset was adopted; for IHP both the *Housing Assistance Program Data – Owners* and *Housing Assistance Program Data – Renters* were adopted. All three PA and IHP datasets were revised to only include funding as a result of Hurricanes Matthew (2016), Irma (2017), Michael (2018), and Florence (2018) by determination of the FEMA disaster number provided in the datasets. These four disaster events were selected for analysis considering they largely impacted the chosen geographic area (i.e., Florida, Georgia, and North Carolina) later in the fifteen-year time frame (i.e., 2005-2020) of this study such that the effectiveness of mitigation could be investigated on the recovery from these hurricane events. Within each of the three original datasets, PA is listed at the project-level while IHP owner and renter data is aggregated per zip code. For this thesis, the final PA dataset includes 18,256 projects; the final IHP owner's and renter's dataset includes 6,100 and 6,836 aggregations, respectively. All final datasets (HMA, PA, IHP-owners, IHP-renters) were aggregated to the county level for analysis.

HMA, PA, and IHP funding were granted throughout the 15-year time frame. Therefore, all monetary amounts were adjusted to the equivalent cost in 2019 dollars to account for inflation using an online calculator that references US CPI data. The year 2019 was chosen to coincide with 2019 5-year American Community Survey (ACS) estimates. The HMA dataset lists four different dates for each project: project Fiscal Year, and when the project was initially approved, approved, and completed. The year chosen for the inflation calculations is the year that the project was approved by FEMA under the assumption that it is the most accurate date for when funds were distributed. The PA dataset lists two dates for each project, the declaration date, and the date the grant was obligated. The obligation date was chosen assuming that it more closely aligns with the date of funding distribution when compared to the date of the disaster declaration. No dates are given in the IHP datasets. Therefore, the year chosen for the inflation calculations is the year of the disaster. Note, that the total project cost was the monetary amount referenced for all three types of FEMA funding not the obligated federal share which has been typically standardized to 75% of the total project amount with the local community matching the remaining 25%.

Throughout this study, the focus is oriented towards Hurricane Matthew and Hurricane Irma as compared to Hurricane Michael and Hurricane Florence. This is due to greater amounts of disaster-level PA and IHP data and the paths of each storm more closely aligning with the chosen geographic area as seen in Figures 3-1a, 3-1b, 3-1c, and 3-1d. As such, there are regression models that include only Hurricane Irma and Hurricane Matthew data, respectively; no such models were analyzed for only Hurricane Michael and Hurricane Florence. Hurricanes Michael and Florence were added to provide additional data and identify consistent funding trends across disaster events in select analyses. Figure 3-2 presents the monetary distribution of all three types of mitigation and recovery funding delegations per state and disaster event for Hurricanes Matthew and Irma only. As shown in Figure 3-2, Florida was granted $736.3M more HMA funding than Georgia and North Carolina combined. This is in part, likely due to Florida's geographical situation as being highly susceptible to the occurrence of frequent coastal storms as well as its population being more than double of both Georgia's and North Carolina's population size. The only type of funding in which Florida was surpassed by one of the other two states is IHP funding as a result of Hurricane Matthew with North Carolina receiving approximately $80 million more dollars; as shown in Figure 3-1a, North Carolina experienced a more direct hit from Hurricane Matthew as compared to Florida which could be the reason for North Carolina receiving more IHP funding. North Carolina received no PA or IHP funding as a result of Hurricane Irma considering the storm did not hit North Carolina (see

Figure 3-1b), and therefore North Carolina did not receive a federal disaster declaration prompting the accessibility to FEMA response and recovery funding.

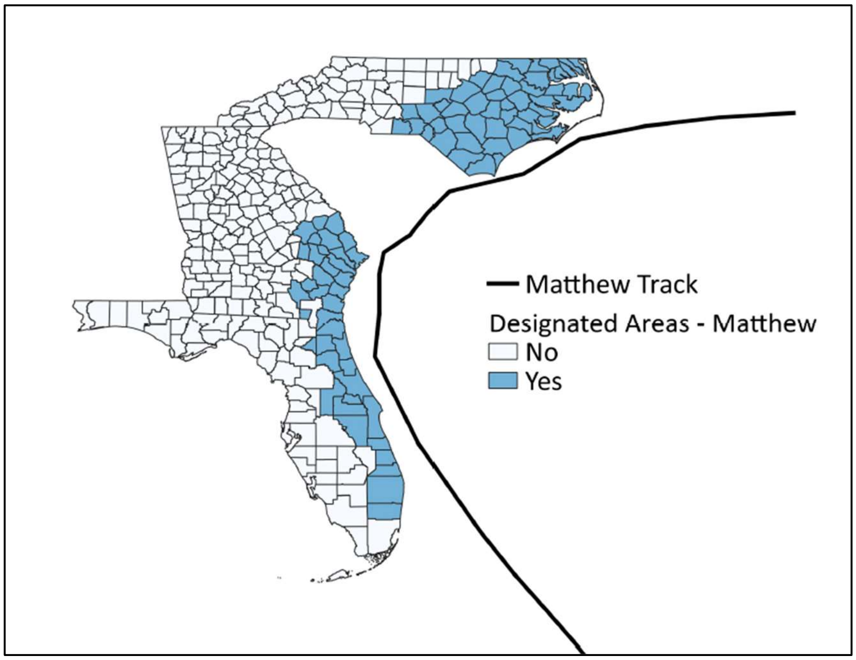


Figure 3-1a: Hurricane Matthew Storm Track and FEMA PA Designated Areas at the County-Level in Florida, Georgia, and North Carolina

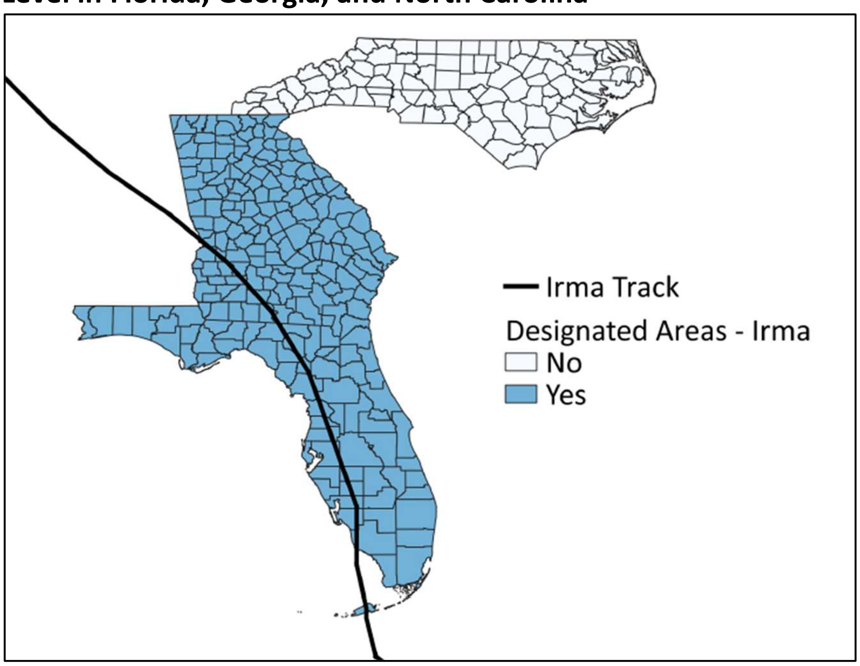


Figure 3-1b: Hurricane Irma Storm Track and FEMA PA Designated Areas at the County-Level in Florida, Georgia, and North Carolina

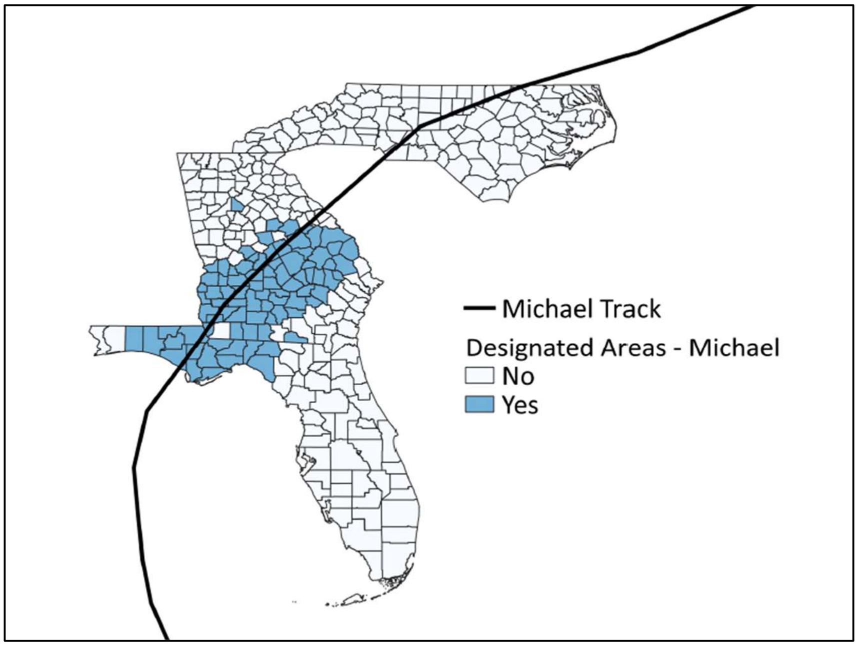


Figure 3-1c: Hurricane Michael Storm Track and FEMA PA Designated Areas at the County-Level in Florida, Georgia, and North Carolina

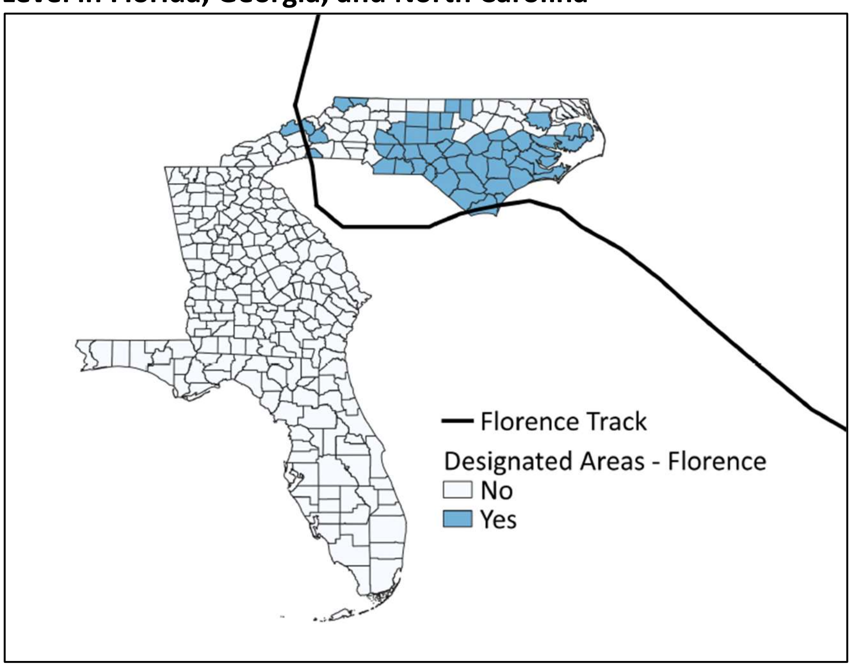


Figure 3-1d: Hurricane Florence Storm Track and FEMA PA Designated Areas at the County-Level in Florida, Georgia, and North Carolina

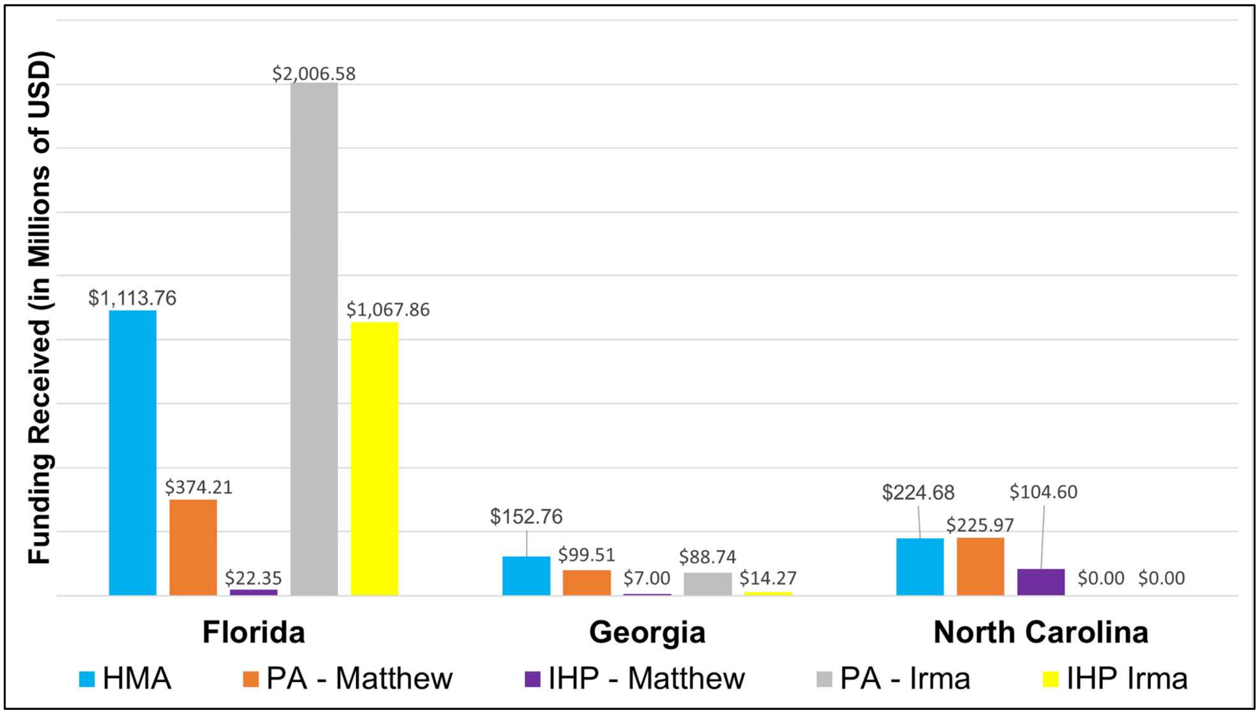


Figure 3-2: FEMA Mitigation and Recovery Funding per State

3.3 Selecting & Modeling Influential Factors

3.3.1 Hazard Level Control Variables

In order to appropriately analyze HMA, PA, and IHP funding across the range of jurisdictions, how each specific jurisdiction was impacted by the hazard event of interest must be considered. To do this, a set of proxy metrics were identified to control for hazard level, including total rainfall, percentage of properties with high flood risk, and proximity to coastline; population density was also used as a control variable. No peak wind gust exceeded the design wind speed listed in the American Society of Civil Engineer's (ASCE) *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (American Society of Civil Engineers, 2017) in any of the locations of interest for Hurricane Matthew and Hurricane Irma, therefore only flood levels have been considered. To account for inundation levels, which were not widely reported within the National Oceanic and Atmospheric Administration (NOAA) storm reports collected, total rainfall is used as a proxy for hazard level. The maximum reported total rainfall amount in each county for all disaster events has been documented in reference to NOAA storm reports (Stewart, 2017; Beven II et al., 2019; Stewart & Berg, 2019; Cangialosi et al., 2021). When no total rainfall amount was documented in the NOAA storm report for a specific county, the National Weather Service's Quantitative Precipitation Estimates (QPE) interactive map was used as reference (National Weather Service, n.d.). Using the QPE tool, the one-day observed total rainfall amounts were summed for all days that the specific hazard event impacted the county of interest. Rain estimates were not included for the counties that were not included in a FEMA PA designated area for each particular hazard event. Considering that rainfall amounts can affect locations with varying geographic features drastically different, the percentage of properties within each jurisdiction at substantial risk of a flood (i.e., FEMA Special Flood Hazard Area (SFHA)) is documented as a second proxy for hazard level. FEMA defines SFHA as follows, "SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year" (FEMA, n.d.-h).

There is a growing consensus among researchers that FEMA underestimates the number of properties at risk of a flood (e.g., in a SFHA) (Wing et al., 2018; First Street Foundation, 2020; Collins et al., 2022). A recent report by the First Street Foundation (2020), a non-profit research and technology group committed to defining flood risk in the contiguous United States, presents an innovative flood model that documents the number of properties at three levels of flood risk (return periods of 1 in 5, 1 in 100, and 1 in 500) within all contiguous states and the District of Columbia. At the national level, the First Street Foundation flood model identifies approximately 70% more properties at substantial risk compared to the FEMA SFHA designation. The report points to several key reasons for the increase, including that the flood model considers recent environmental changes and three different types of flooding (fluvial, pluvial, and coastal). The data represents the current estimated percentage of properties at risk (i.e., 2020) and also future projections for the years 2035 and 2050. Furthermore, the data produced by the model and given in the report can be accessed at the congressional district, county, and zip code level. Nonetheless, considering that FEMA funding is linked to FEMA's risk assessment, for the purposes of this study, the 2020 data for FEMA's SFHA at the county level (i.e., percent of property at the county level that will be inundated by a flood event having a 1-percent chance of being equaled or exceeded in any given year) is used instead of the First Street Foundation flood assessment. The SFHA data was documented from the First Street Foundation report which presents SFHA data estimated by MassiveCert, Inc.

In addition to total rain and properties at risk, proximity to coast is used as a third proxy for hazard level. The distance from each respective county to the nearest coastline was estimated using QGis. A .shp file for US counties and a .shp file for the US coastline were downloaded and input into QGis. The centroids of each county were calculated and the NNJoin tool was utilized to measure the distance from the centroid of each county to the nearest coastline in degrees latitude.

The fourth and final control variable incorporated into the regression analyses was population density to control for the size of the population. The variable was determined by dividing the county population by the land area in square miles. Both population and land area were documented from the 2015-2019 5-year ACS estimates.

The full list of the three hazard level variables and population density evaluated for all counties in Florida, Georgia, and North Carolina is provided in A1 of the Appendix.

3.3.2 Social Vulnerability Variables

There is a plethora of factors that come into play when measuring the social vulnerability of a community. The results from Wilson et al. (2021) show that racial minorities, low-income households, and renters face barriers the most in accessing federal assistance. As such, the social vulnerability variables chosen for this study are related to the categories of race, financial capacity, and housing. To assess each county's racial demographics, proportions of non-Hispanic White, non-Hispanic Black or African American, and Hispanic or Latino are documented. Instead of using median household income, which can be misleading due to varying costs of living and does not adequately capture the most socially vulnerable households, the percent of residents living in poverty is documented as a proxy to assess each county's financial capacity. Particularly given that a significantly higher portion of FEMA IHP funding is available to homeowners and not renters, and that renters have less control over the quality and location of their homes, the percentage of owner-occupied housing is captured as a proxy for social vulnerability for all counties.

Additionally, the Social Vulnerability Index (SoVI) published by the University of South Carolina's Hazards and Vulnerability Research Institute (HVRI) is included to assess a county's overall level of social vulnerability. The SoVI is a comparative metric that comprises a multitude of variables for a range of social vulnerability dimensions such as personal wealth, age, race, ethnicity, and occupation (Cutter et al., 2003). As a result, the SoVI measures how one US county's social vulnerability relates to all other US counties with a continuous range from approximately 0 (i.e., the least socially vulnerable county) to 100 (i.e., the most socially vulnerable county). Additionally, the SoVI is separated into categories from 1 to 5 based on standard deviation: 1 - very low, 2 - relatively low, 3 - relatively moderate, 4 - relatively high, and 5 - very high. However, only the continuous SoVI is included as an independent variable in the subsequent regression models of this chapter and results should be interpreted accordingly. The SoVI presents the relative social vulnerability level of a particular county in respect to all other selected counties and is used to identify the relationship between social vulnerability level and federal funding receipt. Table 3-1 lists the mean and sample standard deviation for each of the six social vulnerability variables by State. The full list of socially vulnerability variables for all counties in Florida, Georgia, and North Carolina is given in A2 of the Appendix.

Table 3-1: Social Vulnerability Variables evaluated at the state-level for Florida, Georgia, and North Carolina

	Florida		**Georgia**		**North Carolina**	
	Mean	St Dev	*Mean*	*St Dev*	*Mean*	*St Dev*
SoVI	41.04	11.67	37.39	10.55	40.43	8.50
Non-Hispanic White (%)	67.00	15.64	61.69	17.33	67.17	17.84
Black African American (%)	14.86	9.37	28.65	17.55	21.03	16.57
Hispanic Latino (%)	14.88	13.39	7.00	5.83	7.67	4.11
Poverty (%)	15.05	5.01	18.18	6.60	15.86	4.72
Owner-occupied Housing (%)	71.83	7.97	68.35	8.99	69.67	7.39

3.4 Measuring Disparities

3.4.1 Overview of All Regression Models Analyzed

OLS regression analysis was the analysis chosen for this study, except in one analysis noted below. Several different dependent variables were used within each of the three general analysis categories relating to HMA, PA, and IHP receipts. For HMA, both the continuous variable of total HMA funding received, and the binary variable of HMA funding received (i.e., yes, or no) were analyzed; binary logistic regression was used for the latter model, and it was the only model that did not use OLS regression in this study. For the continuous variable of total HMA funding received, counties that did not receive any HMA funding were excluded from the corresponding analyses. Many variations of the models were run, including versions that controlled for state, did not control for state, and normalized the continuous dependent variable by population size to examine total funding received per capita for each county.

For PA, the dependent variable was only modeled as continuous (i.e., total PA funds received). Several variations of models were run, including versions that controlled for state, did not control for state, and set the continuous dependent variable to per capita. There were separate models for (a) Hurricane Matthew, (b) Hurricane Irma, and (c) Hurricanes Matthew, Irma, Michael, and Florence, to assess inequities at the disaster-event-level and to identify general inequities within funding trends. Note, that for each disaster event, only the counties in the corresponding FEMA PA designated areas were included in the analyses.

For IHP, the dependent variables, which consists of both the total IHP amount and number of IHP valid registrations, for owners and renters were modeled as continuous. Additionally, a dependent variable was created to assess the approved IHP owners' amount versus the inspected damage amount; this variable is presented as a ratio with approved IHP owners' amount in the numerator and inspected damage amount in the denominator. The total inspected damage includes only those properties within the IHP owners' dataset that received an inspection; not all valid registrants received an inspection. Similar to the PA models, to assess inequities at the disaster-event level and across disasters, there were separate models for Hurricane Matthew, Hurricane Irma, and Hurricanes Matthew, Irma, Michael, and Florence, and only the counties in the corresponding FEMA IA designated areas were included in the analyses.

For normalization, all HMA, PA, and IHP dependent variables have been logged to the base 10 to reduce the influence of numerical outliers with the exception of the IHP model that assessed approved IHP owners' amount versus inspected damage amount which was not normalized considering the reduced range of values as a result of division. All models not further defined in the subsequent section *3.4.2 Regression Model Selection* are presented in A3 - A5 of the Appendix.

3.4.2 Regression Model Selection

3.4.2.1 Mitigation

The regression model with HMA received (i.e., yes, or no) as the dependent variable is not presented in this chapter considering that the majority of the counties assessed received some amount of HMA funding during the 15-year time frame. Considering that the independent variables are input as percentages, the regression model with total HMA received per capita is not presented under the assumption that all social vulnerability variables are independent of total county population size. The regression model with the continuous dependent variable of total HMA funding received was chosen to also be presented with the total HMA funding received per mitigation action (i.e., acquisition & elevation, development regulation, emergency management, property protection, and structural controls) as well as per mitigation category (structural, non-structural, and not applicable). As such, the HMA models presented allow for conclusions as to the influence of social vulnerability on how much total HMA funding and total HMA funding per type of mitigation is received at the county-level.

Hazard level was controlled for by way of two of the previously defined hazard level control variables: properties at risk (i.e., percent of properties in a FEMA SFHA) and proximity to coast. Total Rain was excluded considering HMA funding is not necessarily prompted by a recent disaster event and is not in direct relation to total storm damage like PA and IHP. Population density was also included as a control variable. The independent variables included all social vulnerability variables (i.e., proportion non-Hispanic, White, proportion Black, African American, proportion Hispanic, Latino, percent living in poverty, and owner-occupied housing rate) and state. State was only controlled for in the analyses that examined total HMA funding per mitigation action considering states have different mitigation approaches. As shown in Figures 3-3a, 3-3b, and 3-3c, both Georgia and North Carolina were granted much more funding for acquisition & elevation (i.e., 77% and 88% of total funding received, respectively) as compared to all other mitigation actions. Meanwhile, Florida's mitigation approach is much more diversified with property protection and structural controls outweighing acquisition & elevation (i.e., 37% and 28% of total funding received, respectively, compared to 11%). Statewide mitigation approaches are discussed in more detail in section *4.2 Statewide Mitigation Approaches*.

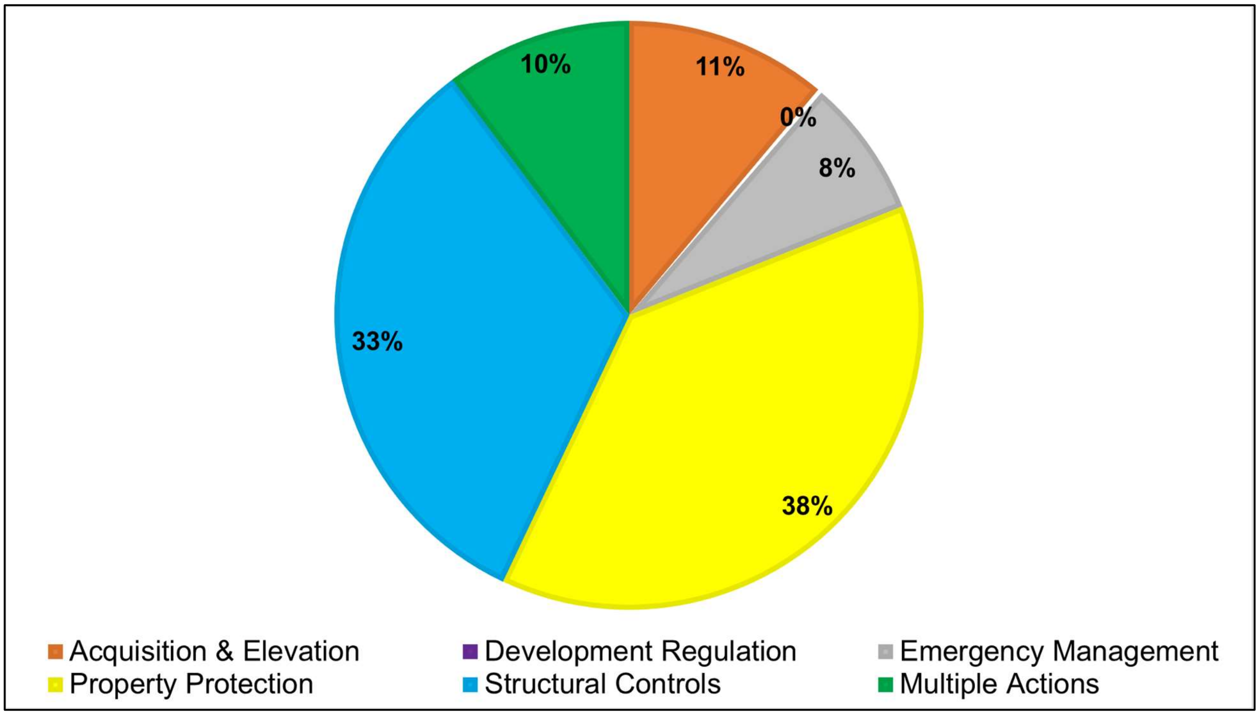


Figure 3-3a: HMA Funding Distribution per Mitigation Action in Florida

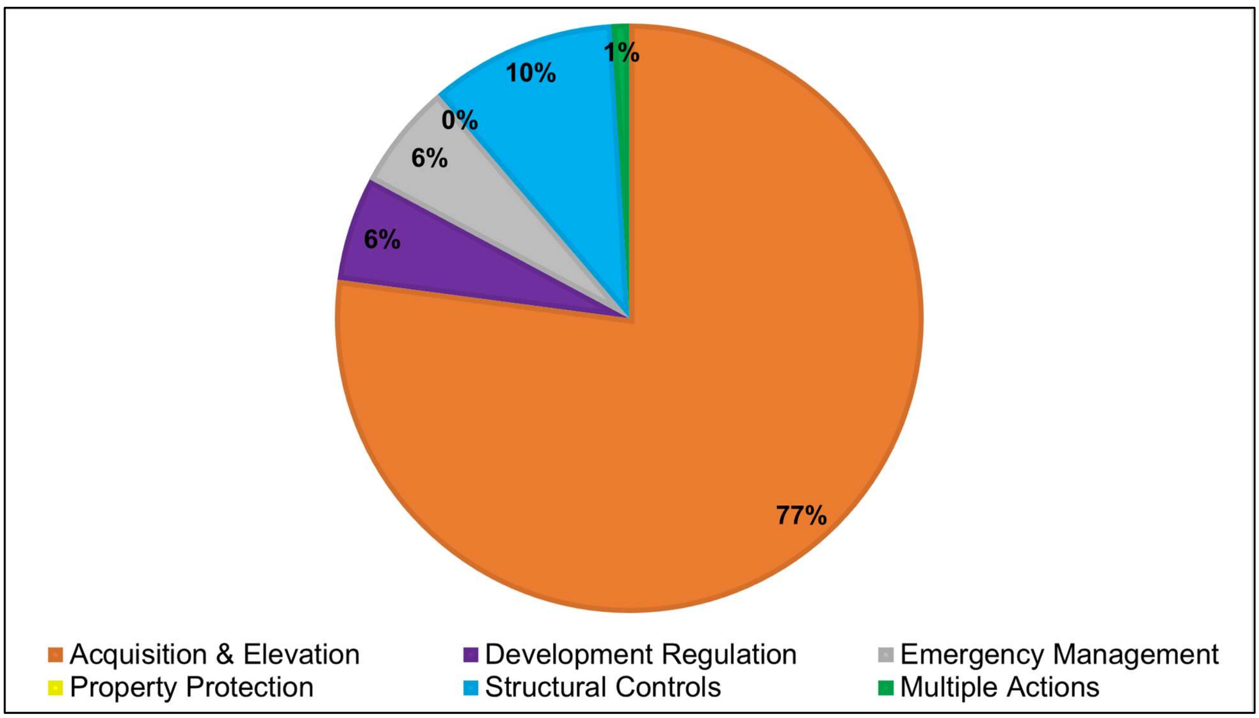


Figure 3-3b: HMA Funding Distribution per Mitigation Action in Georgia

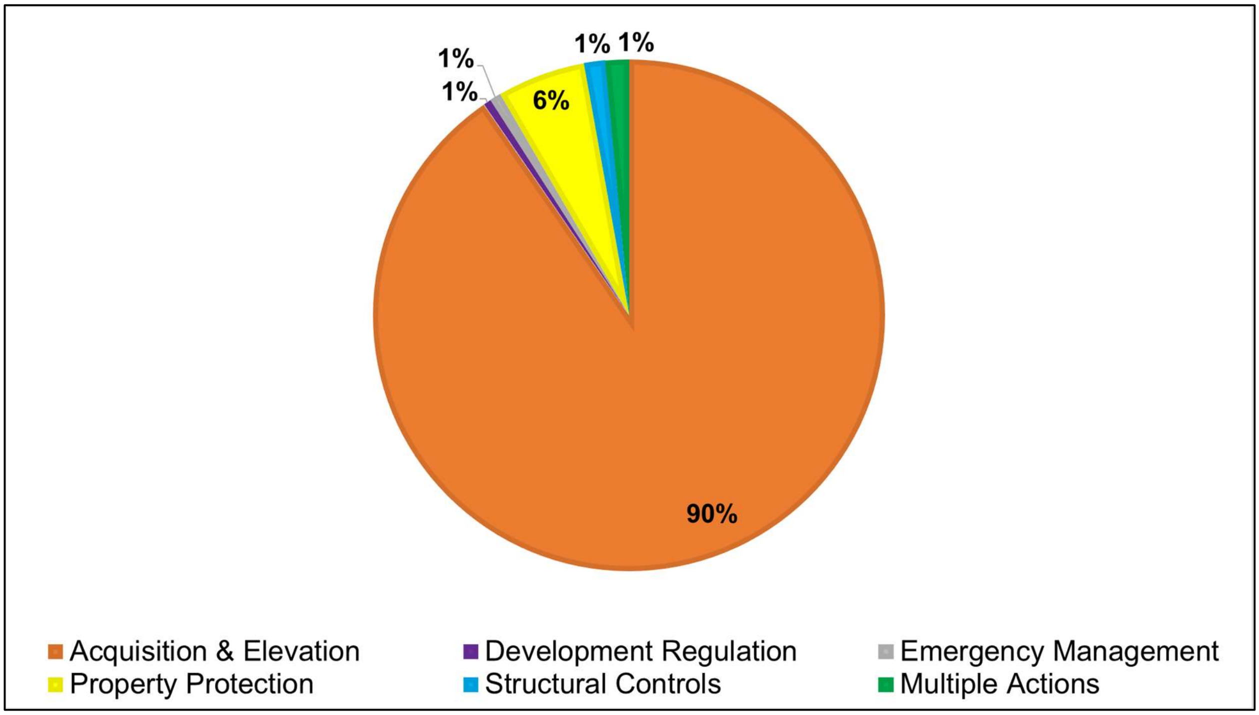


Figure 3-3c: HMA Funding Distribution per Mitigation Action in North Carolina

Apart from the five mitigation actions, there is a classification for 'multiple actions' which includes projects in which HMA funding is designated for two or more mitigation actions. The funding designations within the original dataset are not descriptive enough to understand how much was spent on each action, so those projects have been excluded from being quantified within a particular mitigation action and instead are lumped together as 'multiple actions'.

State was not controlled for in the model that set total HMA funding as the dependent variable since, in theory, counties within each respective state should have equal access to applying for and receiving the same *total* amount of HMA funding when controlling for hazard level and population density.

3.4.2.2 Public Assistance

Using a similar methodology to the selection of the preferred HMA dependent variable, the regression model with total PA received per capita is not presented under the assumption that all social vulnerability variables are independent of total county population. The regression model with the continuous dependent variable set to the total PA amount in each county was chosen to be presented. The hazard level metrics matched those of the HMA analyses with the addition of the total rainfall amount at the county-level for the specified disaster event. The independent variables match those of the HMA analyses except for the state variable. State was not controlled for in the analyses considering that state should not affect a county's access to federal post-disaster PA funding when controlling for hazard level and population density.

3.4.2.3 Individual Assistance

The regression models with the following dependent variables are presented: total IHP approved owners' amount and number of registrations; total IHP approved renters' amount and number of registrations; IHP ratio [total IHP approved owners' amount / total inspected damage]. For the IHP ratio, a value greater than one implies that the registrant received an excess of IHP funding to cover the costs assessed during the damage inspection; a value of less than one implies that the registrant received an inadequate amount of IHP funding to cover the costs assessed during the damage inspection. Independent variables match those of the PA analyses.

Table 3-2 lists all dependent and independent variables included in the regression analyses presented in this chapter and each variables' source. With the exception of the three state variables, all dependent and independent variables listed are continuous variables.

Table 3-2: Dependent and Independent Variables Input into Regression Models

Dependent Variable	**Source**
Total HMA Receipt	OpenFEMA - *Hazard Mitigation Assistance Projects*
Mitigation Action Receipt	OpenFEMA - *Hazard Mitigation Assistance Projects*
PA Receipt	OpenFEMA - *Public Assistance Funded Project Details*
IHP Approved - Owners' Receipt	OpenFEMA - *Housing Assistance Program Data - Owners*
IHP Approved - Owners' Registrations	OpenFEMA - *Housing Assistance Program Data - Owners*
IHP Approved - Renters' Receipt	OpenFEMA - *Housing Assistance Program Data - Renters*
IHP Approved - Renters' Registrations	OpenFEMA - *Housing Assistance Program Data - Renters*
IHP Ratio (IHP Approved - Owners / Total Inspected Damage)	OpenFEMA - *Housing Assistance Program Data - Owners*
Independent Variable	**Source**
SoVI	HVRI
Proportion Non-Hispanic, White	2019 5-year ACS Estimate
Proportion Black, African American	2019 5-year ACS Estimate
Proportion Hispanic, Latino	2019 5-year ACS Estimate
Poverty Rate	2019 5-year ACS Estimate
Owner-Occupied Housing Rate	2019 5-year ACS Estimate
Population Density	2019 5-year ACS Estimate
Percent of Properties in FEMA SFHA Zone	MassiveCert, Inc.
Proximity to Coast	N/A
Total Rain	NOAA, NWS
State - Florida	N/A
State - Georgia	N/A
State - North Carolina	N/A

3.5 Results

The comprehensive regression results are presented in Tables 3-3, 3-4, 3-5a, 3-5b, and 3-5c. Within all three FEMA funding programs being assessed (i.e., HMA, PA, and IHP), multiple examples of equity and inequity are identified with race and SoVI being the most consistent significant predictors in receiving differing amounts of FEMA funding across all regression models as discussed in subsequent sections. All analyses control for hazard level (i.e., proximity to coast, percent of properties in FEMA SFHA zone, and total rain [PA and IHP analyses only]) and population density all of which proved to be significant predictors in many cases. Counties with increased population density often received more of all three types of FEMA funding. Similarly, counties with increased hazard level, i.e., decreased proximity to coast, increased properties at risk, and increased total rainfall, also often received more of all three types of FEMA funding.

Within the context of this thesis, equity refers to the degree to which fair treatment characterizes policies and programs (Bullard, 2005). Except where noted, counties with increased social vulnerability (i.e., increased SoVI, increased poverty rate, decreased proportion of Non-Hispanic, White residents, increased proportion of both Black, African American and Hispanic, Latino residents, and/or decreased owner-occupied housing rate) receiving more pre- and/or post- disaster funding has been identified as examples of equity and results are presented in the subsequent *3.5.1 Identified Equities* section. On the contrary, counties with increased social vulnerability receiving decreased amounts of pre- and/or post-disaster funding has been identified as examples of inequity and results are presented in the subsequent *3.5.2 Identified Inequities* section. Additionally, counties with higher hazard levels and population densities receiving increased amounts of pre- and/or post-disaster funding has been identified as examples of equity.

Table 3-3: OLS Regression Results for HMA Funding Distribution by Mitigation Type

	Total [N=286]	Acq & Elev[a] [N=286]	Dev Reg[a] [N=286]	Emerg Manag[a] [N=286]	Prop Prot[a] [N=286]	Struc Cont[a] [N=286]	S[a] [N=286]	NS[a] [N=286]	N/A[a] [N=286]
SoVI	0.009* (0.004)	-0.028* (0.013)	0.013 (0.008)	0.035* (0.014)	0.024** (0.009)	0.017 (0.010)	0.010 (0.011)	-0.015 (0.011)	0.037** (0.014)
Population Density	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.221*** (0.039)	-0.401** (0.132)	-0.024 (0.080)	0.248 (0.140)	-0.201* (0.094)	-0.029 (0.103)	-0.322** (0.110)	-0.328** (0.110)	0.234 (0.140)
Properties at Risk	0.018*** (0.004)	0.023* (0.011)	0.009 (0.007)	0.013 (0.012)	0.007 (0.008)	0.004 (0.009)	0.031*** (0.010)	0.000 (0.009)	0.012 (0.012)
Georgia	-	-0.856 (0.436)	3.943*** (0.266)	-1.488*** (0.463)	-3.739*** (0.312)	-3.742*** (0.342)	-4.091*** (0.365)	2.606*** (0.364)	-1.567*** (0.464)
North Carolina	-	2.373*** (0.447)	0.435 (0.272)	-2.077*** (0.475)	-2.953*** (0.319)	-4.089*** (0.350)	-2.174*** (0.374)	1.86*** (0.374)	-2.095*** (0.476)
R^2	0.463	0.428	0.624	0.154	0.577	0.526	0.608	0.228	0.157
Std. Error	0.751	2.272	1.384	2.414	1.623	1.779	1.901	1.899	0.139
Poverty Rate	-0.039*** (0.008)	-0.048 (0.026)	-0.016 (0.016)	-0.007 (0.028)	-0.031 (0.019)	-0.044* (0.020)	-0.040 (0.022)	-0.031 (0.022)	-0.009 (0.028)
Population Density	0.001*** (0.000)	0.002*** (0.000)	0.001** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.271*** (0.038)	-0.483*** (0.141)	-0.057 (0.086)	0.227 (0.151)	-0.263** (0.101)	-0.116 (0.110)	-0.400*** (0.117)	-0.381*** (0.117)	0.207 (0.151)

Properties at Risk	0.015*** (0.004)	0.021 (0.011)	0.007 (0.007)	0.011 (0.012)	0.005 (0.008)	0.001 (0.009)	0.028** (0.010)	-0.001 (0.010)	0.011 (0.012)
Georgia	-	-0.477 (0.457)	3.98*** (0.279)	-1.598*** (0.490)	-3.669*** (0.328)	-3.569*** (0.356)	-3.910*** (0.380)	2.835*** (0.381)	-1.670*** (0.492)
North Carolina	-	2.529*** (0.455)	0.479 (0.277)	-2.071*** (0.488)	-2.870*** (0.327)	-3.962*** (0.354)	-2.056*** (0.378)	1.958*** (0.379)	-2.081*** (0.489)
R^2	0.498	0.426	0.622	0.134	0.571	0.529	0.612	0.228	0.135
Std. Error	0.726	2.277	1.388	2.442	1.634	1.774	1.893	1.898	2.449
Proportion Non-Hispanic, White	0.004 (0.003)	-0.002 (0.009)	0.001 (0.006)	-0.005 (0.010)	0.001 (0.007)	0.000 (0.007)	-0.001 (0.008)	-0.001 (0.008)	-0.005 (0.010)
Population Density	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001** (0.000)
Proximity to Coast	-0.243*** (0.040)	-0.383** (0.146)	-0.036 (0.088)	0.273 (0.155)	-0.214* (0.104)	-0.033 (0.114)	-0.318** (0.121)	-0.320** (0.121)	0.258 (0.156)
Properties at Risk	0.017*** (0.004)	0.024* (0.012)	0.008 (0.007)	0.012 (0.012)	0.006 (0.008)	0.003 (0.009)	0.030** (0.010)	0.001 (0.010)	0.012 (0.012)
Georgia	-	-0.770 (0.464)	3.916*** (0.282)	-1.724*** (0.495)	-3.818*** (0.333)	-3.814*** (0.363)	-4.150*** (0.386)	2.654*** (0.386)	-1.811*** (0.496)
North Carolina	-	2.366*** (0.462)	0.446 (0.280)	-2.147*** (0.492)	-2.950*** (0.331)	-4.096*** (0.361)	-2.190*** (0.384)	1.858*** (0.384)	-2.166*** (0.494)
R^2	0.458	0.419	0.621	0.135	0.557	0.521	0.607	0.223	0.136
Std. Error	0.754	2.290	1.391	2.441	1.642	1.789	1.904	1.905	2.448
Proportion Black, African American	-0.009*** (0.003)	0.005 (0.010)	-0.003 (0.006)	0.003 (0.010)	-0.012 (0.007)	0.001 (0.008)	0.002 (0.008)	0.000 (0.008)	0.004 (0.010)
Population Density	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.259*** (0.039)	-0.361* (0.149)	-0.049 (0.090)	0.262 (0.159)	-0.288** (0.106)	-0.028 (0.116)	-0.310* (0.124)	-0.324** (0.124)	0.254 (0.159)
Properties at Risk	0.015*** (0.004)	0.0250* (0.012)	0.008 (0.007)	0.012 (0.012)	0.004 (0.008)	0.003 (0.009)	0.0310** (0.010)	0.000 (0.010)	0.012 (0.012)
Georgia	-	-0.862 (0.500)	3.972*** (0.303)	-1.719*** (0.533)	-3.543*** (0.357)	-3.832*** (0.390)	-4.187*** (0.416)	2.666*** (0.416)	-1.828*** (0.535)
North Carolina	-	2.306*** (0.477)	0.483 (0.290)	-2.145*** (0.509)	-2.772*** (0.341)	-4.108*** (0.373)	-2.214*** (0.397)	1.865*** (0.397)	-2.178*** (0.511)
R^2	0.475	0.419	0.621	0.134	0.571	0.521	0.607	0.223	0.135
Std. Error	0.742	2.289	1.390	2.442	1.634	1.789	1.904	1.905	0.117
Proportion Hispanic, Latino	0.015** (0.006)	-0.026 (0.018)	0.004 (0.011)	0.005 (0.019)	0.024 (0.013)	-0.003 (0.014)	-0.011 (0.015)	-0.010 (0.015)	0.003 (0.019)
Population Density	0.001*** (0.000)	0.003*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.215*** (0.039)	-0.390** (0.132)	-0.027 (0.081)	0.238 (0.142)	-0.210* (0.095)	-0.033 (0.104)	-0.323** (0.110)	-0.323** (0.110)	0.224 (0.142)
Properties at Risk	0.0170*** (0.004)	0.0250* (0.011)	0.008 (0.007)	0.011 (0.012)	0.005 (0.008)	0.003 (0.009)	0.031*** (0.010)	0.001 (0.010)	0.011 (0.012)
Georgia	-	-0.917* (0.450)	3.915*** (0.274)	-1.599*** (0.482)	-3.678*** (0.322)	-3.833*** (0.353)	-4.204*** (0.375)	2.601*** (0.376)	-1.703*** (0.483)
North Carolina	-	2.217*** (0.463)	0.454 (0.282)	-2.058*** (0.495)	-2.811*** (0.331)	-4.115*** (0.363)	-2.246*** (0.386)	1.803*** (0.386)	-0.497
R^2	0.469	0.423	0.621	0.134	0.572	0.521	0.608	0.224	0.135

Std. Error	0.747	2.281	1.391	2.442	1.632	1.788	1.903	1.903	2.449
Owner-occupied Housing Rate	-0.001 (0.006)	-0.023 (0.017)	0.007 (0.011)	-0.019 (0.019)	0.004 (0.012)	-0.012 (0.014)	0.004 (0.014)	-0.012 (0.014)	-0.020 (0.019)
Population Density	0.001*** (0.000)	0.002*** (0.000)	0.001*** (0.000)	0.001** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001** (0.000)
Proximity to Coast	-0.227*** (0.039)	-0.354** (0.136)	-0.040 (0.083)	0.273 (0.145)	-0.213* (0.098)	-0.012 (0.106)	-0.332** (0.113)	-0.302** (0.113)	0.259 (0.146)
Properties at Risk	0.018*** (0.004)	0.025* (0.011)	0.008 (0.007)	0.012 (0.012)	0.006 (0.008)	0.004 (0.009)	0.030** (0.010)	0.001 (0.010)	0.012 (0.012)
Georgia	-	-0.908* (0.453)	3.943*** (0.276)	-1.775*** (0.484)	-3.811*** (0.326)	-3.903*** (0.354)	-4.104*** (0.378)	2.575*** (0.377)	-1.863*** (0.485)
North Carolina	-	2.247*** (0.461)	0.473 (0.281)	-2.207*** (0.493)	-2.940*** (0.332)	-4.170*** (0.361)	-2.155*** (0.385)	1.790*** (0.384)	-2.226*** (0.494)
R^2	0.455	0.422	0.621	0.137	0.567	0.522	0.607	0.225	0.138
Std. Error	0.757	2.283	1.390	2.438	1.642	1.786	1.904	1.902	2.445

[a]Acq Elev = Acquisition & Elevation; Dev Reg = Development Regulations; Emerg Manag = Emergency Management; Prop Prot = Property Protection; Struc Cont = Structural Controls; S = Structural; NS = Non-Structural; N/A = Not Applicable
*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

Table 3-4: OLS Regression Results for PA Funding Distribution by Disaster Event(s)

	Total - Matthew [N=87]	Total - Irma [N=226]	Total - Combined [N=449]
SoVI	0.008 (0.010)	0.007 (0.007)	0.019** (0.006)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.565** (0.183)	-0.283*** (0.084)	-0.505*** (0.068)
Properties at Risk	0.000 (0.007)	0.002 (0.008)	0.006 (0.005)
Total Rain	0.103*** (0.026)	0.277*** (0.028)	0.112*** (0.013)
R^2	0.361	0.556	0.426
Std. Error	0.891	1.208	1.330
Poverty Rate	-0.018 (0.019)	-0.001 (0.015)	-0.008 (0.011)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.497* (0.192)	-0.292*** (0.089)	-0.528*** (0.070)
Properties at Risk	0.000 (0.007)	0.002 (0.008)	0.005 (0.005)
Total Rain	0.103*** (0.026)	0.278*** (0.029)	0.113*** (0.013)
R^2	0.363	0.555	0.415
Std. Error	0.889	1.210	1.343
Proportion Non-Hispanic, White	0.002 (0.007)	-0.010* (0.005)	-0.009* (0.004)
Population Density	0.001*** (0.000)	0.001** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.533** (0.197)	-0.255** (0.085)	-0.499*** (0.069)
Properties at Risk	0.000 (0.007)	0.005 (0.008)	0.008 (0.005)
Total Rain	0.105*** (0.027)	0.281*** (0.028)	0.114*** (0.013)
R^2	0.357	0.563	0.421

Std. Error	0.894	1.200	1.336
Proportion Black, African American	-0.013 (0.008)	0.012* (0.005)	0.007 (0.004)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.430* (0.197)	-0.241** (0.086)	-0.510*** (0.069)
Properties at Risk	-0.001 (0.006)	0.008 (0.008)	0.007 (0.005)
Total Rain	0.114*** (0.027)	0.292*** (0.029)	0.116*** (0.013)
R^2	0.375	0.565	0.418
Std. Error	0.881	1.200	1.340
Proportion Hispanic, Latino	0.019 (0.014)	-0.005 (0.010)	0.009 (0.008)
Population Density	0.001** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.550** (0.181)	-0.285** (0.084)	-0.512*** (0.069)
Properties at Risk	0.000 (0.006)	0.003 (0.008)	0.005 (0.005)
Total Rain	0.111*** (0.027)	0.284*** (0.030)	0.114*** (0.013)
R^2	0.371	0.555	0.416
Std. Error	0.884	1.210	1.342
Owner-occupied Housing Rate	0.005 (0.014)	-0.008 (0.010)	-0.004 (0.008)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.532** (0.191)	-0.282*** (0.084)	-0.518*** (0.069)
Properties at Risk	0.000 (0.007)	0.003 (0.008)	0.006 (0.005)
Total Rain	0.104*** (0.026)	0.281*** (0.028)	0.115*** (0.013)
R^2	0.357	0.556	0.415
Std. Error	0.893	1.209	1.343

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

Table 3-5a: OLS Regression Results for IHP Funding Distribution and Number of Valid Registrations Resulting from Hurricane Matthew

	Approved - owners [N=64]	Registrations - owners [N=64]	Approved - renters [N=64]	Registrations - renters [N=64]	IA Ratio [N=64]
SoVI	0.014 (0.008)	0.013* (0.006)	0.020* (0.009)	0.015* (0.007)	-0.001 (0.002)
Population Density	0.000 (0.000)	0.001** (0.000)	0.001* (0.000)	0.001** (0.000)	0.000* (0.000)
Proximity to Coast	-0.238 (0.124)	-0.307** (0.098)	-0.105 (0.138)	-0.202 (0.118)	0.0530 (0.034)
Properties at Risk	-0.002 (0.004)	-0.005 (0.003)	0.004 (0.005)	-0.003 (0.004)	-0.002 (0.001)
Total Rain	0.128*** (0.023)	0.086*** (0.019)	0.128*** (0.026)	0.099*** (0.022)	0.007 (0.007)
R^2	0.437	0.473	0.414	0.427	0.189
Std. Error	0.560	0.443	0.623	0.533	0.155

Poverty Rate	0.013 (0.015)	0.017 (0.012)	0.018 (0.017)	0.024 (0.014)	0.003 (0.004)
Population Density	0.000 (0.000)	0.001** (0.000)	0.001* (0.000)	0.001** (0.000)	0.000 (0.000)
Proximity to Coast	-0.263 (0.135)	-0.346** (0.107)	-0.139 (0.152)	-0.261* (0.127)	0.043 (0.036)
Properties at Risk	-0.002 (0.005)	-0.005 (0.004)	0.004 (0.005)	-0.004 (0.004)	-0.002 (0.001)
Total Rain	0.134*** (0.024)	0.090*** (0.019)	0.136*** (0.027)	0.103*** (0.022)	0.006 (0.006)
R^2	0.410	0.453	0.371	0.415	0.194
Std. Error	0.573	0.452	0.645	0.539	0.154
Proportion Non-Hispanic, White	-0.001 (0.006)	-0.004 (0.005)	-0.007 (0.006)	-0.010 (0.005)	-0.002 (0.002)
Population Density	0.000 (0.000)	0.000* (0.000)	0.001 (0.000)	0.001* (0.000)	0.000* (0.000)
Proximity to Coast	-0.236 (0.140)	-0.338** (0.111)	-0.153 (0.157)	-0.283* (0.131)	0.035 (0.037)
Properties at Risk	-0.002 (0.005)	-0.005 (0.004)	0.005 (0.005)	-0.003 (0.004)	-0.002 (0.001)
Total Rain	0.135*** (0.025)	0.088*** (0.020)	0.132*** (0.028)	0.097*** (0.023)	0.005 (0.007)
R^2	0.403	0.442	0.371	0.416	0.204
Std. Error	0.576	0.456	0.645	0.538	0.153
Proportion Black, African American	-0.006 (0.006)	-0.003 (0.005)	0.000 (0.007)	0.001 (0.006)	0.001 (0.002)
Population Density	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)	0.001* (0.000)	0.000* (0.000)
Proximity to Coast	-0.160 (0.139)	-0.265* (0.112)	-0.085 (0.159)	-0.199 (0.135)	0.040 (0.038)
Properties at Risk	-0.003 (0.005)	-0.005 (0.004)	0.004 (0.005)	-0.004 (0.004)	-0.002 (0.001)
Total Rain	0.142*** (0.024)	0.096*** (0.019)	0.140*** (0.027)	0.107*** (0.023)	0.006 (0.006)
R^2	0.414	0.437	0.358	0.385	0.196
Std. Error	0.571	0.458	0.652	0.553	0.154
Proportion Hispanic, Latino	0.028 (0.016)	0.026* (0.012)	0.025 (0.018)	0.031* (0.015)	0.000 (0.004)
Population Density	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000* (0.000)
Proximity to Coast	-0.219 (0.124)	-0.290** (0.098)	-0.079 (0.142)	-0.182 (0.118)	0.052 (0.034)
Properties at Risk	-0.002 (0.004)	-0.005 (0.003)	0.004 (0.005)	-0.004 (0.004)	-0.002 (0.001)
Total Rain	0.135*** (0.023)	0.092*** (0.018)	0.139*** (0.026)	0.106*** (0.022)	0.007 (0.006)
R^2	0.434	0.472	0.378	0.426	0.187
Std. Error	0.561	0.444	0.642	0.534	0.155
Owner-occupied Housing Rate	-0.005 (0.010)	-0.008 (0.008)	-0.021 (0.011)	-0.023* (0.009)	-0.002 (0.003)
Population Density	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000* (0.000)

Proximity to Coast	-0.242 (0.135)	-0.329** (0.107)	-0.175 (0.149)	-0.284* (0.124)	0.042 (0.036)
Properties at Risk	-0.002 (0.005)	-0.005 (0.004)	0.004 (0.005)	-0.004 (0.004)	-0.002 (0.001)
Total Rain	0.136*** (0.024)	0.093*** (0.019)	0.139*** (0.026)	0.107*** (0.022)	0.007 (0.006)
R^2	0.404	0.443	0.396	0.441	0.196
Std. Error	0.575	0.456	0.632	0.527	0.154

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

Table 3-5b: OLS Regression Results for IHP Funding Distribution and Number of Valid Registrations Resulting from Hurricane Irma

	Approved - owners [N=56]	Registrations - owners [N=56]	Approved - renters [N=56]	Registrations - renters [N=56]	IA Ratio [N=56]
SoVI	0.021*** (0.004)	0.023*** (0.004)	0.026*** (0.006)	0.023*** (0.005)	0.001 (0.004)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.211 (0.180)	-0.193 (0.180)	-0.451 (0.246)	-0.349 (0.223)	-0.109 (0.175)
Properties at Risk	0.006 (0.003)	0.003 (0.003)	0.006 (0.004)	0.003 (0.004)	0.001 (0.003)
Total Rain	0.096*** (0.018)	0.079*** (0.018)	0.110*** (0.024)	0.086*** (0.022)	-0.057** (0.017)
R^2	0.730	0.747	0.724	0.720	0.482
Std. Error	0.356	0.355	0.487	0.441	0.346
Poverty Rate	-0.037* (0.014)	-0.042** (0.014)	-0.055** (0.018)	-0.044** (0.016)	-0.011 (0.012)
Population Density	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.012 (0.228)	0.038 (0.230)	-0.132 (0.294)	-0.099 (0.270)	-0.032 (0.192)
Properties at Risk	0.008* (0.003)	0.005 (0.004)	0.009 (0.005)	0.005 (0.004)	0.001 (0.003)
Total Rain	0.078*** (0.022)	0.059** (0.022)	0.082** (0.028)	0.064* (0.026)	-0.063*** (0.018)
R^2	0.644	0.659	0.677	0.664	0.490
Std. Error	0.408	0.412	0.527	0.483	0.343
Proportion Non-Hispanic, White	-0.006 (0.004)	-0.005 (0.004)	-0.009 (0.005)	-0.010* (0.004)	0.007* (0.003)
Population Density	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.355 (0.222)	-0.331 (0.229)	-0.650* (0.290)	-0.558* (0.256)	-0.009 (0.170)
Properties at Risk	0.007* (0.004)	0.004 (0.004)	0.007 (0.005)	0.004 (0.004)	0.002 (0.003)
Total Rain	0.095*** (0.021)	0.079*** (0.022)	0.109*** (0.028)	0.084*** (0.024)	-0.053** (0.016)
R^2	0.612	0.611	0.638	0.652	0.540

Std. Error	0.426	0.440	0.558	0.492	0.326
Proportion Black, African American	-0.009 (0.006)	-0.011 (0.007)	-0.009 (0.009)	-0.002 (0.008)	-0.016** (0.005)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.235 (0.218)	-0.212 (0.222)	-0.484 (0.289)	-0.404 (0.263)	-0.047 (0.160)
Properties at Risk	0.007 (0.004)	0.004 (0.004)	0.007 (0.005)	0.004 (0.005)	-0.001 (0.003)
Total Rain	0.093*** (0.022)	0.075*** (0.022)	0.107*** (0.029)	0.088*** (0.026)	-0.066*** (0.016)
R^2	0.607	0.618	0.623	0.616	0.572
Std. Error	0.429	0.436	0.568	0.517	0.314
Proportion Hispanic, Latino	0.013** (0.004)	0.014** (0.004)	0.018** (0.006)	0.016** (0.005)	-0.002 (0.004)
Population Density	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.410 (0.207)	-0.399 (0.213)	-0.712* (0.271)	-0.583* (0.244)	-0.091 (0.178)
Properties at Risk	0.005 (0.004)	0.002 (0.004)	0.004 (0.005)	0.001 (0.004)	0.002 (0.003)
Total Rain	0.085*** (0.020)	0.068*** (0.021)	0.094*** (0.027)	0.072** (0.024)	-0.055** (0.017)
R^2	0.658	0.661	0.679	0.680	0.484
Std. Error	0.400	0.411	0.524	0.472	0.345
Owner-occupied Housing Rate	-0.010 (0.008)	-0.007 (0.008)	-0.016 (0.011)	-0.020* (0.009)	0.018** (0.006)
Population Density	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.339 (0.225)	-0.304 (0.233)	-0.642* (0.294)	-0.553* (0.259)	0.014 (0.167)
Properties at Risk	0.007 (0.004)	0.004 (0.004)	0.007 (0.005)	0.003 (0.004)	0.003 (0.003)
Total Rain	0.092*** (0.022)	0.078*** (0.023)	0.103*** (0.029)	0.077** (0.025)	-0.046** (0.016)
R^2	0.605	0.602	0.632	0.646	0.558
Std. Error	0.430	0.445	0.562	0.496	0.319

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

Table 3-5c: OLS Regression Results for IHP Funding Distribution and Number of Valid Registrations Resulting from Hurricanes Matthew, Irma, Michael, and Florence

	Approved - owners [N=186]	Registrations - owners [N=186]	Approved - renters [N=186]	Registrations - renters [N=186]	IA Ratio [N=186]
SoVI	0.019*** (0.004)	0.020*** (0.004)	0.024*** (0.005)	0.023*** (0.005)	0.006* (0.002)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)

Proximity to Coast	-0.433*** (0.083)	-0.462*** (0.076)	-0.422*** (0.096)	-0.495*** (0.093)	-0.113** (0.043)
Properties at Risk	0.003 (0.003)	-0.001 (0.003)	0.004 (0.003)	-0.002 (0.003)	0.000 (0.002)
Total Rain	0.037*** (0.008)	0.018* (0.007)	0.038*** (0.009)	0.017 (0.009)	-0.014*** (0.004)
R^2	0.423	0.466	0.462	0.453	0.331
Std. Error	0.615	0.565	0.710	0.690	0.318
Poverty Rate	0.004 (0.009)	0.007 (0.009)	-0.001 (0.011)	0.008 (0.011)	0.001 (0.005)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.436*** (0.092)	-0.473*** (0.086)	-0.409*** (0.107)	-0.511*** (0.104)	-0.113* (0.046)
Properties at Risk	0.003 (0.003)	-0.001 (0.003)	0.004 (0.004)	-0.001 (0.004)	0.000 (0.002)
Total Rain	0.039*** (0.009)	0.021** (0.008)	0.040*** (0.010)	0.021* (0.010)	-0.013** (0.004)
R^2	0.361	0.391	0.392	0.386	0.309
Std. Error	0.647	0.603	0.754	0.732	0.323
Proportion Non-Hispanic, White	-0.003 (0.003)	-0.005 (0.003)	-0.006 (0.004)	-0.009* (0.004)	0.002 (0.002)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.459*** (0.094)	-0.502*** (0.087)	-0.476*** (0.109)	-0.572*** (0.105)	-0.094* (0.047)
Properties at Risk	0.003 (0.003)	-0.001 (0.003)	0.005 (0.004)	-0.001 (0.003)	0.000 (0.002)
Total Rain	0.038*** (0.009)	0.020* (0.008)	0.039*** (0.010)	0.019 (0.010)	-0.013** (0.004)
R^2	0.364	0.397	0.401	0.400	0.312
Std. Error	0.645	0.600	0.749	0.723	0.322
Proportion Black, African American	-0.008* (0.004)	-0.007* (0.004)	-0.007 (0.004)	-0.006 (0.004)	-0.005* (0.002)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.340*** (0.095)	-0.379*** (0.089)	-0.333** (0.111)	-0.423*** (0.108)	-0.062 (0.047)
Properties at Risk	0.002 (0.003)	-0.002 (0.003)	0.004 (0.004)	-0.002 (0.004)	-0.001 (0.002)
Total Rain	0.038*** (0.008)	0.020* (0.008)	0.040*** (0.010)	0.020* (0.010)	-0.014*** (0.004)
R^2	0.377	0.402	0.402	0.390	0.332
Std. Error	0.639	0.597	0.748	0.729	0.318
Proportion Hispanic, Latino	0.022*** (0.005)	0.024*** (0.005)	0.027*** (0.006)	0.030*** (0.006)	0.006* (0.003)
Population Density	0.000*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.409*** (0.083)	-0.437*** (0.076)	-0.392*** (0.096)	-0.464*** (0.092)	-0.107* (0.043)
Properties at Risk	0.002 (0.003)	-0.003 (0.003)	0.003 (0.003)	-0.003 (0.003)	-0.001 (0.002)

Total Rain	0.037*** (0.008)	0.018* (0.007)	0.038*** (0.009)	0.017 (0.009)	-0.014*** (0.004)
R^2	0.417	0.464	0.455	0.466	0.329
Std. Error	0.618	0.566	0.714	0.682	0.318
Owner-occupied Housing Rate	0.000 (0.006)	-0.004 (0.006)	-0.012 (0.007)	-0.015* (0.007)	0.012*** (0.003)
Population Density	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.001*** (0.000)
Proximity to Coast	-0.426*** (0.095)	-0.477*** (0.088)	-0.478*** (0.110)	-0.571*** (0.106)	-0.045 (0.046)
Properties at Risk	0.003 (0.003)	-0.001 (0.003)	0.004 (0.004)	-0.002 (0.003)	0.000 (0.001)
Total Rain	0.039*** (0.009)	0.020* (0.008)	0.039*** (0.010)	0.019* (0.010)	-0.013** (0.004)
R^2	0.361	0.391	0.401	0.399	0.358
Std. Error	0.647	0.603	0.749	0.724	0.311

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

3.5.1 Identified Equities

Counties with a higher SoVI received 0.9% more total HMA funding per unit increase in SoVI (Table 3-3); received 1.9% and 2.4% more funding and submitted 2.0% and 2.3% more valid registrations for IHP owners and renters, respectively, and experienced a 0.006 increase in IHP ratio per unit increase in SoVI when considering all four disaster events (Table 3-5c). Similarly, counties with higher percentages of Hispanic, Latino residents received 1.5% more total HMA funding per unit increase (Table 3-3); received 2.2% and 2.7% more funding and submitted 2.4% and 3.0% more valid registrations for IHP owners and renters, respectively, and experienced a 0.006 increase in IHP ratio per unit increase when considering all four disaster events (Table 3-5c). Additionally, a pair of significant findings can be drawn from the PA regression models. As identified in the Hurricane Irma regression model, counties with higher proportions of Black, African American residents received 1.2% more total PA funding per unit increase (Table 3-4). This finding was not significant for the Hurricane Matthew PA model nor was it significant for the combined model which included data for Hurricanes Matthew, Irma, Michael, and Florence (Table 3-4). As identified in the combined model only, however, counties with a higher SoVI received 1.9% more total PA funding per unit increase (Table 3-4).

In most HMA, PA, and IHP regression models, population density had a significantly positive relationship with a one unit increase equating to approximately a 0.1% increase in the dependent variable (Tables 3-3, 3-4, 3-5a, 3-5b, 3-5c). In approximately half of the HMA, PA, and IHP regression models, proximity to coast had a significantly negative relationship with a one unit increase ranging from approximately a 20% decrease to upwards of a 90% decrease in the dependent variable (Tables 3-3, 3-4, 3-5a, 3-5b, 3-5c). Percent of properties at risk was identified to have a significantly positive relationship to many of the dependent variables in the HMA regression models with a one unit increase ranging from approximately a 1.5% increase to upwards of a 3% increase in the dependent variable (Table 3-3); percent of properties at risk was not a significant predictor for any of the PA and IHP regression models (Tables 3-4, 3-5a, 3-5b, 3-5c). Total rain was identified to have a significantly positive relationship to many of the dependent variables in the PA and IHP regression models with a one unit increase ranging from approximately a 6% increase to upwards of a 35% increase in the dependent variable (Tables 3-4, 3-5a, 3-5b, 3-5c).

3.5.2 Identified Inequities

Counties with higher poverty rates received 3.8% less total HMA funding and 4.3% less funding for structural controls projects per unit increase (Table 3-3). Counties with higher proportions of Black, African American residents received 0.9% less total HMA funding per unit increase (Table 3-3); received 0.8% less funding and submitted 0.7% fewer valid registrations for IHP owners and experienced a 0.005 decrease in IHP ratio per unit increase when considering all four disaster events (Table 3-5c). Counties with a higher SoVI received 3.6% and 2.4% more funding for emergency management and property protection projects, respectively, and 2.8% less funding for acquisition & elevation per unit increase (Table 3-3). Although the positive relationship between SoVI and emergency management and property protection funding receipt may seem like an example of equity, when paired with the negative relationship between SoVI and acquisition & elevation funding receipt, importantly there is an identifiable inequity within local mitigation approaches that promote (or do not promote) long-term risk reduction and resilience. This is further critiqued in the subsequent section *3.6.1 Mitigation*. Counties with higher owner-occupied housing rates experienced a 0.012 increase in IHP ratio per unit increase when considering all four disaster events (Table 3-5c). Similar to what was seen when identifying examples of equity, certain examples of inequity can be identified at an event-level. As seen in Hurricane Irma post-disaster funding distribution, counties with higher poverty rates received 3.6% and 5.4% less funding and submitted 4.1% and 4.3% fewer valid registrations for IHP owners and renters, respectively, per unit increase (Table 3-5b).

3.6 Discussion

3.6.1 Mitigation

Although counties with a higher SoVI received 0.9% more total HMA funding per unit increase when controlling for hazard level, when separating HMA funding by mitigation action it can be seen that a disproportionate amount of funding is granted in socially vulnerable counties for emergency management and property protection projects (3.6% and 2.8% more funding per unit increase, respectively) as compared to acquisition & elevation projects (2.8% less funding per unit increase). This reveals that socially vulnerable counties are not being equipped to move development away from hazard prone areas and thus engaging in long-term risk reduction. The results of this research are insufficient for explaining whether this is due to local stakeholder decisions, local capacity to pursue more impactful projects, or systemic inequity considering that the data consists of only the amount of HMA funding granted not the amount and type of HMA funding included in applications. Nonetheless, this reveals inequities in mitigation strategies at the county-level and resulting community resilience.

Locations with higher poverty rates are often more susceptible to the devastating impacts of a disaster event considering lower financial capacity and greater hazard exposure. This susceptibility is being exacerbated by counties with higher poverty rates receiving 3.8% less HMA funding per unit increase in poverty rate. Furthermore, counties with higher poverty rates received 4.3% less funding for structural control projects per unit increase. This is of particular concern when considering that a primary approach to mitigate future disaster losses in areas with poorer residents who do not have the financial capacity to move away from the high-risk area or to have access to sufficient insurance policies is through the implementation of structural control projects such as dams and levees.

Although institutional racism remains a form of oppression, scholars continue to stress that procedural inequity is commonplace within bureaucratic proceedings and as a result, minorities are often disadvantaged as can be seen in the implications of these results. Counties with higher proportions of Black, African American residents received 0.9% less total HMA funding per unit increase. However, when controlling for state, proportion of Black, African American is no longer a significant variable. As shown in A4 of the Appendix, counties in

Georgia received significantly less funding than counties in Florida. Population density was a statistically significant predictor, indicating that counties with higher concentrations of people receive more HMA funds; counties in Georgia have lower population densities than counties in Florida considering the lower state population and the greater number of counties. As shown in Table 3-1 counties in Georgia also have higher proportions of black residents, nearly double that of Florida on average. As such, these results are inconclusive in determining whether counties with higher proportions of Black, African American residents received less FEMA HMA funding due to systemic inequity or as a coincidence of primarily being in less populated areas. Nonetheless, counties with higher proportions of Black, African American residents received less total HMA funding which has important implications for resilience against future disaster events.

Counties with higher proportions of Hispanic, Latino residents received 1.5% more total HMA funding per unit increase. But similar to the discussion related to proportion of Black, African American, counties in Florida have higher proportions of Hispanic residents than counties in both Georgia and North Carolina on average as shown in Table 3-1. As such, when controlling for state, proportion of Hispanic, Latino is no longer a significant variable as seen in A4 of the Appendix while both hazard level variables (percent of properties in FEMA's SFHA zone; proximity to coast) are significant reducing the chance of potential bias from Florida's increased hazard level. These results imply that it may be that counties with higher proportions of Hispanic residents received more total HMA funding because they are located in a state that is better equipped to apply for and secure FEMA grant funding and/or because that state has higher county population sizes on average. To further refine the interpretive application of the results of this study, more in-depth qualitative research is needed, as well as a correlation analysis testing each social vulnerability variable and county population size.

Mitigation is the primary avenue to combat future disaster losses and as these results indicate, socially vulnerable communities experience decreased access to federal HMA funding which hinders long-term disaster risk reduction.

3.6.2 Public Assistance

All three significant findings from the PA regression analyses (i.e., counties with higher proportions of Non-Hispanic, White residents received 0.9% less PA funding per unit increase and counties with a higher SoVI received 1.9% more PA funding per unit increase when considering all four disaster events assessed; counties with higher proportions of Black, African American residents received 1.2% more PA funding per unit increase as a result of Hurricane Irma) are examples of equity. When considering the results of the HMA regression analyses, these PA findings align with the reasonable expectation that socially vulnerable communities be granted more PA funding as a result of insufficient HMA funding to prepare for hazard events.

Overall, the significant findings from the PA regression analyses were fewer when compared to the HMA and IHP analyses. This can reasonably be explained by either insufficient data to be representative of all counties or perhaps social vulnerability does not affect PA funding distribution in the same way that it affects HMA and IHP. This latter explanation becomes more plausible when considering that PA funds are distributed at the jurisdictional level not the individual normalizing the range of socially vulnerable households across the local jurisdiction and PA funding commonly supports debris removal, emergency protective measures, and permanent repair work, which are in direct proportion to the level of damage and does not require adequate planning to be in place like with HMA funding. Furthermore, the cost share percentages for PA are similar to that of HMA implying that the immediate benefits of public assistance are more desirable than the long-term and uncertain benefits of mitigation for socially vulnerable communities with lower financial capital.

3.6.3 Individual Assistance

As to be expected considering individual variability, there are more significant findings from the IHP regression analyses than either of the other two types of federal funding assessed. The results point to examples of both equity and inequity within IHP funding distribution for both owners and renters.

Counties with a higher SoVI received 1.9% and 2.4% more funding for IHP owners and renters, respectively, and experienced a 0.006 increase in IHP ratio per unit increase when considering all four disaster events. Additionally, counties with higher proportions of Hispanic, Latino residents received 2.2% and 2.7% more funding for IHP owners and renters, respectively, and experienced a 0.006 increase in IHP ratio per unit increase when considering all four disaster events. These two examples of equity should not be surprising considering that socially vulnerable communities typically have more uninsured or under-insured residents who, as such, are in greater need of federal relief and recovery funding.

Counties with higher proportions of Black, African American residents received 0.8% less funding and submitted 0.7% fewer registrations for IHP owners per unit increase when considering all four disaster events. This could be due to there being fewer homeowners in primarily black communities considering income disparities and housing inequality, including historical redlining practices, and/or that counties in Georgia and North Carolina have higher proportions of Black, African American residents and lower populations on average. Importantly, individuals in primarily black communities experienced a 0.005 decrease in IHP ratio per unit increase when considering all four disaster events creating cause of concern for systemic inequity. Further research is required to better understand how this is made possible by analyzing the quality and consistency of FEMA inspections. Not only do black communities submit fewer IHP applications and as such receive less total IHP funding, but even what these communities do receive is insufficient to cover the necessary expenses assessed.

It is interesting that there is not a significant relationship between owner-occupied housing rate and IHP funding but there is a significant positive relationship (0.012 per unit increase when considering all four disaster events) between owner-occupied housing rate and the ratio of IHP funding received versus inspected damage. Similar to what has been mentioned, further investigation needs to be done to determine the reason for this inequity.

Across the majority of models, counties with higher hazard levels and increased population density received increased access to all three types of funding. However, a rather odd situation is identified in the IHP analyses as it relates to one of the control variables, total rain, in the analyses that examine IHP ratio. Counties that received more total rainfall from the corresponding disaster event experienced a 0.046 decrease in IHP ratio per unit increase for Hurricane Irma and a 0.013 decrease in IHP ratio per unit increase when considering all four disaster events. In theory, the inspected damage amount in counties that experience heavier rainfall should increase which would decrease the ratio if the IHP funding amount does not proportionally increase as well. As such, although counties that received more rainfall experienced more damage, the amount of IHP funding being granted did not match this increase. A potential explanation is that the assessed damage was covered through other funding sources such as NFIP funds. Nonetheless, this may still point to inconsistencies within FEMA inspections and at least demonstrates lack of transparency within publicly accessible OpenFEMA data.

Similar to the PA analyses, in addition to significant findings across multiple disaster events, significant findings can also be identified at an event-level. Counties with higher poverty rates received 3.6% and 5.4% less funding and submitted 4.1% and 4.3% fewer registrations for IHP owners and renters, respectively, per unit increase after Hurricane Irma. Additionally, counties with higher proportions of Non-Hispanic, White experienced a 0.007 increase in IHP ratio per unit increase after Hurricane Irma. Neither poverty rate nor proportion Non-Hispanic, White were significant variables in the Hurricane Matthew and combined (i.e., Hurricanes Matthew, Irma, Michael, and Florence) IHP regression models which reinforces the possibility of inequities manifesting themselves in dissimilar ways across disasters (Domingue & Emrich, 2019) and challenges the existing application and distribution processes to be more consistent from one disaster to another.

An additional plausible explanation for why socially vulnerable communities received less federal disaster funding is that the typical federal share of the total project cost is set at 75% with local communities, or individuals in the case of IHP, being required to cover the additional 25%. Therefore, low-resource communities and individuals who lack the necessary financial capacity are unable to apply for and receive funding whenever 25% of the needed amount exceeds what the community or individual is able to pay. An equitable strategy moving forward would be to consider social vulnerability when obligating the federal share percentage. This way the obligated federal share could be increased in socially vulnerable communities who lack the financial resources to cover necessary mitigation and recovery project costs.

Chapter 4: Assessing Local Mitigation Strategies

As shown in Figure 1-1 and building upon the results of Chapter 3, the final stage of this research first assesses mitigation strategies in all counties within Florida, Georgia, and North Carolina, and second within a sample of ten counties. The goal is to inform local decision makers by identifying good mitigation strategies that advance community resilience at the local level while considering social vulnerability, hazard level, mitigation and recovery plan quality, and state planning context.

4.1 Social Vulnerability and Community Resilience Indicators

Rather than incorporating all social vulnerability variables referenced in Chapter 3 into the assessments in this chapter, only the SoVI has been considered as a proxy for the level of social vulnerability in a county since it considers a wide range of social vulnerability factors including race, income, and housing which were the focus of the individual social vulnerability variables utilized in Chapter 3. In Chapter 3, only the continuous SoVI was used; throughout this chapter, both the continuous SoVI and the corresponding category (i.e., very low, relatively low, relatively moderate, relatively high, or very high) is used.

To evaluate resilience, the BRIC is used (Cutter et al., 2014). The derivation of the BRIC included indicators for all six capitals of resilience - social, economic, community, housing/infrastructure, institutional, and environmental. The ten-year average per capita spending for mitigation was included as an indicator for institutional capital with high mitigation spending being shown as a strong predictor of the most resilient counties in terms of institutional capital (Cutter et al., 2014). This chapter advances the understanding of the relationship between mitigation spending and BRIC by categorizing mitigation spending into the five mitigation actions and comparing how that fairs by BRIC. However, considering the BRIC is a comparative metric, throughout this chapter the BRIC should not be interpreted as a complete measure of resilience at the local level but rather serves as a general reference across counties. Throughout this chapter, both the continuous BRIC for each county is used and the corresponding category (i.e., very low, relatively low, relatively moderate, relatively high, or very high).

County level data for SoVI and BRIC were downloaded directly from FEMA.gov (FEMA, n.d.-i) considering that both SoVI and BRIC have been input into the publicly accessible FEMA National Risk Index Map (FEMA, n.d.-j). Note that for BRIC, within the FEMA National Risk Index Map the BRIC score given is the original value derived by Cutter et al. (2014) multiplied by 20 thus increasing the range of values.

As identified by Cutter et al. (2014), there is statistical overlap (25%) between the SoVI and BRIC, but the authors clarify that the two are distinct quantitative measurements. As such, throughout this chapter, the two comparative measurements are treated as two different variables with SoVI representing a proxy for social vulnerability and BRIC representing a proxy for community resilience.

4.2 Statewide Mitigation Approaches

As seen in Figure 3-3a, Florida has allocated the largest percentage of its HMA funding to property protection projects (37% of total expenditures) such as building relocations, dry floodproofing of private and/or public structures, retrofitting of private and/or public structures, and utility and infrastructure protective measures. After property protection, Florida has allocated the second largest percentage of its HMA funding to structural control projects (28% of total expenditures) such as stormwater management in the form of culverts, diversions, floodgates, and detention/retention basins, and flood control in the form of floodwalls, levees, and dikes. When considering Florida's geographical context as a peninsula and its corresponding state-wide hazard level, it makes sense that the state would prioritize spending money on mitigation strategies that will strengthen existing buildings and infrastructure and resist flooding. The remainder of Florida's HMA expenditures are classified as follows: 17% to multiple actions, 11% to acquisition & elevation, 7% to emergency management, and ~0% to development regulation.

As seen in Figure 3-3b, Georgia has allocated the vast majority of its HMA funding to acquisition & elevation projects (77% of total expenditures) such as acquisition of public and private property in both riverine and coastal areas, acquisition of vacant land, and elevation of public and private structures; the majority (approximately 90%) of acquisition & elevation expenditures have been put towards acquisition of private property. Surprisingly, Georgia allocated $0 to property protection projects during the 15-year time period assessed. As such, possibly due to its lower population size and decreased hazard level, Georgia has taken a different approach to mitigation than Florida favoring the non-structural action of acquisition over the structural actions of property protection and structural controls. The remainder of Georgia's HMA expenditures can be separated as follows: 9% to structural controls, 6% to development regulation, 6% to emergency management, 2% to multiple actions, and 0% to property protection. Georgia allocated a greater percentage of its HMA funding (6%) to development regulation when compared to the other two states (~0% for both Florida and North Carolina). Development regulation largely consisted of projects related to the adoption or updating of mitigation plans.

As seen in Figure 3-3c, North Carolina has allocated an even larger percentage of its HMA funding to acquisition & elevation projects (88% of total expenditures). North Carolina differs from Georgia in that approximately 67% of acquisition & elevation expenditures have been directly put towards acquisition of private property instead of 90% with the remainder of the funds going towards acquisition of public property and elevation of private structures. Unlike Georgia, North Carolina did allocate funds to property protection projects (6% of total expenditures) with property protection being a distant second behind acquisition & elevation. The remainder of North Carolina's HMA expenditures can be characterized as follows: 4% to multiple actions, 1% to structural controls, 1% to emergency management, and ~0% to development regulation.

Overall, North Carolina and Georgia appear to have a similar approach to mitigation, allocating the majority of budget expenditures towards acquisition & elevation projects, particularly acquisition of private property. Florida takes a much more diversified approach while favoring projects that intend to strengthen and protect both private and public buildings and infrastructure.

4.3 Effects of SoVI and BRIC on HMA Funding Distribution

Figure 4-1 presents a bar chart that showcases the HMA budget distribution within each SoVI category (1-very low, 2-relatively low, 3-relatively moderate, 4-relatively high, 5-very high) across all counties in Florida, Georgia, and North Carolina. As supported by the regression analysis results of Chapter 3, counties with a higher SoVI allocated less HMA funding to acquisition & elevation and more to property protection. Considering the decreased access to insurance in socially vulnerable communities, it makes sense that a substantial amount of HMA funding be put towards strengthening buildings in order to decrease reliance on private insurance. As such, with property protection projects absorbing much of the HMA funding, there is less to spend on non-structural mitigation approaches such as land acquisition which have been proven to be more beneficial in combatting disaster losses. On the contrary, using the same plausible methodology counties with a lower SoVI are less reliant on FEMA HMA funding to protect private property considering the greater access to insurance that will largely cover future disaster losses and therefore are more equipped to allocate funding towards non-structural mitigation approaches.

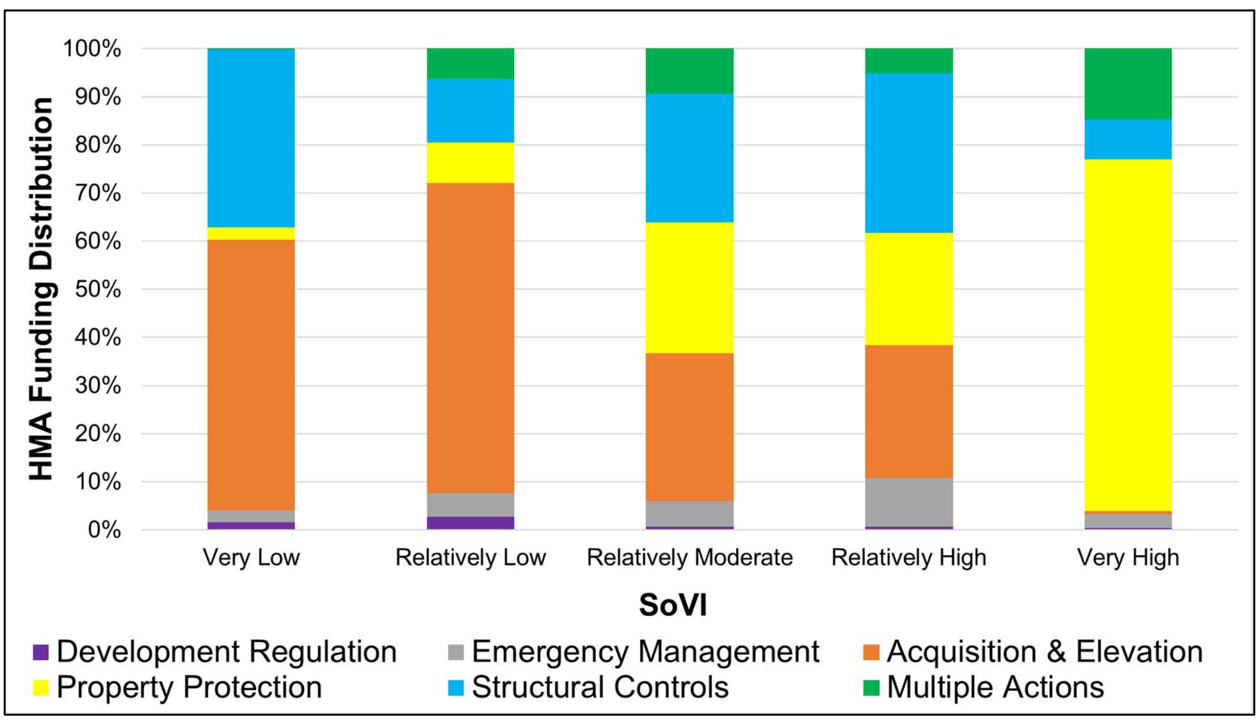


Figure 4-1: HMA Funding Distribution per Mitigation Action within each SoVI Category

Figure 4-2 presents a bar chart that showcases the HMA budget distribution within each BRIC category (1-very low, 2-relatively low, 3-relatively moderate, 4-relatively high, 5-very high) across all counties in Florida, Georgia, and North Carolina. As shown in Table 4-1, there were no counties in the study that were granted a *very high* BRIC. Counties with a higher BRIC allocated more HMA funding to acquisition & elevation projects and less to structural control projects which aligns with the body of research that has shown non-structural mitigation approaches such as land acquisition are most beneficial in preparing for a disaster event and thus advancing community resilience. Additionally, counties with a higher BRIC allocated less HMA funding to development regulation and emergency management. As stated previously, development regulation projects primarily consisted of adopting or updating mitigation plans. Although adequate mitigation planning is necessary for building community resilience, counties that allocate a noticeable percentage of mitigation budget expenditures towards simply adopting and updating mitigation plans may be only going through the motions to secure future post-disaster funding rather than taking the initiative to prepare for future disaster events. Emergency management projects such as warning systems and generators are ineffective for mitigating future disaster losses but assist in the short-term preparedness and response stages of the disaster cycle. As such, counties with higher levels of community resilience allocated less HMA funding to emergency management projects which do not contribute to long-term risk reduction.

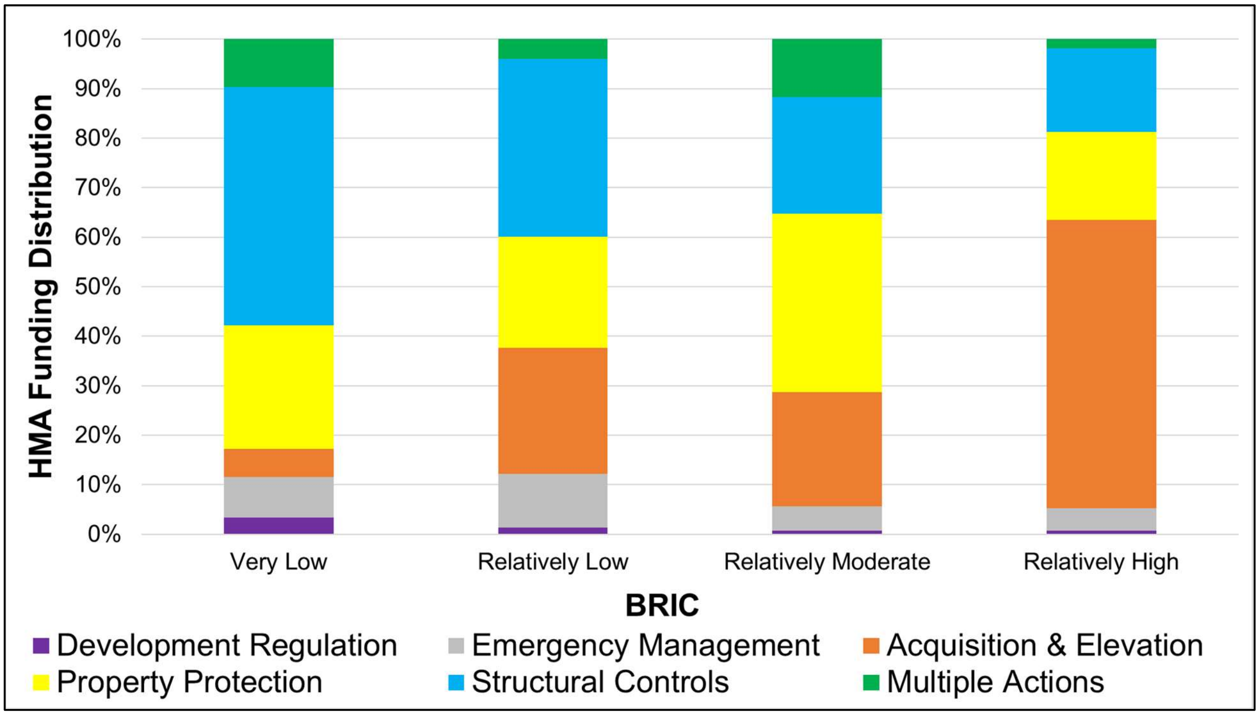


Figure 4-2: HMA Funding Distribution per Mitigation Action within each BRIC Category

Table 4-1: Number of Counties per SoVI/BRIC Category

Category	*Number of Counties – SoVI*	*Number of Counties – BRIC*
Very Low	29	22
Relatively Low	80	106
Relatively Moderate	115	143
Relatively High	91	55
Very High	11	0

Both Figures 4-1 and 4-2 do not factor in population density nor hazard level as included in the regression analyses of Chapter 3. Therefore, they simply represent general trends in mitigation budget distribution across all counties in the study.

4.4 10-County Sample

As an extension to the previous state-wide assessments, a 10-county sample has been selected for detailed assessment to identify preferred mitigation strategies at the local level as it relates to advancing community resilience. The ten counties were selected based on shared disaster experience (e.g., Hurricanes Matthew, Irma, Michael, and Florence); similar hazard level (e.g., floods and tropical storms); variation in state land use policy and mitigation approach; and variation in local planning practice.

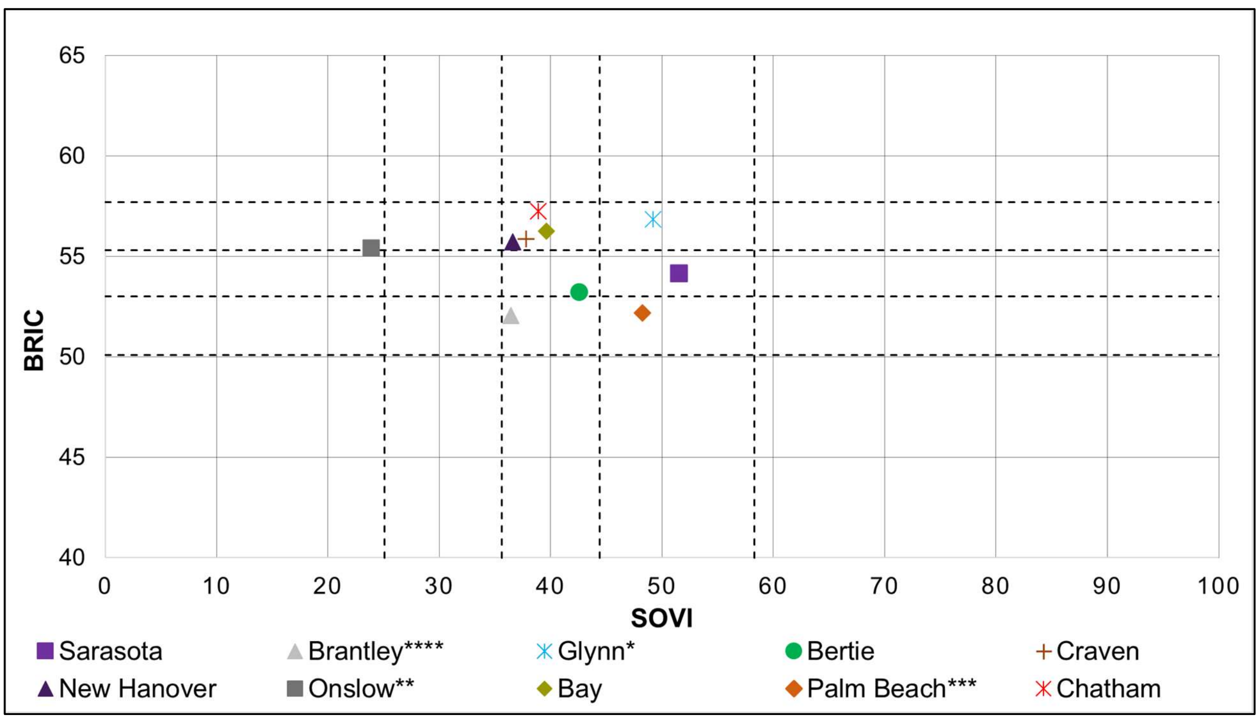
4.4.1 Social Vulnerability, Community Resilience, and Plan Quality Evaluation

Table 4-2 introduces the ten counties by providing each county's state, hazard level, SoVI, and BRIC. Both SoVI and BRIC are categorized by 1-very low, 2-relatively low, 3-relatively moderate, 4-relatively high, 5-very high and ranked amongst all ten counties with 1 being the lowest and 10 being the highest. None of the ten counties have a *very high* SoVI; none of the ten counties have a *very high* nor *very low* BRIC. Figure 4-3 presents the range of BRIC and SoVI for all ten counties. The dashed horizontal lines divide the plot into the five BRIC categories; the dashed vertical lines divide the plot into the five SoVI categories. The range of the x and y axes correspond to the national SoVI and BRIC ranges, respectively. Across these ten counties, Brantley County, GA was identified as having low community resilience (i.e., BRIC) and low social vulnerability (i.e., SoVI); Palm Beach County, FL was identified as having low community resilience and high social vulnerability; Onslow County, NC was identified as having high community resilience and low social vulnerability; Glynn County, GA was identified as having high community resilience and high social vulnerability. These four counties have been given increased attention throughout this chapter in order to assess HMA funding distributions across the quantified range of both social vulnerability and community resilience levels.

Table 4-2: Hazard Level, Social Vulnerability Level, and Community Resilience Level for each County

County	Bay	Palm Beach***	Sarasota	Brantley* ***	Chatham	Glynn*	Bertie	Craven	New Hanover	Onslow**
State	FL	FL	FL	GA	GA	GA	NC	NC	NC	NC
Population Density	230.5	759.8	780.1	43.2	679.4	203.1	27.1	144.1	1221.2	259.4
% Properties at Risk	22.6	6.8	15.7	9	18.1	21.5	6.3	17.3	13.2	9
Proximity to Coast	0.182	0.428	0.146	0.539	0.152	0.170	1.132	0.467	0.088	0.224
SoVI	39.6	48.2	51.6	36.4	38.9	49.2	42.6	37.8	36.6	23.9
SoVI - Category	3[c]	4[d]	4[d]	3[c]	3[c]	4[d]	3[c]	3[c]	3[c]	1[a]
SoVI - Rank	6	8	10	2	5	9	7	4	3	1
BRIC	56.3	52.2	54.2	52.1	57.2	56.9	53.2	55.9	55.7	55.4
BRIC - Category	4[d]	2[b]	3[c]	2[b]	4[d]	4[d]	3[c]	4[d]	4[d]	4[d]
BRIC - Rank	8	2	4	1	10	9	3	7	6	5

*High BRIC – High SoVI
**High BRIC – Low SoVI
***Low BRIC – High SoVI
****Low BRIC – Low SoVI
[a]Very Low
[b]Relatively Low
[c]Relatively Moderate
[d]Relatively High



*High BRIC – High SoVI
**High BRIC – Low SoVI
***Low BRIC – High SoVI
****Low BRIC – Low SoVI

Figure 4-3: Relation Between BRIC and SoVI for each County

Mitigation and recovery plans have been collected, coded, and scored for all ten counties as part of the larger project (Lyles et al., n.d.; Wu et al., n.d.). Although details of this process are not elaborated here, the resulting plan quality scores are used as an important lens. More details about the importance of studying plan quality and details of plan quality evaluation methodologies can be found in Berke et al. (2014b) and Lyles & Stevens (2014), respectively. The corresponding mitigation and recovery plan quality (PQ) scores are presented in Table 4-3 along with the rank amongst all ten counties with 1 being the lowest PQ and 10 being the highest PQ. Bay County, FL and Palm Beach County, FL have drastically lower mitigation PQ scores than any of the other eight counties, yet the two counties are ranked ninth and tenth as it relates to recovery PQ. The only other county in which mitigation and recovery PQ scores change by more than four coded items is Brantley County, GA which is ranked ninth for mitigation PQ and second for recovery PQ out of all ten counties. As such, Bay County, FL and Palm Beach County, FL have been identified as having low mitigation PQ and high recovery PQ while Brantley County, GA has been identified as having high mitigation PQ and low recovery PQ. Chatham County, GA ranked ninth and tenth for mitigation and recovery PQ, respectively, therefore it has been identified as having high mitigation PQ and high recovery PQ. Onslow County, GA ranked fourth and first for mitigation and recovery PQ, respectively, therefore it has been identified as having low mitigation PQ and low recovery PQ. Mitigation and recovery PQ will be considered again when assessing each county’s mitigation budget distribution.

Table 4-3: Mitigation and Recovery Plan Quality for each County

County	Bay***	Palm Beach***	Sarasota	Brantley **	Chatham *	Glynn	Bertie	Craven	New Hanover*	Onslow ****
State	FL	FL	FL	GA	GA	GA	NC	NC	NC	NC
Mitigation PQ	5	1	11	19	19	15	18	17	20	11
Mitigation PQ - Rank	2	1	4	9	9	5	7	6	10	4
Recovery PQ	19	23	15	13	18	15	15	14	17	8
Recovery PQ - Rank	9	10	6	2	8	6	6	3	7	1

*High Mitigation PQ – High Recovery PQ
**High Mitigation PQ – Low Recovery PQ
***Low Mitigation PQ – High Recovery PQ
****Low Mitigation PQ – Low Recovery PQ

4.4.2 Assessment of Mitigation Budget Distribution

4.4.2.1 Bay County, FL

Low Mitigation PQ – High Recovery PQ

Table 4-4: Bay County, FL – HMA Funding Distribution

Acquisition & Elevation	$3,443,141.23	29.79%
Development Regulation	$127,217.53	1.10%
Emergency Management	$83,302.11	0.72%
Property Protection	$3,308,590.97	28.62%
Structural Controls	$2,479,520.70	21.45%
Multiple Actions	$2,118,112.09	18.32%
Total Amount	$11,559,884.63	
Total Amount per Capita	$66.17	

Bay County has a *relatively moderate* SoVI and a *relatively high* BRIC (ranked 3rd highest); it has low mitigation PQ but high recovery PQ; it is a coastal county and has the highest percentage of properties at risk (22.6%) out of all ten counties implying high relative hazard level. In contrast to Florida as a whole, as shown in Table 4-4 Bay County allocated the largest percentage of HMA funding to acquisition & elevation projects (29.79%); as shown in A6 of the Appendix, this funding was granted for private and public land acquisition projects and private building elevations. Likely due to the county's high hazard level, substantial percentages of HMA funding have been allocated to property protection (28.62%) and structural control

(21.45%) projects that strengthen buildings and infrastructure and resist floods. Two projects were approved that included multiple actions, as shown in A6 of the Appendix the larger of which consisted of acquisition of public and vacant land, storm water management (culverts and diversions), and “other major structural control projects” for a subdivision. Little HMA funding (1.10% and 0.72%, respectively) was allocated to development regulation and emergency management projects. Considering Bay County’s increased funding allocation to acquisition & elevation compared to Florida as a whole, and its minimal funding allocation to development regulation and emergency management, the *relatively high* BRIC corresponds well to mitigation spending. Additionally, the county’s mitigation strategy is a good example for counties with high hazard levels.

4.4.2.2 Palm Beach County, FL

Low BRIC – High SoVI
Low Mitigation PQ – High Recovery PQ

Table 4-5: Palm Beach County, FL – HMA Funding Distribution

Acquisition & Elevation	$0.00	0.00%
Development Regulation	$257,735.26	0.45%
Emergency Management	$1,700,266.30	2.99%
Property Protection	$37,740,816.71	66.28%
Structural Controls	$16,057,454.14	28.20%
Multiple Actions	$1,181,242.34	2.07%
Total Amount	$56,937,514.76	
Total Amount per Capita	$38.04	

Palm Beach County has a *relatively high* SoVI (ranked 3rd highest) and *relatively low* BRIC (ranked 2nd lowest); it has low mitigation PQ but high recovery PQ; it is a coastal county but has the second lowest percent of properties at risk implying low relative hazard level. As shown in Table 4-5, Palm Beach County allocated the largest percentage of HMA funding to property protection projects (66.28%) surpassing the Florida state average by approximately 28%. As shown in A7 of the Appendix, the majority of property protection projects involved wind retrofit of public structures eliminating the possibility of funds being allocated towards property protection projects to support socially vulnerable individuals that lack quality insurance. The second largest percentage of HMA funding was allocated to structural control projects (28.20%) that largely consisted of storm water management projects to provide adequate drainage and reduce the risk of severe flooding. One acquisition of private property project was approved as a part of a multiple action project that also included storm water management. The low emphasis on land acquisition is possibly due to the low mitigation PQ and/or the relatively low percent of properties in an SFHA. As it relates to mitigation spending the *relatively low* BRIC seems appropriate considering that a disproportionate amount of funding is being granted towards retrofitting public structures. Palm Beach County's mitigation strategy is not an ideal example for socially vulnerable counties; although public retrofits can assist with reducing incurred disaster damages at the county level, these types of projects do not move development away from high-risk areas and thus engage in long-term risk reduction nor do these types of projects reduce disaster risk for socially vulnerable individuals directly.

4.4.2.3 Sarasota County, FL

Table 4-6: Sarasota County, FL – HMA Funding Distribution

Acquisition & Elevation	$985,475.37	13.61%
Development Regulation	$0.00	0.00%
Emergency Management	$3,143,242.00	43.42%
Property Protection	$911,403.46	12.59%
Structural Controls	$950,328.73	13.13%
Multiple Actions	$1,248,362.47	17.25%
Total Amount	$7,238,812.03	
Total Amount per Capita	$16.69	

Sarasota County has the highest SoVI out of all ten counties and a *relatively moderate* BRIC; it has mitigation PQ and recovery PQ scores around the 10-county median for each (ranked 4th and 6th, respectively); it is a coastal county with 15.7% of properties at risk. As shown in Table 4-6, Sarasota County allocated the largest percentage of HMA funding to emergency management projects (43.42%). As shown in A8 of the Appendix, all of these emergency management projects included the purchase and installation of generators which do not reduce long-term disaster risk. As shown in A8 of the Appendix, although 13.61% of HMA funding was allocated to acquisition & elevation projects, all projects involved the elevation of private structures implying that development has not moved away from high-risk areas. As such, the *relatively moderate* BRIC does not align with the county's mitigation strategy; it seems as though Sarasota County has not taken enough initiative to increase capacity to prepare for and respond to future disaster events. These observations demonstrate that Sarasota County's mitigation strategy is a poor example for socially vulnerable counties.

4.4.2.4 Brantley County, GA

Low BRIC – Low SoVI
High Mitigation PQ – Low Recovery PQ

Table 4-7: Brantley County, GA – HMA Funding Distribution

Acquisition & Elevation	$0.00	0.00%
Development Regulation	$12,222.11	39.46%
Emergency Management	$18,750.00	60.54%
Property Protection	$0.00	0.00%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$30,972.11	
Total Amount per Capita	$1.62	

Brantley County has a *relatively moderate* SoVI (ranked 2nd lowest) and the lowest BRIC out of all ten counties; it has high mitigation PQ and low recovery PQ; it is not a coastal county and only has 9% of properties at risk implying a low relative hazard level. As shown in Table 4-7, Brantley County allocated all HMA funding to emergency management (60.54%) and development regulation projects (39.46%) and received the lowest HMA funding per capita amount of only $1.62 ($8.79 is next lowest HMA funding per capita amount in 10-county sample). As shown in A9 of the Appendix, only two mitigation projects were approved, warning systems and a mitigation plan update; Brantley County received no HMA funding for projects that assisted in reducing long-term disaster risk. Considering that Brantley County has the second highest mitigation PQ and that one of the only mitigation projects approved was a mitigation plan update, the county likely updated the mitigation plan thus improving its mitigation PQ but only so that it could be eligible for certain types of funding as stipulated by the DMA of 2000. Overall, Brantley County holding the lowest BRIC is very appropriate and the county's mitigation strategy is one of the poorest out of all ten counties assessed.

4.4.2.5 Chatham County, GA

High Mitigation PQ – High Recovery PQ

Table 4-8: Chatham County, GA – HMA Funding Distribution

Acquisition & Elevation	$18,883,038.66	80.40%
Development Regulation	$103,660.91	0.44%
Emergency Management	$0.00	0.00%
Property Protection	$0.00	0.00%
Structural Controls	$4,500,983.46	19.16%
Multiple Actions	$0.00	0.00%
Total Amount	$23,487,683.02	
Total Amount per Capita	$81.15	

Chatham County, GA has a *relatively moderate* SoVI and the highest BRIC out of all ten counties; it has high mitigation and recovery PQ ranking 9th and 8th, respectively; it is a coastal county and has 18.1% of properties at risk. As shown in Table 4-8, Chatham County allocated the majority of HMA funding to acquisition & elevation projects (80.4%). As shown in A10 of the Appendix, fifteen of the eighteen acquisition & elevation projects were acquisitions of private real property implying that the county made efforts to move development away from high-risk areas and thus engaging in long-term risk reduction. The county's emphasis on land acquisition could be due to its high mitigation PQ. In contrast to Brantley County, GA, Chatham County seems to be making good use of its mitigation plans rather than simply going through the motions to secure funding. Chatham County received no HMA funding for property protection projects which means no actions were taken towards strengthening existing structures; but this was a trend in Georgia with no HMA funding being allocated to property protection across the state. As it relates to mitigation, Chatham County having the highest BRIC seems appropriate and its mitigation strategy is a good example, particularly for counties in Georgia.

4.4.2.6 Glynn County, GA

High BRIC – High SoVI

Table 4-9: Glynn County, GA – HMA Funding Distribution

Acquisition & Elevation	$0.00	0.00%
Development Regulation	$24,501.44	3.27%
Emergency Management	$725,002.00	96.73%
Property Protection	$0.00	0.00%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$749,503.44	
Total Amount per Capita	$8.79	

Glynn County, GA has the second highest SoVI and BRIC out of all ten counties; it has mitigation PQ and recovery PQ scores around the 10-county median (ranked 5th and 6th, respectively); it is a coastal county with the second highest percentage of properties at risk (21.5%) implying high relative hazard level. As shown in Table 4-9, Glynn County allocated nearly all HMA funding to emergency management projects (96.73%) and had the second lowest HMA funding per capita (behind only Brantley County, GA). Glynn County not only received an insufficient amount of HMA funding, but even what was received was largely allocated to a portable generator application as shown in A11 of the Appendix that did nothing to reduce long-term disaster risk. As seen in the results of Chapter 3, counties with a higher

SoVI received more HMA funding for emergency management projects; Glynn County is an example of a county with a *relatively high* SoVI that received substantial emergency management funding. As it relates to mitigation, Glynn County's *relatively high* BRIC seems puzzling; the county must either have strong institutional capital indicators besides mitigation spending and/or strong indicators in the other capitals of resilience (social, economic, community, housing/infrastructure, and environmental) as identified by Cutter et al. (2014). Nonetheless, Glynn County's mitigation strategy is a poor example for socially vulnerable counties, substantial amounts of HMA funding need to be allocated towards mitigation projects other than emergency management.

4.4.2.7 Bertie County, NC

Table 4-10: Bertie County, NC – HMA Funding Distribution

Acquisition & Elevation	$6,331,090.44	100.00%
Development Regulation	$0.00	0.00%
Emergency Management	$0.00	0.00%
Property Protection	$0.00	0.00%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$6,331,090.44	
Total Amount per Capita	$334.15	

Bertie County, NC has a *relatively moderate* SoVI and BRIC; it has mitigation and recovery PQ scores around the 10-county median (ranked 7th and 6th, respectively); it is a coastal county but has the lowest percentage of properties at risk implying low relative hazard level. The state planning context in North Carolina is heavily oriented towards acquisition & elevation projects as is represented in the mitigation strategies of all four North Carolina counties assessed. However, Bertie County is the only county out of the four that allocated 100% of HMA funding to acquisition & elevation projects as shown in Table 4-10. As shown in

A12 of the Appendix, this funding went towards four total projects that included the acquisition of 41 residential structures and the elevation of 13 residential structures. Although land acquisition has been proven to be most beneficial in combatting future disaster losses, it is cause for concern to allocate no HMA funding to property protection projects that strengthen existing buildings nor structural control projects that provide adequate drainage to reduce flood risk. As such, Bertie County having the lowest BRIC out of the four North Carolina counties assessed seems to align with the county's mitigation approach.

4.4.2.8 Craven County, NC

Table 4-11: Craven County, NC – HMA Funding Distribution

Acquisition & Elevation	$6,723,359.42	95.49%
Development Regulation	$147,400.10	2.09%
Emergency Management	$0.00	0.00%
Property Protection	$169,830.34	2.41%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$7,040,589.86	
Total Amount per Capita	$68.93	

Craven County, NC has a *relatively moderate* SoVI and a *relatively high* BRIC; it has mitigation and recovery PQ scores around the 10-county median (ranked 6th and 3rd, respectively); it is a coastal county with 17.3% of properties at risk. As shown in Table 4-11, like all North Carolina counties assessed, Craven County allocated the majority of HMA funding to acquisition & elevation projects (95.49%). As shown in A13 of the Appendix, this funding went towards nine elevation of private structures projects and three acquisition of private property projects; other than acquisition & elevation, there were two projects approved for development regulation that consisted of an update and an adoption of mitigation plans and there were two property protection projects that both consisted of retrofitting public structures. Considering North Carolina's planning context, the mitigation strategy in Craven County is to be expected and as it relates to mitigation spending its *relatively high* BRIC seems appropriate.

4.4.2.9 New Hanover County, NC

High Mitigation PQ – High Recovery PQ

Table 4-12: New Hanover County, NC – HMA Funding Distribution

Acquisition & Elevation	$5,738,595.87	99.58%
Development Regulation	$21,299.93	0.37%
Emergency Management	$0.00	0.00%
Property Protection	$3,138.85	0.05%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$5,763,034.64	
Total Amount per Capita	$24.58	

New Hanover County, NC has a *relatively moderate* SoVI and a *relatively high* BRIC; it has the highest mitigation PQ out of the ten counties assessed and is ranked 7th in recovery PQ; it is a coastal county with 13.2% of properties at risk. As shown in Table 4-12, the majority of HMA funding was allocated to acquisition & elevation projects (99.58%). As shown in A14 of the Appendix, this funding went towards one acquisition of private property project that consisted of the acquisition of 11 residential properties and seven elevation of private structures projects; other than acquisition & elevation, there was a project approved for development regulation that consisted of a mitigation plan adoption and a project approved for property protection that consisted of a residential reconstruction. The high mitigation PQ is not expressed in New Hanover County's mitigation strategy when considering how similar it is to the other three North Carolina counties. Nonetheless, similar to Craven County, NC, New Hanover County's *relatively high* BRIC seems appropriate as it relates to mitigation spending.

4.4.2.10 Onslow County, NC

High BRIC – Low SoVI
Low Mitigation PQ – Low Recovery PQ

Table 4-13: Onslow County, NC – HMA Funding Distribution

Acquisition & Elevation	$2,435,548.95	97.50%
Development Regulation	$0.00	0.00%
Emergency Management	$62,504.72	2.50%
Property Protection	$0.00	0.00%
Structural Controls	$0.00	0.00%
Multiple Actions	$0.00	0.00%
Total Amount	$2,498,053.67	
Total Amount per Capita	$12.62	

Onslow County, NC has the lowest SoVI out of the ten counties assessed and the only county that has a *very low* SoVI; it has a *relatively high* BRIC; it has low mitigation and recovery PQ ranking 4th and 1st, respectively; it is a coastal county and has 9% of properties at risk. As shown in Table 4-13, the majority of HMA funding was allocated to acquisition & elevation projects (97.5%). As shown in A15 of the Appendix, two acquisition of private property projects were approved that consisted of the acquisition of 16 multifamily residential units and the acquisition of 6 residential properties. The remaining HMA funding was allocated to a generator project. Onslow County was the only North Carolina county assessed that allocated no funding for the elevation of private structures. Considering the county's low social vulnerability, residents are more likely to have access to quality insurance to cover costs of flood damage and therefore less of a need for private elevation projects. Additionally, the greater access to resources could possibly be the reason for the low mitigation and recovery PQ scores considering that the county has increased financial capacity to prepare for and recover from a disaster event. The county's mitigation strategy is similar to the other three North Carolina counties with less total HMA funding and less total HMA funding per capita being spent likely due to the low social vulnerability; this is supported by the regression results from Chapter 3 with SoVI having a positive relationship to total HMA funding. As such, the *relatively high* BRIC is likely influenced more by economic, housing/infrastructure, and community capitals of resilience as compared to institutional.

4.5 Discussion

Based on the 10-county sample assessment, both good and bad examples of mitigation expensing are critiqued in this section for socially vulnerable counties and counties with high hazard levels; general observations as it relates to all counties are also provided.

4.5.1 Socially Vulnerable Counties

The three counties with the highest SoVI were Sarasota County, FL, Glynn County, GA, and Palm Beach County, FL. None of these three counties demonstrated an ideal approach to mitigation. Although Glynn County had the highest BRIC out of the three, it had the worst mitigation strategy of the three and arguably the worst mitigation strategy out of the entire 10-county sample considering the low HMA funding per capita and the absence of HMA funding allocated to projects that intend to reduce long-term disaster risk. The fact that Sarasota County received substantially greater amounts of HMA funding for emergency management showcases an inadequate approach to mitigation that prioritizes long-term risk reduction. Palm Beach County unlike Glynn and Sarasota did not allocate the most HMA funding to emergency management projects and instead emphasized property protection and structural controls. Palm Beach County's mitigation strategy, certainly far from being ideal, does demonstrate some components of a good mitigation strategy for socially vulnerable communities. Retrofitting of public structures does reduce future disaster-related financial impacts at the county-level; stormwater management projects affect socially vulnerable households by reducing risk of severe flooding and therefore protecting private property in socially vulnerable communities that are often located in higher risk areas.

Although it was not seen in the mitigation strategy of any of these three socially vulnerable counties, a substantial amount of HMA funding must be allocated to acquisition of private property and elevation of private structures to both move development away from high-risk areas and protect private property from flood damage. Reflecting on the results of Chapter 3 which identified that SoVI had a negative relationship to acquisition & elevation funding, federal funding distribution must change in order to advance community resilience within socially vulnerable communities that are most at risk to the devastating impacts of a disaster event.

4.5.2 Counties with High Hazard Levels

Bay County, FL was deemed as the county with the highest hazard level within the 10-county sample considering it is a coastal county with the highest percentages of properties at risk. The county's mitigation strategy was the most diverse out of all ten counties with acquisition & elevation, property protection, and structural controls being granted over 20% of total HMA funding. Counties with high hazard levels often cannot simply move development away from high-risk areas considering the financial advantages of developing desirable coastal land. As a result, efforts must be pursued to strengthen existing structures and protect property from coastal flooding and wind damage. This can be seen in Bay County's mitigation strategy with approximately 50% of HMA funding being allocated to property protection and structural control projects. Additionally, Bay County complemented these efforts by taking initiative to move development away from high-risk areas through the elevation of private property and the acquisition of both public and private property.

Counties with high hazard levels can look to Bay County's mitigation strategy for recommendations on how best to reduce long-term risk reduction and advance disaster resilience.

4.5.3 General Observations

Local mitigation strategies are influenced by the planning context of the state. For example, counties in Florida are more likely to be awarded funding for property protection and structural control projects than counties in Georgia or North Carolina. Nonetheless, a county need not be entirely constrained within the statewide planning context but should rather orient itself towards applying for projects that will advance community resilience at the local level based on county characteristics.

Counties should make efforts to improve the quality of mitigation and recovery plans so that the plans not only provide detailed descriptions of mitigation strategies but also detail the procedural actions necessary for the implementation and enforcement of the contents of the plan. With that being said, substantial amounts of HMA funding should not be directed towards simply adopting and/or updating mitigation plans as seen in Brantley County, GA which allocated over 60% of HMA funding to updating mitigation plans; HMA funding directed towards development regulation should be kept at least below 5% as seen in all other counties in the sample considering the lower cost compared to projects included in the other four mitigation actions.

Emergency management projects do not reduce long-term risk but rather assist during the short-term preparedness and response stages of the disaster cycle. Therefore, counties should not be allocating substantial amounts of HMA funding to emergency management but should redirect funding applications toward acquisition & elevation, property protection, and structural control projects that do engage in long-term risk reduction and contribute to advancements in community resilience during the long-term stage of mitigation. Bay County, FL, Chatham County, GA, and Craven County, NC each showcased a good mitigation strategy in each of the three states, all allocating less than 1% of HMA funding to emergency management.

Chapter 5: Conclusions

There were two major goals for this project: (a) evaluate how social vulnerability influences access to federal disaster funding while pinpointing specific examples of inequity, and (b) identify good mitigation strategies by investigating how different localities with varying social vulnerability, hazard level, and mitigation and recovery plan quality allocate mitigation funding and how mitigation expensing in these localities affect community resilience. In support of the first goal, the analyses presented in this thesis demonstrate that socially vulnerable counties do indeed have different access to FEMA HMA, PA, and IHP funding with examples of equity and inequity being identified in the regression analyses of Chapter 3. In support of the second goal, counties that showcased the best mitigation strategies emphasized land acquisition, private elevation of structures, building retrofit, and/or stormwater management projects over generators, warning systems, and/or mitigation plan updates as discussed in Chapter 4.

To further strengthen the applicability of these results, a correlation analysis should be completed between the social vulnerability variables of the regression models and county population size. This would eliminate any potential statistical bias as it relates to varying county population sizes across Florida, Georgia, and North Carolina.

The inequities identified in the regression analyses of Chapter 3 and the transparent inequities seen at the local level in the 10-county sample of Chapter 4 reveal the necessity of incorporating social vulnerability into federal disaster-related funding application and distribution processes. FEMA needs to implement strategies to incentivize non-structural mitigation approaches in communities with lower financial capital that prioritize the benefits of immediate disaster relief and recovery funding (i.e., PA funding) over the long-term and uncertain benefits of mitigation. One such way could be increasing the typical federal share of 75% to 90% for non-structural mitigation projects in socially vulnerable communities. Prompted by the Consolidated Appropriations Act, FEMA recently increased the federal share for select HMA, PA, and IHP projects to a minimum of 90% for any emergency or major disaster declaration from January 1st, 2020, to December 31st, 2021 (FEMA, n.d.-k). Additionally, the Swift Current Initiative has prioritized funding distribution to disadvantaged communities (FEMA, n.d.-l). Further research could pinpoint how best to incorporate social vulnerability into federal disaster-related funding application and distribution processes to advance community resilience and foster equity, including through recovery funding that provides better coverage for renters and considers recovery capacity of the individual or household relative to the total assessed damage.

Future research can investigate why counties in Georgia have not received HMA funding allocated to property protection; high hazard level counties in Georgia could greatly benefit from the strengthening of both public and private structures and infrastructure. These investigations could look into whether property protection is mentioned in mitigation plans across the state and/or whether counties are applying for property protection funding and being rejected or not applying for property protection funding at all. In order to do the latter, FEMA would need to publish all submitted HMA applications. When categorizing each mitigation project into its corresponding mitigation action, extensive efforts were conducted to access original FEMA HMA applications that detail the amount of funding proportioned for each component of the project. The efforts included contacting local officials and submitting a Freedom of Information Act (FOIA) request; these efforts were widely unsuccessful. A greater level of transparency is needed within FEMA's application process in order to identify the roots of problems relating to unequal access to federal disaster funding. Such data is critical for in-depth analysis and pinpointing root causes for inequities and identifying best ways forward.

One of the most concerning findings of this study was that homeowners in socially vulnerable communities, in particular those with higher proportions of Black-African American residents, were more likely to receive an inadequate amount of IHP funding than what was assessed by FEMA during inspection. Further research should investigate the cause of this inequity by reviewing documents used to assess damage ensuring appropriate application across a range of properties with differing financial values and examining how the decision to allocate the amount of IHP funding is made.

Across the 10-county sample, certain counties demonstrated signs of good mitigation strategies, but others partly due to low HMA funding receipts have not taken the initiative to engage in long-term risk reduction. One county in each of the three states demonstrated a good mitigation strategy within the state planning context: Bay County, FL, Chatham County, GA, and Craven County, NC. In particular, Bay County, FL demonstrated a good mitigation strategy for counties with high hazard levels. High hazard level areas often have desirable developmental potential especially when located near the coastline. Considering the potential financial advantages, communities cannot simply move development entirely away from these areas. Rather, the community needs to take a balanced approach that includes regulating development while also strengthening existing structures and infrastructure. This can be seen in Bay County's mitigation approach in that the county allocated the largest HMA funding amount to acquisition & elevation that consisted of private and public land acquisition projects and private building elevations; approximately 50% of HMA funding was allocated to property protection and structural control projects to protect existing structures and infrastructure; minimal HMA funding was allocated to development regulation and emergency management. For counties with high hazard levels, as seen in Bay County, a diversified mitigation approach is key to take advantage of financial incentives of coastal development while also advancing community resilience.

Results of the 10-county sample analysis showed that many counties allocated a substantial portion of HMA funding to emergency management projects that do not reduce long-term disaster risk. A recommendation for FEMA is to separate emergency management funding from HMA, particularly from HMGP which was the program that granted the most funds in this study, as emergency management projects do not reduce long-term disaster risk which is the purpose of the mitigation stage of the disaster cycle. Instead, emergency management funding should be categorized with preparedness and response efforts.

In Brantley County, GA which was tied for the highest mitigation PQ score, it was identified that high mitigation PQ does not directly result in ideal mitigation expensing. Brantley County received the least HMA funding per capita out of all counties in the sample and allocated all funding to emergency management and development regulation. The large percentage of funding to development regulation implies that the county prioritized improving mitigation plans but not ensuring that the actions in the plans are actually being implemented. This finding is further supported by the results of Chapter 4 as it relates to all counties in the sample; counties with a lower BRIC allocated greater percentages of HMA funding to development regulation. FEMA should restructure post-disaster funding application requirements so that counties need to be not only implementing and updating mitigation plans but also ensuring that what is described in the plans is being put into action.

Throughout this study, the BRIC rating was used as a general proxy for community resilience. Future research, as it relates to the relationship between mitigation expensing and community resilience, could look to utilize only the institutional capital index of the BRIC to better understand how mitigation expensing contributes to advancements in community resilience.

The results of this study identify overarching issues and accomplishments within federal funding distribution and local mitigation expensing and should serve to inform local decision makers in their efforts to advance community resilience by pursuing meaningful mitigation projects that engage in long-term risk reduction.

Appendix

A1 – Population Density and Hazard Level for All Counties in Florida, Georgia, and North Carolina

State	*County*	*Percent Properties at Risk*	*Proximity to Coast (deg. latitude)*	*Population Density (people / sq. mile)*	*Total Rain - Matthew (in)*	*Total Rain - Irma (in)*	*Total Rain - Michael (in)*	*Total Rain - Florence (in)*
FL	Alachua	6.3	0.69	307.48	0	12.4	0	0
FL	Baker	9.5	0.87	49.93	0	12.2	0	0
FL	Bay	22.6	0.18	230.48	0	1.7	11.62	0
FL	Bradford	19.5	0.84	95.92	4.1	11.74	0	0
FL	Brevard	11.2	0.12	592.46	17.01	12.87	0	0
FL	Broward	20.8	0.38	1613.87	1.61	10.81	0	0
FL	Calhoun	19.2	0.51	24.88	0	2.3	6.7	0
FL	Charlotte	49.1	0.38	277.81	0	6.3	0	0
FL	Citrus	14.5	0.21	257.14	0	8.52	0	0
FL	Clay	7.3	0.53	363.00	10.55	11.32	0	0
FL	Collier	76.2	0.31	192.64	0	14.48	0	0
FL	Columbia	11.6	0.97	89.83	0	9.8	0	0
FL	DeSoto	15.7	0.60	59.66	0	11.34	0	0
FL	Dixie	45.5	0.19	23.87	0	4.9	0	0
FL	Duval	5.5	0.27	1256.90	13.02	11.04	0	0
FL	Escambia	7.7	0.35	485.24	0	0	0	0
FL	Flagler	8.7	0.18	237.28	6.52	9.1	0	0
FL	Franklin	65.4	0.10	22.66	0	2.75	4.2	0
FL	Gadsden	4.7	0.61	88.49	0	2.3	4.07	0
FL	Gilchrist	17.6	0.52	53.09	0	7.6	0	0
FL	Glades	14.5	0.89	17.14	0	7.7	0	0
FL	Gulf	50.1	0.15	24.18	0	1.6	4.3	0
FL	Hamilton	23.7	0.92	27.72	0	7.7	0	0
FL	Hardee	8.4	0.67	42.22	0	10.58	0	0
FL	Hendry	18.0	0.71	36.45	0	10.31	0	0
FL	Hernando	9.8	0.23	409.98	0	7.36	0	0
FL	Highlands	6.3	1.03	104.45	0	9.42	0	0
FL	Hillsborough	14.9	0.10	1443.11	0	7.32	0	0
FL	Holmes	20.5	0.62	40.95	0	1.7	6.8	0
FL	Indian River	23.0	0.22	317.94	4.53	10	0	0
FL	Jackson	6.3	0.83	50.56	0	2.4	10.82	0
FL	Jefferson	14.4	0.36	23.82	0	1.8	3	0
FL	Lafayette	43.2	0.40	15.51	0	4.31	0	0
FL	Lake	9.5	0.84	391.38	6.27	11.03	0	0
FL	Lee	33.0	0.17	981.63	0	10.07	0	0
FL	Leon	5.6	0.37	440.15	0	2.2	3.79	0

FL	Levy	15.9	0.18	37.12	0	7.92	0	0
FL	Liberty	21.0	0.45	9.99	0	2.4	5.95	0
FL	Madison	20.8	0.56	26.57	0	2.3	2.5	0
FL	Manatee	23.8	0.29	542.74	0	7.25	0	0
FL	Marion	5.9	0.70	230.65	0	10.12	0	0
FL	Martin	8.1	0.29	296.50	2.45	10.53	0	0
FL	Miami-Dade	45.3	0.25	1431.48	0	9.16	0	0
FL	Monroe	92.2	0.04	75.51	0	12.54	0	0
FL	Nassau	14.2	0.36	136.56	9.51	12.7	0	0
FL	Okaloosa	7.2	0.30	226.60	0	0.7	2.2	0
FL	Okeechobee	32.5	0.59	54.83	0	12.4	0	0
FL	Orange	5.0	0.65	1543.14	6.14	17.44	0	0
FL	Osceola	15.9	0.57	283.16	3.9	12	0	0
FL	Palm Beach	6.8	0.43	759.78	2.38	9.24	0	0
FL	Pasco	23.6	0.31	741.56	0	8.67	0	0
FL	Pinellas	27.2	0.02	3558.38	0	7.74	0	0
FL	Polk	12.2	0.70	403.10	0	11	0	0
FL	Putnam	11.9	0.52	102.36	9.96	11.51	0	0
FL	Santa Rosa	11.3	0.46	182.13	0	0.5	0	0
FL	Sarasota	15.7	0.15	780.11	0	10.81	0	0
FL	Seminole	5.9	0.20	1526.94	8.99	12.46	0	0
FL	St. Johns	15.8	0.34	440.39	13.6	13.7	0	0
FL	St. Lucie	5.2	0.15	573.95	3.92	15.88	0	0
FL	Sumter	5.9	0.58	242.08	0	10.59	0	0
FL	Suwannee	16.1	0.68	64.47	0	6.9	0	0
FL	Taylor	42.1	0.15	20.68	0	2.2	2.2	0
FL	Union	10.1	1.00	62.45	0	9.62	0	0
FL	Volusia	15.7	0.23	502.53	7.98	10.03	0	0
FL	Wakulla	34.4	0.15	55.67	0	2.2	4.1	0
FL	Walton	16.7	0.30	71.36	0	0.8	3.57	0
FL	Washington	8.2	0.45	43.69	0	2.09	11.1	0
GA	Appling	9.3	1.05	36.26	0	6.6	1.25	0
GA	Atkinson	4.7	1.43	24.09	0	6.5	1.3	0
GA	Bacon	2.4	1.12	43.10	0	7.4	1.4	0
GA	Baker	15.3	1.26	5.19	0	2.5	4.01	0
GA	Baldwin	2.2	2.46	173.99	0	3.6	0	0
GA	Banks	1.4	3.35	82.91	0	2.3	0	0
GA	Barrow	2.2	3.34	520.25	0	2.9	0	0
GA	Bartow	2.1	4.13	234.21	0	0	0	0
GA	Ben Hill	3.7	1.84	66.80	0	4.8	2.7	0
GA	Berrien	6.3	1.41	42.91	0	4.7	1.8	0
GA	Bibb	1.4	2.72	612.64	0	4.6	0	0
GA	Bleckley	2.3	2.25	59.60	0	5.4	6.3	0

GA	Brantley	9.0	0.54	43.23	6.29	10.34	0	0
GA	Brooks	4.2	0.86	31.35	0	2.7	1.8	0
GA	Bryan	16.9	0.38	90.89	11.09	6.66	0	0
GA	Bulloch	6.5	0.87	118.29	7.13	4.7	2.5	0
GA	Burke	2.4	1.39	27.07	0	6.2	2.4	0
GA	Butts	4.3	3.18	135.52	0	3.9	0	0
GA	Calhoun	8.5	1.49	22.10	0	0	6.3	0
GA	Camden	16.9	0.19	89.18	8.5	13.44	0	0
GA	Candler	4.5	1.11	44.46	5.52	6.1	2.2	0
GA	Carroll	2.2	3.43	240.46	0	6.7	0	0
GA	Catoosa	5.7	4.69	417.16	0	0	0	0
GA	Charlton	6.1	0.68	17.30	0	9.85	0	0
GA	Chatham	18.1	0.15	679.41	13.86	5.03	0	0
GA	Chattahoochee	1.4	2.33	43.80	0	4.1	5.4	0
GA	Chattooga	4.8	4.22	79.20	0	0	0	0
GA	Cherokee	0.8	4.13	613.21	0	2.3	0	0
GA	Clarke	1.7	3.02	1078.41	0	2.8	0	0
GA	Clay	1.1	1.67	14.53	0	3.3	6.7	0
GA	Clayton	1.6	3.45	2058.14	0	4.5	0	0
GA	Clinch	20.6	1.22	8.27	0	8.5	0	0
GA	Cobb	2.2	3.87	2235.71	0	4.4	0	0
GA	Coffee	3.4	1.48	75.26	0	5.1	1.9	0
GA	Colquitt	4.5	1.11	83.82	0	2.4	2.52	0
GA	Columbia	1.0	1.88	540.39	0	4.6	0	0
GA	Cook	15.1	1.21	76.08	0	3.3	2.05	0
GA	Coweta	1.2	3.31	336.76	0	5.1	0	0
GA	Crawford	1.2	2.61	38.17	0	4.1	5.2	0
GA	Crisp	9.3	1.84	81.95	0	3.1	4.59	0
GA	Dade	3.2	4.56	92.62	0	0	0	0
GA	Dawson	1.0	3.96	123.73	0	2.5	0	0
GA	De Kalb	6.5	0.86	2833.20	0	3.4	0	0
GA	Decatur	2.2	3.66	44.23	0	2.6	3.42	0
GA	Dodge	2.0	2.01	41.54	0	4.9	4.1	0
GA	Dooly	5.6	2.07	34.16	0	4.7	5.65	0
GA	Dougherty	14.1	1.43	267.34	0	3.1	4.26	0
GA	Douglas	1.4	3.65	731.72	0	4.3	0	0
GA	Early	5.2	1.40	19.86	0	3.3	5.07	0
GA	Echols	4.2	1.11	9.65	0	7.5	0.8	0
GA	Effingham	6.5	0.54	134.51	11.23	7.86	0	0
GA	Elbert	0.6	2.69	10.37	0	2.3	0	0
GA	Emanuel	3.2	1.41	33.25	4.69	5.4	3.6	0
GA	Evans	6.6	0.82	58.22	6.25	5.1	2.6	0
GA	Fannin	5.0	4.32	67.67	0	0	0	0

GA	Fayette	3.0	3.33	589.80	0	4.5	0	0
GA	Floyd	5.2	4.05	193.13	0	0	0	0
GA	Forsyth	0.9	3.81	1090.41	0	2.8	0	0
GA	Franklin	0.5	3.15	89.12	0	2.2	0	0
GA	Fulton	1.5	3.70	2018.86	0	4.4	0	0
GA	Gilmer	4.0	4.33	73.46	0	2.6	0	0
GA	Glascock	1.5	2.01	20.63	0	3.7	4.1	0
GA	Glynn	21.5	0.17	203.08	10.29	11.65	0	0
GA	Gordon	5.8	4.37	162.82	0	3.3	0	0
GA	Grady	2.7	0.79	54.14	0	2.1	3	0
GA	Greene	0.5	2.66	47.35	0	3.4	0	0
GA	Gwinnett	1.4	3.60	2177.33	0	3.3	0	0
GA	Habersham	1.4	3.55	163.64	0	1.9	0	0
GA	Hall	0.8	3.60	520.21	0	2.6	0	0
GA	Hancock	2.3	2.38	17.92	0	4.7	3.15	0
GA	Haralson	1.3	3.60	105.65	0	5.2	0	0
GA	Harris	1.9	2.69	75.94	0	3.1	0	0
GA	Hart	0.4	2.94	112.95	0	2.2	0	0
GA	Heard	2.1	3.14	40.28	0	0	0	0
GA	Henry	1.6	3.35	728.45	0	4.6	0	0
GA	Houston	2.1	2.38	419.85	0	5.8	4.08	0
GA	Irwin	3.6	1.67	26.60	0	4.2	2.4	0
GA	Jackson	1.0	3.29	214.64	0	2.8	0	0
GA	Jasper	2.0	2.96	38.64	0	3.8	0	0
GA	Jeff Davis	3.6	1.40	45.66	0	0	1.7	0
GA	Jefferson	2.0	1.76	29.21	0	5.2	3.43	0
GA	Jenkins	9.1	1.24	25.00	5.2	4.4	3.1	0
GA	Johnson	1.5	1.76	31.83	0	5.1	5.6	0
GA	Jones	1.9	2.70	72.93	0	4.1	4.7	0
GA	Lamar	1.4	2.97	103.68	0	4.5	0	0
GA	Lanier	4.7	1.28	56.34	0	6.1	0	0
GA	Laurens	2.1	1.88	58.92	0	5.5	2.71	0
GA	Lee	3.9	1.67	84.25	0	3.9	6	0
GA	Liberty	14.6	0.32	125.38	12	6.63	0	0
GA	Lincoln	0.2	2.18	37.72	0	2.9	0	0
GA	Long	8.1	0.53	48.90	6.1	7.65	0	0
GA	Lowndes	2.6	1.00	236.71	0	4.3	0	0
GA	Lumpkin	1.4	3.89	118.76	0	2.9	0	0
GA	Macon	0.6	2.25	32.29	0	4.1	5.5	0
GA	Madison	17.4	2.99	105.96	0	2.8	0	0
GA	Marion	3.0	2.28	22.84	0	3.8	4.4	0
GA	McDuffie	0.9	2.02	82.93	0	3.6	0	0
GA	McIntosh	0.3	0.15	33.91	11.42	6	0	0

GA	Meriwether	2.2	2.99	42.25	0	4.7	0	0
GA	Miller	5.7	1.18	20.28	0	2.4	6.3	0
GA	Mitchell	12.3	1.13	42.70	0	2.4	4.16	0
GA	Monroe	2.6	2.91	69.64	0	3.7	0	0
GA	Montgomery	7.1	1.42	38.22	0	5.6	2.2	0
GA	Morgan	4.6	2.96	55.55	0	3.5	0	0
GA	Murray	2.6	4.63	116.56	0	0	0	0
GA	Muscogee	2.7	2.50	906.34	0	3.6	0	0
GA	Newton	1.3	3.23	410.82	0	3.8	0	0
GA	Oconee	1.1	3.02	218.91	0	3.2	0	0
GA	Oglethorpe	1.0	2.74	34.76	0	3.3	0	0
GA	Paulding	0.9	3.82	540.60	0	0	0	0
GA	Peach	0.9	2.47	183.64	0	4.8	5.5	0
GA	Pickens	1.9	4.23	140.48	0	3.3	0	0
GA	Pierce	4.8	0.82	61.60	4.9	8.45	0	0
GA	Pike	0.7	3.00	87.79	0	0	0	0
GA	Polk	5.7	3.80	137.46	0	0	0	0
GA	Pulaski	4.4	2.20	44.73	0	0	6.3	0
GA	Putnam	10.2	2.70	64.11	0	3.8	3.62	0
GA	Quitman	2.9	1.86	15.23	0	3.4	8.2	0
GA	Rabun	4.7	3.62	46.32	0	2.4	0	0
GA	Randolph	0.7	1.75	15.84	0	4.1	7.68	0
GA	Richmond	3.2	1.62	865.46	0	4.8	0	0
GA	Rockdale	0.8	3.43	699.20	0	3.6	0	0
GA	Schley	0.2	2.17	31.48	0	4	5.2	0
GA	Screven	4.6	0.90	21.65	6.74	7.2	2.8	0
GA	Seminole	22.6	1.05	34.43	0	2.3	4.81	0
GA	Spalding	1.6	3.16	340.32	0	5.4	0	0
GA	Stephens	3.0	3.32	144.83	0	1.7	0	0
GA	Stewart	1.2	2.08	14.42	0	3.9	5.72	0
GA	Sumter	4.2	1.94	61.13	0	3.8	5.52	0
GA	Talbot	1.2	2.63	15.84	0	4.6	0	0
GA	Taliaferro	2.1	2.40	7.88	0	3.4	0	0
GA	Tattnall	5.1	0.92	52.79	5.9	6.1	1.9	0
GA	Taylor	1.8	2.46	21.27	0	3.9	0	0
GA	Telfair	3.7	1.72	36.29	0	4.7	2.66	0
GA	Terrell	1.2	1.70	25.47	0	3.9	7.66	0
GA	Thomas	4.0	0.77	81.56	0	2.2	3.3	0
GA	Tift	5.8	1.44	156.93	0	3.1	3.07	0
GA	Toombs	4.2	1.21	73.71	5.1	5.9	2.5	0
GA	Towns	3.5	3.89	72.08	0	0	0	0
GA	Treutlen	1.7	1.53	34.68	0	5.2	3.3	0
GA	Troup	2.5	2.93	168.89	0	4.5	0	0

GA	Turner	2.5	1.66	28.02	0	3.1	3.3	0
GA	Twiggs	1.2	2.43	22.68	0	6.1	6.53	0
GA	Union	7.1	4.04	76.12	0	2.8	0	0
GA	Upson	1.7	2.78	81.49	0	4.7	0	0
GA	Walker	3.8	4.49	156.41	0	3.2	0	0
GA	Walton	3.9	3.26	290.16	0	3.3	0	0
GA	Ware	8.7	0.94	40.06	4.1	9.2	0	0
GA	Warren	0.3	2.15	18.50	0	3.7	0	0
GA	Washington	3.2	2.03	30.05	0	4.8	5.32	0
GA	Wayne	3.7	0.65	46.62	6.14	8.56	0	0
GA	Webster	1.2	1.98	12.47	0	3.6	5	0
GA	Wheeler	6.3	1.57	26.63	0	5.3	2.66	0
GA	White	2.3	3.73	127.79	0	1.9	0	0
GA	Whitfield	3.1	4.64	360.79	0	0	0	0
GA	Wilcox	3.8	1.96	23.21	0	4.8	4.2	0
GA	Wilkes	0.5	2.41	20.85	0	3.4	0	0
GA	Wilkinson	2.2	2.25	20.03	0	4.9	6.53	0
GA	Worth	5.8	1.46	35.46	0	2.5	4.1	0
NC	Alamance	1.6	2.34	399.79	0	0	0	5.4
NC	Alexander	0.7	3.20	144.22	0	0	0	0
NC	Alleghany	1.1	3.59	47.39	0	0	0	7.7
NC	Anson	1.3	1.77	46.04	6.75	0	0	19.7
NC	Ashe	4.6	3.79	63.86	0	0	0	4.4
NC	Avery	3.0	3.84	71.08	0	0	0	0
NC	Beaufort	39.6	0.80	56.82	8.93	0	0	18.5
NC	Bertie	6.3	1.13	27.11	10.75	0	0	6.6
NC	Bladen	7.1	0.74	37.44	18.85	0	0	35.93
NC	Brunswick	16.7	0.16	168.62	11.85	0	0	27.44
NC	Buncombe	2.1	3.67	397.55	0	0	0	0
NC	Burke	1.6	3.46	178.47	0	0	0	0
NC	Cabarrus	2.0	2.38	597.94	0	0	0	5.8
NC	Caldwell	2.6	3.48	174.11	0	0	0	0
NC	Camden	31.6	0.37	45.09	10.2	0	0	0
NC	Carteret	37.4	0.14	137.30	10.5	0	0	22
NC	Caswell	0.9	2.65	53.19	0	0	0	0
NC	Catawba	1.4	3.04	399.88	0	0	0	0
NC	Chatham	1.2	1.97	424.38	6	0	0	12.5
NC	Cherokee	2.5	4.28	62.88	0	0	0	0
NC	Chowan	5.8	0.82	81.06	12.25	0	0	0
NC	Clay	5.1	3.99	52.24	0	0	0	0
NC	Cleveland	0.8	3.03	211.09	0	0	0	0
NC	Columbus	7.1	0.42	59.24	10.86	0	0	25.91
NC	Craven	17.3	0.47	144.06	7.66	0	0	18.5

NC	Cumberland	1.9	1.22	514.58	17.05	0	0	18
NC	Currituck	17.4	0.17	105.97	10.6	0	0	0
NC	Dare	73.8	0.24	96.63	12.31	0	0	5.8
NC	Davidson	1.7	2.48	303.09	0	0	0	22.21
NC	Davie	1.7	2.79	162.30	0	0	0	0
NC	Duplin	4.0	0.64	71.99	12.19	0	0	26
NC	Durham	2.3	2.08	1124.08	0	0	0	0
NC	Edgecombe	10.0	1.36	101.92	12.91	0	0	0
NC	Forsyth	1.2	2.79	937.00	0	0	0	0
NC	Franklin	1.3	1.81	141.64	7.84	0	0	0
NC	Gaston	1.7	2.77	630.70	0	0	0	0
NC	Gates	6.8	0.66	34.01	12.5	0	0	0
NC	Graham	6.2	4.26	28.91	0	0	0	0
NC	Granville	1.0	2.18	113.61	0	0	0	9
NC	Greene	3.6	1.00	79.21	12	0	0	16
NC	Guilford	1.4	2.52	831.54	0	0	0	6.2
NC	Halifax	2.3	1.51	69.07	10.2	0	0	0
NC	Harnett	1.6	1.54	228.53	12.93	0	0	16
NC	Haywood	6.3	3.86	112.49	0	0	0	0
NC	Henderson	2.3	3.41	314.79	0	0	0	0
NC	Hertford	3.4	0.92	67.07	11.1	0	0	0
NC	Hoke	1.4	1.32	141.26	12.91	0	0	16.5
NC	Hyde	93.5	0.52	8.05	9.2	0	0	7.8
NC	Iredell	0.8	2.91	316.74	0	0	0	0
NC	Jackson	3.0	3.74	89.49	0	0	0	0
NC	Johnston	2.2	1.36	264.65	10.72	0	0	16
NC	Jones	8.8	0.44	20.00	9.25	0	0	24
NC	Lee	2.2	1.73	242.27	6.9	0	0	11.5
NC	Lenoir	11.6	0.76	139.52	16.5	0	0	22
NC	Lincoln	1.2	2.93	288.96	0	0	0	0
NC	Macon	2.6	3.97	69.49	0	0	0	0
NC	Madison	3.3	1.18	48.34	0	0	0	2.5
NC	Martin	3.3	3.53	48.68	10.27	0	0	0
NC	McDowell	2.2	3.82	103.76	0	0	0	6
NC	Mecklenburg	1.2	2.48	2119.00	0	0	0	0
NC	Mitchell	1.7	3.88	67.71	0	0	0	0
NC	Montgomery	0.6	1.93	55.23	5.1	0	0	15
NC	Moore	2.4	1.69	144.53	8.5	0	0	16
NC	Nash	4.5	1.57	174.63	12.91	0	0	0
NC	New Hanover	13.2	0.09	1221.21	6.59	0	0	30.1
NC	Northampton	2.6	1.21	36.28	12.2	0	0	0
NC	Onslow	9.0	0.22	259.42	5.35	0	0	29
NC	Orange	1.2	2.25	373.06	0	0	0	9

NC	Pamlico	52.9	0.45	37.76	9.1	0	0	22
NC	Pasquotank	20.8	0.47	175.44	10.87	0	0	0
NC	Pender	21.7	0.30	72.48	9.66	0	0	29.52
NC	Perquimans	9.6	0.64	54.51	10.84	0	0	0
NC	Person	0.8	2.43	100.74	0	0	0	10
NC	Pitt	6.3	0.99	277.21	11.43	0	0	17
NC	Polk	1.9	3.21	87.08	0	0	0	6.5
NC	Randolph	1.1	2.20	183.48	0	0	0	13.5
NC	Richmond	1.7	1.57	94.58	9.2	0	0	17
NC	Robeson	8.9	0.93	137.64	15.09	0	0	22.76
NC	Rockingham	1.4	2.80	160.80	0	0	0	0
NC	Rowan	2.0	2.55	278.06	0	0	0	9
NC	Rutherford	1.6	3.23	118.85	0	0	0	0
NC	Sampson	2.1	0.96	67.23	18.52	0	0	15
NC	Scotland	2.5	1.28	109.16	9.75	0	0	18
NC	Stanly	1.1	2.12	159.00	0	0	0	10
NC	Stokes	1.1	3.01	101.54	0	0	0	0
NC	Surry	1.0	3.26	134.93	0	0	0	0
NC	Swain	5.3	4.12	27.03	0	0	0	0
NC	Transylvania	3.4	3.47	90.73	0	0	0	0
NC	Tyrrell	78.6	0.57	10.32	8.75	0	0	7
NC	Union	1.2	2.08	379.52	0	0	0	11.5
NC	Vance	0.5	2.09	175.33	0	0	0	0
NC	Wake	1.2	1.75	1331.45	10.21	0	0	0
NC	Warren	0.7	1.81	46.10	0	0	0	0
NC	Washington	15.4	0.90	33.28	10.66	0	0	0
NC	Watauga	2.7	3.78	179.48	0	0	0	0
NC	Wayne	6.4	1.04	222.66	15.48	0	0	18
NC	Wilkes	1.7	3.40	90.73	0	0	0	0
NC	Wilson	4.1	1.31	222.29	10.54	0	0	12
NC	Yadkin	1.5	3.04	112.44	0	0	0	0
NC	Yancey	3.6	3.83	57.73	0	0	0	4.5

A2 – Social Vulnerability and BRIC for All Counties in Florida, Georgia, and North Carolina

State	*County*	*SoVI*	*Non-Hispanic, White (%)*	*Black, African American (%)*	*Hispanic, Latino (%)*	*Poverty Rate (%)*	*Owner-Occupied Housing (%)*	*BRIC*
FL	Alachua	34.65	60.6	20.6	10.5	18.4	55	54.8
FL	Baker	26.37	80.4	14.2	2.8	14.9	75.3	54.7
FL	Bay	39.61	76.6	11.3	6.7	12.1	65.1	56.3
FL	Bradford	33.98	72.2	20.6	4.7	21	69.3	52.3
FL	Brevard	42.73	73.8	10.8	10.9	9.4	74.3	55.0
FL	Broward	43.95	34.8	30.2	31.1	12.3	62.1	54.5

FL	Calhoun	40.36	77.8	12.5	5.7	20.3	81.4	49.8
FL	Charlotte	61.53	83.8	5.9	7.7	11.4	79.7	52.7
FL	Citrus	60.03	87.5	3.2	6.1	15.2	81.9	51.4
FL	Clay	27.16	71.7	12.6	10.4	8.3	75	55.2
FL	Collier	55.89	62.2	7.3	28.6	9.4	73.3	52.2
FL	Columbia	36.58	71.8	18.7	6.7	15.6	71.4	53.3
FL	DeSoto	45.37	54.2	12.7	32.1	21.8	69.7	47.2
FL	Dixie	35.91	83.6	9.8	4.2	22.2	78.6	49.7
FL	Duval	36.97	52.0	30.8	10.5	13.5	56.7	55.8
FL	Escambia	39.14	64.0	23.3	5.9	15.5	62	55.6
FL	Flagler	51.24	74.4	10.9	10.9	9.7	76	52.7
FL	Franklin	38.86	78.5	13.3	5.7	19.2	74.6	54.7
FL	Gadsden	43.87	32.5	55.5	10.9	19.7	72.9	53.8
FL	Gilchrist	32.91	85.9	5.7	6	15	83	50.8
FL	Glades	48.96	59.5	13.7	21.8	19.3	79.6	47.0
FL	Gulf	26.29	82.5	11.3	3	14	74.2	54.6
FL	Hamilton	28.81	54.7	33.2	9.8	32.5	67.9	51.6
FL	Hardee	46.28	47.0	7.6	43.6	22.1	64.9	49.3
FL	Hendry	45.49	31.3	11.8	55.3	19.5	65.3	48.1
FL	Hernando	51.99	76.5	6.1	14.8	12.4	78.1	51.9
FL	Highlands	64.88	66.1	10.5	21.1	15.8	75.3	49.7
FL	Hillsborough	38.08	47.7	18	29.7	13.5	58.6	54.5
FL	Holmes	37.45	86.4	6.7	2.9	20.1	76.4	51.0
FL	Indian River	54.04	75.0	9.6	12.7	11.5	79.2	53.3
FL	Jackson	39.97	65.7	26.3	4.9	19.4	69.8	52.3
FL	Jefferson	36.42	60.4	33.5	4.2	17.6	77	52.7
FL	Lafayette	18.33	71.8	12.7	13.9	18	84.4	51.8
FL	Lake	48.05	68.7	11.5	16.7	10.9	74.5	53.1
FL	Lee	54.36	66.2	9.1	22.5	11.2	72.3	52.6
FL	Leon	30.35	55.9	32	6.7	20.8	53	55.2
FL	Levy	45.84	79.2	9.3	8.8	18.2	77.7	49.5
FL	Liberty	17.62	71.0	19.7	7	23	75.4	51.1
FL	Madison	34.73	54.6	37.8	5.7	22.7	73.6	52.4
FL	Manatee	48.84	70.6	9.3	16.9	11.3	72.9	52.9
FL	Marion	55.62	69.6	13.5	14.1	14.9	75	51.4
FL	Martin	45.13	77.7	5.7	14.2	8.9	78	53.8
FL	Miami-Dade	63.85	12.9	17.7	69.4	15.7	51.2	53.4
FL	Monroe	38.75	65.1	7.1	25.3	9.9	59.5	54.7
FL	Nassau	31.34	86.6	6.1	4.7	9	80	56.0
FL	Okaloosa	33.46	73.0	10.5	9.7	10.6	63.4	54.4
FL	Okeechobee	40.91	62.5	9	26	18.4	72.2	49.8
FL	Orange	40.17	39.4	22.8	32.7	12.6	55.4	53.7
FL	Osceola	53.92	30.1	14.1	55.8	13.4	61.6	52.7

FL	Palm Beach	48.25	53.5	19.8	23.4	11.4	68.9	52.2
FL	Pasco	43.44	72.7	6.7	16.5	11.3	72.1	53.1
FL	Pinellas	47.34	73.6	11.1	10.2	11.4	67	53.0
FL	Polk	46.31	56.9	16.2	24.6	14	68.9	53.4
FL	Putnam	48.21	71.2	16.4	10.2	22.4	70.7	51.2
FL	Santa Rosa	24.08	82.0	6.5	5.9	9.8	76	55.4
FL	Sarasota	51.56	82.8	4.7	9.6	7.8	74.9	54.2
FL	Seminole	22.70	58.9	13.1	22.5	9.3	64.6	54.8
FL	St. Johns	56.33	81.9	5.6	7.5	6.4	80.4	52.9
FL	St. Lucie	31.42	55.9	21.4	19.9	10.5	73.2	54.8
FL	Sumter	61.25	85.1	7.3	5.9	8.9	89.7	49.8
FL	Suwannee	38.51	75.3	12.6	9.9	17.1	74.3	50.6
FL	Taylor	30.78	72.3	19.9	4.2	19.9	77.4	52.3
FL	Union	17.42	69.8	22.6	5.6	19.9	66.1	53.4
FL	Volusia	49.35	70.6	11.5	15	13.1	70.3	54.0
FL	Wakulla	14.07	79.2	13.9	3.9	12	82	56.0
FL	Walton	41.55	84.0	5.3	6.5	10.8	74.6	52.7
FL	Washington	30.39	77.1	15.1	3.8	20.1	77.7	51.0
GA	Appling	35.08	68.7	19.6	10	20.9	76.4	53.9
GA	Atkinson	39.10	56.0	17.4	25.4	23.2	73.3	53.1
GA	Bacon	32.05	73.4	16.2	8.6	19.2	72.4	53.5
GA	Baker	40.20	47.9	44	6.4	24.8	65.3	51.5
GA	Baldwin	44.46	52.4	42.5	2.3	22.9	58.5	52.6
GA	Banks	23.97	87.3	2.9	7.2	12.8	75.4	53.7
GA	Barrow	27.63	69.4	12.9	12.2	9.7	75.6	55.6
GA	Bartow	31.57	76.9	11.3	9.2	12.5	66.3	52.3
GA	Ben Hill	51.08	54.8	37	6.3	22.8	58.8	53.0
GA	Berrien	38.12	80.9	11.2	5.5	20.1	64.2	52.9
GA	Bibb	47.97	37.4	55.8	3.5	23.2	52.3	56.0
GA	Bleckley	46.24	67.8	26.9	3.2	18.5	74.3	51.9
GA	Brantley	36.42	91.8	4	2.3	16.1	80.3	52.1
GA	Brooks	41.31	56.3	35.2	6.2	21.9	74	52.7
GA	Bryan	20.73	72.2	15.2	7.6	7.8	70.1	57.7
GA	Bulloch	33.11	63.3	29.6	4.2	21.9	53.9	51.8
GA	Burke	44.74	47.8	46.9	3.5	23.6	70.8	53.4
GA	Butts	30.31	65.7	28.9	3.6	14.7	69.8	53.8
GA	Calhoun	38.67	32.7	60.8	5.1	35.9	65.6	49.3
GA	Camden	23.26	69.3	19.2	7.1	13.8	62.5	54.7
GA	Candler	48.64	61.2	24.9	12.3	23.1	57.6	50.9
GA	Carroll	32.09	70.4	19.7	7.2	14.9	66.9	53.9
GA	Catoosa	32.60	90.5	2.9	3.2	10	74	52.4
GA	Charlton	26.65	60.2	30.2	5.4	25.9	71.3	50.4
GA	Chatham	38.90	47.8	41.2	6.7	14.8	54.7	57.2

GA	Chattahoochee	0.12	57.0	19.4	16.9	18.5	24.6	49.3
GA	Chattooga	34.69	82.5	9.8	5.5	17.4	68.2	52.8
GA	Cherokee	21.17	77.8	7.7	11.1	6.5	76.8	52.3
GA	Clarke	41.43	55.2	28.3	11	25.7	39	53.7
GA	Clay	63.74	36.3	60.4	1.7	28.8	72.9	49.9
GA	Clayton	45.01	9.1	72.8	13.4	16	49.5	53.2
GA	Clinch	47.65	64.4	27.6	5.8	22	74.9	53.3
GA	Cobb	24.36	51.1	28.8	13.3	8.3	64.5	52.9
GA	Coffee	32.76	57.3	28.8	12.1	20.2	63.1	52.9
GA	Colquitt	46.95	55.4	23.8	19.6	21.9	63	52.1
GA	Columbia	19.12	67.4	18.8	7.1	5.6	79.5	54.7
GA	Cook	39.97	64.2	27.9	6	21.4	66.4	53.9
GA	Coweta	24.75	70.5	18.4	7.3	9	72.8	55.5
GA	Crawford	28.50	72.8	20.8	3.6	15.3	77.9	51.9
GA	Crisp	49.11	49.2	44.8	3.8	26.7	54.5	53.5
GA	Dade	34.02	93.3	1.4	2.3	13.5	71.5	51.8
GA	Dawson	25.46	91.3	1.1	5.2	8.8	81.5	53.2
GA	De Kalb	44.82	29.3	54.8	8.5	12.9	54.6	52.3
GA	Decatur	35.87	49.4	42.7	6.5	23.4	57.5	53.1
GA	Dodge	31.22	64.5	30.5	3.6	20.6	67.8	53.7
GA	Dooly	31.38	42.1	50.2	7	28.2	69.6	50.5
GA	Dougherty	53.21	24.3	71	3.1	27.6	46	55.4
GA	Douglas	28.06	37.4	49.7	10.2	10.9	64.3	55.1
GA	Early	50.69	44.2	51.7	2.3	27.3	64	55.0
GA	Echols	41.31	61.0	6.2	29.8	21.6	67.8	48.6
GA	Effingham	18.68	77.7	14.3	4.9	9.1	75.9	56.9
GA	Elbert	45.37	63.4	29	6	20.6	72.2	52.4
GA	Emanuel	47.26	59.1	34.7	4.6	20.9	63.8	51.2
GA	Evans	37.17	56.3	31.1	11.8	24.1	68	53.5
GA	Fannin	50.69	94.4	0.9	2.6	12.1	79	52.2
GA	Fayette	16.99	60.6	25.3	7.5	5.4	82	54.2
GA	Floyd	45.05	70.6	15	11.6	16.4	61	53.0
GA	Forsyth	10.92	69.0	4.4	9.7	4.5	84	53.3
GA	Franklin	38.90	82.9	9.5	4.8	17.3	66.4	53.8
GA	Fulton	26.25	39.6	44.5	7.2	13.8	51.6	52.7
GA	Gilmer	42.57	85.5	1.4	11.8	14.6	74.5	51.6
GA	Glascock	32.91	87.5	8.5	1.9	16.9	74.7	52.3
GA	Glynn	49.19	63.6	26.6	6.8	15.4	62.5	56.9
GA	Gordon	33.58	76.7	4.4	16.5	12.3	65.1	53.5
GA	Grady	41.47	57.4	29.8	12.1	21.7	64.3	51.9
GA	Greene	50.30	58.4	32.9	6.4	15	74.6	51.3
GA	Gwinnett	28.03	35.4	29.8	21.7	9.2	66.3	52.2
GA	Habersham	41.86	76.9	3.9	15.5	15.2	78.3	53.7

GA	Hall	36.03	60.1	8.1	29.1	13.5	69.5	54.1
GA	Hancock	46.59	24.4	71	2.7	31.2	70.6	49.0
GA	Haralson	36.42	90.8	4.5	2	14.4	68.4	52.8
GA	Harris	18.80	76.5	16.7	3.9	6.5	87.6	55.1
GA	Hart	38.59	74.6	19.1	3.8	14.6	74.8	53.1
GA	Heard	32.79	84.6	9.8	2.9	16.7	71.1	51.5
GA	Henry	26.53	40.0	48.4	7.2	8.1	70.4	55.4
GA	Houston	29.29	54.9	32.9	6.6	11	63.6	56.0
GA	Irwin	27.67	66.8	27.8	3.9	20.5	73.6	53.2
GA	Jackson	27.32	80.7	7.4	8.4	10.3	77.9	55.4
GA	Jasper	33.98	74.7	19.5	4.1	12.4	76.8	51.6
GA	Jeff Davis	34.41	70.4	15.3	12.8	21.2	65.1	53.7
GA	Jefferson	53.37	42.1	52.6	4	25.1	63.2	51.3
GA	Jenkins	49.55	50.4	42.6	6.2	29	71.4	52.4
GA	Johnson	23.57	61.9	34.3	2.8	24.2	67.3	50.8
GA	Jones	28.66	71.0	25.2	1.9	12.8	80.2	54.5
GA	Lamar	37.72	65.2	29.8	2.6	14.8	69.2	54.8
GA	Lanier	37.45	68.1	22	6.4	18.5	64.4	53.6
GA	Laurens	42.37	57.4	37.5	2.9	23.9	64.2	53.6
GA	Lee	16.32	69.7	23.2	3.2	9.3	72.8	56.6
GA	Liberty	27.83	37.7	45	12.7	14.5	75.4	55.8
GA	Lincoln	46.20	66.7	28.9	2.1	17.3	75	50.7
GA	Long	24.95	57.2	27.5	11	14.2	69.1	51.9
GA	Lowndes	37.76	53.0	37.4	6	20.4	52.3	54.6
GA	Lumpkin	31.14	90.2	1.7	5.1	14.5	70.7	53.3
GA	Macon	43.79	32.8	60.7	4.5	29.4	64	53.6
GA	Madison	42.89	80.7	9.6	6.1	15.6	74.7	54.5
GA	Marion	37.56	59.1	30.9	7.7	21.1	78.4	50.3
GA	McDuffie	31.93	53.1	41.5	3.4	18	61.3	53.5
GA	McIntosh	33.15	62.2	33.5	2.3	18.7	79.8	53.6
GA	Meriwether	44.66	56.7	38.5	2.5	22.2	68.5	51.9
GA	Miller	43.36	67.0	28.3	2.9	21.3	65.5	55.1
GA	Mitchell	37.09	45.5	48	4.8	30.7	62.2	52.7
GA	Monroe	31.34	72.7	22.7	2.4	10.6	79.1	53.4
GA	Montgomery	32.60	66.1	25.9	7	19.4	69.2	52.3
GA	Morgan	35.28	72.9	21.8	3.2	11.1	73.2	53.4
GA	Murray	33.46	81.8	1.2	15.7	14.5	69.6	51.7
GA	Muscogee	43.24	39.6	48	7.7	18.4	48	55.0
GA	Newton	34.17	43.9	47.7	6.1	11.2	67.6	55.0
GA	Oconee	15.57	83.7	5.2	5.7	5.6	82.9	55.8
GA	Oglethorpe	28.66	75.2	17.3	5	12.8	77.2	54.3
GA	Paulding	20.77	68.4	21.9	7.1	6.8	75.8	55.9
GA	Peach	36.03	44.7	44.4	8.4	19.8	65.4	54.4

GA	Pickens	29.68	93.3	1.3	3.2	10.3	75.9	53.7
GA	Pierce	34.65	83.8	8.8	5.1	16.4	77.5	53.5
GA	Pike	25.78	87.1	9.2	1.8	8.7	84	54.2
GA	Polk	40.24	71.6	12.8	13.6	16.2	64.6	54.4
GA	Pulaski	52.23	61.8	32	3.6	20.7	64.3	53.7
GA	Putnam	43.04	66.1	26.3	6.2	15.1	77	51.4
GA	Quitman	41.55	47.6	48.5	2	22.8	70.2	47.1
GA	Rabun	50.30	88.1	1.6	7.9	13	74.3	52.1
GA	Randolph	59.80	35.1	61.5	2.7	25.3	57.2	51.0
GA	Richmond	46.79	33.7	57.7	5.1	21.7	52.6	55.3
GA	Rockdale	36.74	28.9	58.1	10.5	12.1	66.4	54.3
GA	Schley	33.31	72.1	20.3	5.7	15.9	71.5	52.9
GA	Screven	43.79	54.8	41	2.5	24.1	73.5	53.5
GA	Seminole	44.50	61.4	33.1	3.6	22.6	65.3	54.8
GA	Spalding	43.83	57.5	34.9	5	17.7	62.5	55.0
GA	Stephens	42.22	81.9	11	3.9	15	69.8	54.8
GA	Stewart	48.68	22.3	48.5	33.4	34.7	73.5	45.0
GA	Sumter	49.03	39.0	52.9	6.2	26.7	55.5	54.5
GA	Talbot	46.24	40.8	55.1	2.9	19.6	79	51.3
GA	Taliaferro	63.74	38.1	55.1	4	22.5	69	50.3
GA	Tattnall	28.10	57.5	29.5	12.2	26.5	67.2	51.1
GA	Taylor	43.56	57.9	37.6	2.6	22.9	70.5	51.9
GA	Telfair	39.65	49.0	36.9	15.2	27.7	67	49.9
GA	Terrell	54.39	35.7	60.1	2.9	28.2	55	52.6
GA	Thomas	45.80	57.6	36.2	3.9	18	61.2	54.4
GA	Tift	43.79	55.1	30.7	12.2	21.5	60	53.6
GA	Toombs	46.16	60.1	26.3	11.8	19.2	60.5	52.2
GA	Towns	59.64	93.4	1.2	3.2	12.7	78.3	53.4
GA	Treutlen	46.31	63.8	31.9	3	31.6	66.9	49.3
GA	Troup	41.07	55.8	36.5	3.7	19.2	57.4	54.6
GA	Turner	40.44	53.4	40	4.8	28	69.1	52.9
GA	Twiggs	40.20	55.1	40.7	2.7	19	80.9	51.1
GA	Union	55.66	93.6	0.9	3.6	11.6	77.2	52.7
GA	Upson	47.50	67.1	28.4	2.4	19.1	67.6	54.3
GA	Walker	34.57	90.5	4.4	2.5	14.7	71.8	53.2
GA	Walton	30.86	73.2	18.9	4.9	10.8	74.3	55.1
GA	Ware	43.79	62.9	30.2	4.4	26.3	63.6	55.1
GA	Warren	48.32	38.3	58.3	1.7	26.5	66.6	49.6
GA	Washington	40.20	42.2	53.8	2.6	21.4	66.6	51.9
GA	Wayne	34.02	71.1	20.2	6.5	18.4	63.5	53.2
GA	Webster	33.19	51.3	42.2	5	18.4	83.9	52.1
GA	Wheeler	8.51	56.1	37.8	5.4	34.2	63.3	48.9
GA	White	39.46	92.1	2	3.4	10.9	75.9	52.8

GA	Whitfield	40.56	57.1	4.4	36.3	12.7	64.6	50.8
GA	Wilcox	27.36	58.9	34.5	5	29.4	76.1	51.3
GA	Wilkes	52.86	51.4	41.1	5.4	19.6	67.5	52.0
GA	Wilkinson	35.91	56.8	38	3.1	17	75.2	53.1
GA	Worth	38.94	67.7	28	2.4	20.3	65.4	52.6
NC	Alamance	41.78	62.9	20.9	13.1	14.6	65.2	55.3
NC	Alexander	28.38	86.7	5.9	4.8	11.7	75.7	56.2
NC	Alleghany	46.00	86.7	1.8	9.9	16.9	76.3	53.3
NC	Anson	38.00	44.3	48.5	4.1	21.4	66.1	53.1
NC	Ashe	45.21	92.3	1	5.1	14.6	75.9	54.7
NC	Avery	34.80	88.5	4.7	5.1	16.4	75.3	53.8
NC	Beaufort	46.00	65.9	24.8	8	17.6	69.9	55.5
NC	Bertie	42.61	34.7	61.1	2.4	24.2	74.4	53.2
NC	Bladen	45.49	54.9	34	7.8	21.2	71.4	52.3
NC	Brunswick	45.05	82.3	10	4.9	10.2	80.7	53.9
NC	Buncombe	40.13	83.4	6.3	6.8	12.2	63.4	55.4
NC	Burke	42.33	81.4	6.9	6.5	18.4	73.9	55.1
NC	Cabarrus	29.80	63.4	19.6	11.1	7.9	71.5	56.0
NC	Caldwell	38.47	86.7	5.2	5.9	12	72.5	54.3
NC	Camden	23.69	80.5	11.5	3	7.6	81.9	57.2
NC	Carteret	42.41	86.5	5.6	4.4	10.4	72.6	55.2
NC	Caswell	41.78	61.0	32.3	4.6	16.2	76.4	51.5
NC	Catawba	35.63	74.9	8.9	10.1	13.3	69.4	55.9
NC	Chatham	36.07	47.8	41.2	6.7	14.8	54.7	53.5
NC	Cherokee	49.74	91.1	1.6	3.3	17.7	79	50.9
NC	Chowan	49.39	59.8	34.4	3.7	18.5	66.7	54.4
NC	Clay	53.33	92.5	1.3	3.9	14	78	49.7
NC	Cleveland	41.31	72.8	20.8	3.8	19	67.8	55.1
NC	Columbus	45.45	59.1	30.6	5.6	22.3	72.5	54.8
NC	Craven	37.80	65.6	21.4	7.6	13.8	62.9	55.9
NC	Cumberland	37.56	42.4	39.1	12.1	18	50.7	55.7
NC	Currituck	26.76	86.9	5.8	4.4	8.8	82	56.3
NC	Dare	37.41	87.0	2.8	7.7	8.9	74.4	56.7
NC	Davidson	35.95	79.4	10.1	7.4	15.2	69.8	55.1
NC	Davie	33.07	83.9	6.5	7.3	10.9	79.8	56.7
NC	Duplin	43.79	51.0	25.5	23	17.7	70.4	52.5
NC	Durham	36.46	43.0	36.9	13.7	14	54.4	56.1
NC	Edgecombe	53.88	36.0	57.8	5	21	58.8	55.0
NC	Forsyth	40.48	56.3	27.5	13.3	15.2	61.6	56.1
NC	Franklin	29.44	63.0	25.9	9	11.6	73.8	54.7
NC	Gaston	38.35	71.1	17.9	7.6	11.6	65.3	55.8
NC	Gates	30.04	63.6	31.2	2.4	14.7	77.5	52.6
NC	Graham	46.67	86.1	0.5	3.7	16.8	83	52.4

NC	Granville	28.66	57.8	31.9	8.5	14.6	72.1	55.4
NC	Greene	34.10	46.6	36.8	15.7	20.2	70.7	52.4
NC	Guilford	37.60	49.4	35.4	8.4	16	58.8	55.4
NC	Halifax	52.90	38.0	53.8	3.1	23.8	62.6	53.8
NC	Harnett	32.09	60.7	21.9	13.4	15.6	65.4	54.1
NC	Haywood	43.87	92.2	1.4	4.3	10.6	73	55.2
NC	Henderson	45.05	83.1	3.4	10.3	10.6	73.3	52.6
NC	Hertford	50.26	32.7	61	4.1	23	65.8	53.3
NC	Hoke	38.23	38.7	35.5	13.9	16.9	67.1	54.1
NC	Hyde	34.49	61.8	26.7	9.8	19.2	67.8	53.3
NC	Iredell	27.12	75.4	12.3	8	8.2	72.3	54.9
NC	Jackson	50.61	80.6	2.4	6.2	19.3	64.3	51.9
NC	Johnston	30.82	66.8	17	14.1	12.5	73	55.9
NC	Jones	41.86	62.9	29.3	5.1	18.8	73.3	54.2
NC	Lee	42.73	57.8	20	19.6	14.2	66.7	55.9
NC	Lenoir	51.48	48.9	41.4	7.9	23.1	59.3	56.3
NC	Lincoln	26.96	84.6	5.8	7.5	9	76.4	55.8
NC	Macon	38.43	88.6	1.7	7.4	14.3	72.9	54.0
NC	Madison	54.71	93.9	1.5	2.4	14.6	74.1	50.6
NC	Martin	40.13	52.3	42.1	4.1	20.6	68	55.0
NC	McDowell	45.09	87.2	4.2	6.4	13.6	72.7	56.2
NC	Mecklenburg	29.44	46.1	33	13.8	10.3	56.4	53.8
NC	Mitchell	45.64	91.1	0.8	6.2	14.8	78	55.4
NC	Montgomery	45.80	62.9	19	15.6	16.1	74.8	51.8
NC	Moore	44.78	77.0	12	7.1	11.3	75.7	53.5
NC	Nash	38.19	48.9	41.3	7.4	16.4	65.3	55.8
NC	New Hanover	36.58	77.4	13.4	5.8	13	58.1	55.7
NC	Northampton	58.85	38.8	57.2	2.6	21.6	68.4	51.7
NC	Onslow	23.89	65.7	15.8	12.9	12.5	53.1	55.4
NC	Orange	22.07	69.5	11.8	8.6	13.4	62.6	55.7
NC	Pamlico	39.14	74.2	18.9	4.3	15.9	77.7	55.0
NC	Pasquotank	40.52	54.3	36.6	5.8	14.3	59.6	55.3
NC	Pender	32.09	75.4	14.7	7.5	11.5	81.2	54.8
NC	Perquimans	41.58	72.6	22.7	2.7	15	75.4	53.5
NC	Person	39.61	66.3	26.8	4.5	15.4	76.4	55.0
NC	Pitt	38.23	54.1	35.9	6.5	19.2	52.1	57.1
NC	Polk	46.00	87.7	4.2	5.9	12.1	74	54.3
NC	Randolph	35.04	78.4	6.6	12	14.1	71.8	54.7
NC	Richmond	43.59	56.5	31.9	6.8	25.8	66.2	54.2
NC	Robeson	56.84	24.7	23.6	9.2	31.5	65.6	53.3
NC	Rockingham	42.49	72.1	19	6.3	18.4	69.6	55.5
NC	Rowan	39.14	71.4	16.9	9.4	13.9	69.3	55.5
NC	Rutherford	41.74	82.8	9.9	4.8	18.5	71.5	52.5

NC	Sampson	42.49	50.3	26.6	20.6	16.8	69.3	51.3
NC	Scotland	50.22	42.5	38.9	3.3	28.5	60.5	55.0
NC	Stanly	38.59	80.8	11.4	4.4	10.7	74.4	57.3
NC	Stokes	36.03	90.9	4.1	3.3	13	77.6	54.4
NC	Surry	42.96	83.2	4.2	11.1	16	73.5	54.6
NC	Swain	62.36	60.7	1.2	5.8	16.1	71.5	52.9
NC	Transylvania	55.30	90.4	3.5	3.4	13.1	76	50.6
NC	Tyrrell	36.70	49.1	38.1	9.4	25.4	68.3	54.2
NC	Union	19.08	71.1	12.5	11.5	7.3	81.3	55.7
NC	Vance	51.60	39.0	51.5	8.3	18.5	56.5	53.6
NC	Wake	20.81	59.6	21	10.4	8	63.9	55.2
NC	Warren	45.80	38.2	51.4	3.9	21.7	73.2	50.5
NC	Washington	54.95	44.2	48.9	5.6	21.3	66.5	54.4
NC	Watauga	35.79	91.4	1.9	4	21.4	60.1	54.6
NC	Wayne	40.17	52.7	32.4	12.4	18.6	62.1	56.1
NC	Wilkes	40.60	86.7	4.7	6.9	15.2	75.7	53.7
NC	Wilson	47.18	46.8	40.5	10.8	21.5	59.1	56.3
NC	Yadkin	36.97	83.8	3.4	11.5	13.9	76.2	54.8
NC	Yancey	46.51	92.0	1.1	5.5	14.2	73.3	54.4

A3 – Binary Logistic Regression Results for HMA Funding

	HMA Funding (binary) [N=326]
SoVI	-0.002 (0.018)
Population Density	0.001 (0.001)
Proximity to Coast	0.035 (0.173)
Properties at Risk	0.165** (0.062)
Cox & Snell R^2	0.063
Poverty Rate	0.073 (0.038)
Population Density	0.002 (0.001)
Proximity to Coast	0.168 (0.185)
Properties at Risk	0.181** (0.062)
Cox & Snell R^2	0.074
Proportion Non-Hispanic, White	-0.024 (0.013)
Population Density	0.001 (0.001)
Proximity to Coast	0.252 (0.206)
Properties at Risk	0.204** (0.068)
Cox & Snell R^2	0.074
Proportion Black, African American	0.028* (0.013)

Population Density	0.001 (0.001)
Proximity to Coast	0.268 (0.199)
Properties at Risk	0.217** (0.070)
Cox & Snell R^2	0.078
Proportion Hispanic, Latino	-0.016 (0.027)
Population Density	0.001 (0.001)
Proximity to Coast	0.025 (0.174)
Properties at Risk	0.168 (0.062)
Cox & Snell R^2	0.064
Owner-occupied Housing Rate	-.035 (0.025)
Population Density	0.001 (0.001)
Proximity to Coast	0.094 (0.179)
Properties at Risk	0.171** (0.061)
Cox & Snell R^2	0.069

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

A4 – OLS Regression Results for HMA Funding Distribution by Mitigation Type Cont.

	Total [N=286]	Total per Capita [N=286]
SoVI	0.003 (0.004)	0.007* (0.003)
Population Density	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.090* (0.038)	-0.165*** (0.032)
Properties at Risk	0.010** (0.003)	0.019*** (0.003)
Georgia	-1.047*** (0.124)	-
North Carolina	-0.231 (0.127)	-
R^2	0.605	0.331
Std. Error	0.647	0.616
Poverty Rate	-0.019** (0.007)	0.000 (0.007)
Population Density	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.127** (0.040)	-0.170*** (0.033)
Properties at Risk	0.008** (0.003)	0.019*** (0.003)
Georgia	-0.954*** (0.128)	-
North Carolina	-0.174 (0.128)	-
R^2	0.613	0.320
Std. Error	0.640	0.621
Proportion Non-Hispanic, White	-0.004 (0.003)	-0.002 (0.002)
Population Density	0.001*** (0.000)	0.000 (0.000)

Proximity to Coast	-0.062 (0.041)	-0.164*** (0.033)
Properties at Risk	0.010** (0.003)	0.019*** (0.003)
Georgia	-1.136*** (0.131)	-
North Carolina	-0.280* (0.130)	-
R^2	0.608	0.322
Std. Error	0.644	0.620
Proportion Black, African American	0.002 (0.003)	0.001 (0.002)
Population Density	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.077 (0.042)	-0.167*** (0.033)
Properties at Risk	0.010** (0.003)	0.019*** (0.003)
Georgia	-1.109*** (0.141)	-
North Carolina	-0.264 (0.135)	-
R^2	0.604	0.321
Std. Error	0.647	0.621
Proportion Hispanic, Latino	0.007 (0.005)	-0.001 (0.005)
Population Density	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.092 (0.037)	-0.171*** (0.032)
Properties at Risk	0.009** (0.003)	0.019*** (0.003)
Georgia	-1.012*** (0.127)	-
North Carolina	-0.186 (0.131)	-
R^2	0.607	0.320
Std. Error	0.645	0.621
Owner-occupied Housing Rate	-0.012* (0.005)	0.001 (0.005)
Population Density	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.069 (0.038)	-0.172*** (0.032)
Properties at Risk	0.010** (0.003)	0.018*** (0.003)
Georgia	-1.149*** (0.127)	-
North Carolina	-0.305** (0.129)	-
R^2	0.612	0.321
Std. Error	0.640	0.621

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

A5 – OLS Regression Results for PA Funding Distribution by Disaster Event(s) Cont.

	Total - Matthew [N=87]	Total per Capita - Matthew [N=87]	Total - Irma [N=226]	Total per Capita - Irma [N=226]
SoVI	-0.001 (0.011)	0.006 (0.006)	0.007 (0.007)	0.014*** (0.003)
Population Density	0.001* (0.000)	0.000 (0.000)	0.001*** (0.000)	0.000** (0.000)
Proximity to Coast	-0.465* (0.209)	-0.409*** (0.111)	-0.330*** (0.092)	-0.080* (0.032)

Properties at Risk	0.000 (0.007)	0.005 (0.004)	0.006 (0.008)	0.007* (0.003)
Total Rain	0.110*** (0.030)	0.074*** (0.016)	0.284*** (0.029)	0.119*** (0.011)
Georgia	-0.828* (0.352)	-	0.332 (0.263)	-
North Carolina	-0.598 (0.338)	-	-	-
R^2	0.403	0.369	0.560	0.607
Std. Error	0.872	0.540	1.206	0.464
Poverty Rate	-0.008 (0.020)	0.010 (0.012)	-0.008 (0.015)	0.015** (0.006)
Population Density	0.001* (0.000)	0.000 (0.000)	0.001*** (0.000)	0.000 (0.000)
Proximity to Coast	-0.443* (0.216)	-0.431*** (0.116)	-0.358*** (0.102)	-0.060 (0.035)
Properties at Risk	0.000 (0.007)	0.005 (0.004)	0.006 (0.008)	0.009** (0.003)
Total Rain	0.111*** (0.030)	0.074*** (0.016)	0.283*** (0.029)	0.131*** (0.012)
Georgia	-0.781* (0.337)	-	0.373 (0.279)	-
North Carolina	-0.574 (0.332)	-	-	-
R^2	0.404	0.368	0.558	0.580
Std. Error	0.871	0.540	1.208	0.480
Proportion Non-Hispanic, White	0.001 (0.007)	-0.001 (0.004)	-0.009 (0.005)	-0.004* (0.002)
Population Density	0.001* (0.000)	0.000 (0.000)	0.001** (0.000)	0.000*** (0.000)
Proximity to Coast	-0.460* (0.217)	-0.405*** (0.119)	-0.282** (0.096)	-0.076* (0.034)
Properties at Risk	0.000 (0.007)	0.005 (0.004)	0.007 (0.008)	0.009** (0.003)
Total Rain	0.111*** (0.030)	0.074*** (0.016)	0.284*** (0.029)	0.125*** (0.011)
Georgia	-0.811* (0.330)	-	0.172 (0.277)	-
North Carolina	-0.587 (0.331)	-	-	-
R^2	0.403	0.362	0.563	0.575
Std. Error	0.872	0.543	1.201	0.483
Proportion Black, African American	-0.008 (0.008)	0.000 (0.005)	0.011 (0.006)	0.003 (0.002)
Population Density	0.001* (0.000)	0.000 (0.000)	0.001*** (0.000)	0.000** (0.000)
Proximity to Coast	-0.400 (0.217)	-0.398** (0.121)	-0.256* (0.100)	-0.077* (0.035)
Properties at Risk	-0.001 (0.007)	0.005 (0.004)	0.008 (0.008)	0.009** (0.003)
Total Rain	0.116*** (0.030)	0.074*** (0.017)	0.293*** (0.029)	0.128*** (0.012)
Georgia	-0.731* (0.337)	-	0.082 (0.291)	-
North Carolina	-0.520 (0.335)	-	-	-
R^2	0.411	0.362	0.565	0.572
Std. Error	0.866	0.543	1.200	0.485
Proportion Hispanic, Latino	0.009 (0.014)	-0.004 (0.009)	-0.003 (0.010)	0.007 (0.004)
Population Density	0.001* (0.000)	0.000 (0.000)	0.001*** (0.000)	0.000** (0.000)
Proximity to Coast	-0.476* (0.207)	-0.400** (0.111)	-0.331*** (0.093)	-0.096** (0.034)
Properties at Risk	0.000 (0.007)	0.005 (0.004)	0.006 (0.008)	0.007* (0.003)
Total Rain	0.113*** (0.030)	0.072*** (0.016)	0.288*** (0.030)	0.117*** (0.012)
Georgia	-0.747* (0.345)	-	0.312 (0.268)	-

North Carolina	-0.535 (0.340)	-	-	-
R^2	0.406	0.363	0.568	0.562
Std. Error	0.870	0.542	1.209	0.485
Owner-occupied Housing Rate	-0.007 (0.014)	0.002 (0.008)	-0.005 (0.010)	-0.006 (0.004)
Population Density	0.001 (0.000)	0.000 (0.000)	0.001*** (0.000)	0.000** (0.000)
Proximity to Coast	-0.492* (0.212)	-0.390*** (0.116)	-0.326*** (0.094)	-0.086* (0.034)
Properties at Risk	0.000 (0.007)	0.005 (0.004)	0.006 (0.008)	0.008** (0.003)
Total Rain	0.110*** (0.030)	0.074*** (0.016)	0.286*** (0.029)	0.125*** (0.011)
Georgia	-0.874* (0.349)	-	0.288 (0.276)	-
North Carolina	-0.634 (0.340)	-	-	-
R^2	0.405	0.362	0.558	0.571
Std. Error	0.870	0.543	1.208	0.485

*0.05 p-value
**0.01 p-value
***0.001 p-value
Standard Error of coefficients in parentheses

A6 – Bay County, FL HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF PANAMA CITY, BAY COUNTY, POLICE DEPT MAIN BLDG AND WILSON SUBSTA - WIND	Property Protection	2	70444.39	2005
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF PANAMA CITY BEACH, BAY COUNTY, FIRE STATION #2 - WIND RETROFIT	Property Protection	1	9818.63	2005
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF PANAMA CITY BEACH, BAY COUNTY, FIRE STATION #1 - WIND RETROFIT	Property Protection	1	33398.73	2005
HMGP	103.1: Feasibility, Engineering and Design Studies; 200.3: Acquisition of Public Real Property (Structures and Land) - Riverine; 200.5: Acquisition of Vacant Land; 403.1: Stormwater Management - Culverts; 403.2: Stormwater Management - Diversions; 501.1: Other Major Structural Projects	CITY OF SPRINGFIELD, BAY COUNTY, ROBINDALE SUBDIVISION - DRAINAGE/ACQUISITION	Multiple	2	1818973.97	2005
HMGP	103.1: Feasibility, Engineering and Design Studies; 205.8: Retrofitting Public Structures - Wind	Bay County, Haney Building # 1, SHELTER Wind Retrofit	Property Protection	1	224977.54	2006
FMA	202.2: Elevation of Private Structures - Coastal	City of Lynn Haven Residence Elevation - 116 Carolina Avenue	Acquisition & Elevation	1	328558.19	2006
FMA	202.2: Elevation of Private Structures - Coastal	City of Lynn Haven Residence Elevation - 201 Missouri Avenue	Acquisition & Elevation	1	269121.88	2006
HMGP	103.1: Feasibility, Engineering and Design Studies; 205.8: Retrofitting Public Structures - Wind	CENTRAL PANHANDLE FAIR IN BAY COUNTY INC, FAIRGROUNDS EXHIBIT HALL, WIND RETROFI	Property Protection	1	703315.35	2006
HMGP	205.8: Retrofitting Public Structures - Wind	Bay District Schools, Bay County, Rutherford Building # 13, Shelter Project	Property Protection	1	169226.62	2006
HMGP	205.8: Retrofitting Public Structures - Wind	BAY COUNTY, WALLER BLDG #5, SHELTER WIND RETROFIT	Property Protection	1	273147.36	2006
HMGP	205.8: Retrofitting Public Structures - Wind	Bay County, Patterson Building # 16, Shelter Retrofit	Property Protection	1	110565.57	2006
PDM	91.1: Local Multihazard Mitigation Plan	Gulf Coast Community College DRU Hazard Mitigation Plan	Development Regulation	0	100271.40	2007
RFC	202.2: Elevation of Private Structures - Coastal	FY08-RFC-City of Lynn Haven Elevation of 215 Kentucky Ave (Bovard)	Acquisition & Elevation	1	235018.33	2008
RFC	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	FY08-RFC-City of Lynn Haven Acquisition-Demolition of 211 Missouri Ave (Tripp)	Acquisition & Elevation	1	460840.66	2008
RFC	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	FY08-RFC-City of Lynn Haven Acquisition-Demolition of 201 Missouri Ave (Neumann)	Acquisition & Elevation	1	310530.69	2008
FMA	202.2: Elevation of Private Structures - Coastal	Jenks Avenue Drainage Improvement Project	Acquisition & Elevation	1	696149.83	2008
FMA	202.1: Elevation of Private Structures - Riverine	Lee Elevation Callaway	Acquisition & Elevation	1	135316.73	2008

HMGP	205.8: Retrofitting Public Structures - Wind; 405.1: Other Minor Flood Control	Bay County, BOCC, UF Agricultural Extension Bldg, Wind and Flood Retrofit Proj	Property Protection	1	427957.32	2009
HMGP	205.8: Retrofitting Public Structures - Wind	City of Panama City, Traffic Signal Mast Arm Rebuilds, Wind Retrofit Project	Property Protection	2	314699.71	2009
HMGP	403.2: Stormwater Management - Diversions	Bay County South John Pitts Road Area Drainage Improvement Project	Structural Controls	0	618026.04	2009
FMA	91.1: Local Multihazard Mitigation Plan	Review & Update Flood Data for LMS	Development Regulation	0	26946.14	2013
FMA	207.2: Mitigation Reconstruction	Harris-Elevation6111HilltopAv	Property Protection	1	316317.83	2013
HMGP	403.1: Stormwater Management - Culverts	City of Panama City Beach, Gulf Highlands, Drainage Improvement Project	Structural Controls	0	646694.55	2013
HMGP	601.2: Generators - Regular	City of Lynn Haven, EOC, Emergency Generator Project	Emergency Management	0	83302.11	2013
HMGP	205.8: Retrofitting Public Structures - Wind; 602.1: Other Equipment Purchase and Installation	Bay County BOCC EMS Substation Wind Retrofit & Generator Project	Multiple	1	299138.12	2013
HMGP	103.1: Feasibility, Engineering and Design Studies; 403.1: Stormwater Management - Culverts	Bay County, Critical Roadway Flood Protection Drainage Improvement	Structural Controls	0	1214800.11	2013
HMGP	205.8: Retrofitting Public Structures - Wind	Bay County BOCC Fire Station 4 - West End Wind Retrofit Project.	Property Protection	1	20642.96	2013
HMGP	205.8: Retrofitting Public Structures - Wind	Bay County BOCC Fire Station 3 Thomas Dr. Wind Retrofit & Emergency Generator	Property Protection	1	265543.00	2013
HMGP	205.8: Retrofitting Public Structures - Wind	Bay County BOCC Fire Station 12 George Bayou Wind Retrofit & Emer Generator	Property Protection	1	252159.00	2013
HMGP	103.1: Feasibility, Engineering and Design Studies	Parker Volunteer Fire Dept Inc., Parker Volunteer Fire Dept. Wind Retrofit Prjct	Property Protection	0	116376.96	2013
HMGP	200.3: Acquisition of Public Real Property (Structures and Land) - Riverine	Bay County BOCC 6429 ZINNIA ST ACQUISITION & DEMOLITION PROJECT	Acquisition & Elevation	1	213939.37	2013
HMGP	200.3: Acquisition of Public Real Property (Structures and Land) - Riverine	Bay County BOCC 2405 E. 17th Street Acquisition & Demolition Project	Acquisition & Elevation	1	998.79	2013
HMGP	202.1: Elevation of Private Structures - Riverine	Bay County Board County Commissioners, 10304 River Alley Rd, Elevation Project	Acquisition & Elevation	1	0.00	2014
HMGP	202.1: Elevation of Private Structures - Riverine	Bay County BOCC, 6439 E. Zinnia Street, Elevation Project	Acquisition & Elevation	1	0.00	2014
FMA	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	FY15-FMA-City of Lynn Haven Aquire/Demo - 710 Kentucky Ave (Mormile)	Acquisition & Elevation	1	246061.60	2015
FMA	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	1720 Vecuna Circle, Bay County Acquisition Project	Acquisition & Elevation	1	267624.17	2017
FMA	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	1708 Vecuna Circle, Bay County Acquisition Project	Acquisition & Elevation	1	278980.97	2017

A7 – Palm Beach County, FL HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
HMGP	205.8: Retrofitting Public Structures - Wind	PALM BEACH COUNTY, CITY OF BOCA RATON, OLD TOWN HALL, WIND RETROFIT.	Property Protection	1	134348.11	2006
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF LAKE WORTH, PALM BEACH COUNTY, CITY HALL ANNEX, WIND RETROFIT	Property Protection	1	61441.05	2006
HMGP	103.1: Feasibility, Engineering and Design Studies	CITY OF WEST PALM BEACH, VILLAGES OF PALM BEACH STORMWATER IMPROVEMENT PROJECT	Structural Controls	0	14395.21	2006
HMGP	205.8: Retrofitting Public Structures - Wind	PALM BEACH COUNTY, DOWNTOWN GOVERNMENT COMPLEX - WIND RETROFIT	Property Protection	3	12286174.52	2006
HMGP	103.1: Feasibility, Engineering and Design Studies; 200.1: Acquisition of Private Real Property (Structures and Land) - Riverine; 403.4: Stormwater Management - Detention/Retention Basins	Palm Beach County - Belverdere Homes Community	Multiple	9	431242.34	2006
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF LAKE WORTH, PALM BEACH COUNTY, LAKE WORTH PUBLIC LIBRARY , WIND RETROFIT	Property Protection	1	45866.30	2006
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF LAKE WORTH, PALM BEACH COUNTY, CITY HALL, WIND RETROFIT	Property Protection	1	79061.18	2006
HMGP	205.8: Retrofitting Public Structures - Wind	CITY OF BOYNTON BCH, PALM BCH COUNTY, BOYNTON BCH FIRE STATION #5/EOC - WIND	Property Protection	1	2803825.01	2006
PDM	91.1: Local Multihazard Mitigation Plan	Developing a Multi-Hazard Mitigation Plan for FAU, Palm Beach County	Development Regulation	0	166128.16	2007
HMGP	205.8: Retrofitting Public Structures - Wind	Village of Wellington, Community Center, Wind Retrofit	Property Protection	1	372839.83	2008
HMGP	401.1: Water and Sanitary Sewer System Protective Measures; 403.2: Stormwater Management - Diversions	City of Greenacres,Palm Beach County,Storm Sewer System rehab drainage	Structural Controls	0	229230.45	2008
HMGP	205.8: Retrofitting Public Structures - Wind	City of Greenacres Wind Retrofit Public Safety Headquarters (Shutter Replacement	Property Protection	1	55438.60	2008
HMGP	205.8: Retrofitting Public Structures - Wind	LAKE WORTH, PALM BEACH COUNTY, LAKE WORTH RESOURCE CENTER, WIND RETROFIT	Property Protection	1	48631.14	2008
HMGP	401.1: Water and Sanitary Sewer System Protective Measures	City of Greenacres, Palm Beach County, A&B Canal Restoration, Drainage	Property Protection	0	538399.37	2008
HMGP	205.8: Retrofitting Public Structures - Wind	Palm Beach County, Highridge Family Center Shutter Installation, Wind Retrofit	Property Protection	1	290581.44	2008

HMGP	403.1: Stormwater Management - Culverts	Palm Beach County, West Gate/Belvedere Home Community, Drainage	Structural Controls	0	78489.83	2008
FMA	91.1: Local Multihazard Mitigation Plan	City of Boynton Beach Flood Plain Management Plan	Development Regulation	0	46855.24	2010
FMA	91.1: Local Multihazard Mitigation Plan	Town of Juno Beach Floodplain Management Plan	Development Regulation	0	44751.85	2012
PDM	405.1: Other Minor Flood Control	Corbett Berm	Structural Controls	0	4118186.48	2016
HMGP	205.8: Retrofitting Public Structures - Wind	Town of Lantana, Library Hurricane Shutter System, Retrofit	Property Protection	1	70976.58	2017
HMGP	205.8: Retrofitting Public Structures - Wind	City of South Bay, Retrofit City Hall	Property Protection	1	165888.00	2017
HMGP	205.8: Retrofitting Public Structures - Wind	Town of Lantana, Police Department (901 8th Street), Retrofit	Property Protection	1	1536600.00	2017
HMGP	300.2: Vegetation Management - Wildfire	Palm Beach County, Wildfire Mitigation	Natural Mitigation Actions	0	750000.00	2017
HMGP	403.1: Stormwater Management - Culverts	City of Boynton Beach, Lakeside Gardens Improvements, Drainage	Structural Controls	0	1133400.00	2017
HMGP	405.1: Other Minor Flood Control	Village of Palm Springs, Miller Road Stormwater Improvement	Structural Controls	0	109140.15	2017
HMGP	405.1: Other Minor Flood Control	Indian Trail Improvement District, Moss Property Stormwater Pump, Drainage	Structural Controls	1	409760.00	2017
HMGP	205.8: Retrofitting Public Structures - Wind	Town of Jupiter, Municipal Complex/Police Department, Code Plus	Property Protection	1	1246868.00	2017
HMGP	403.2: Stormwater Management - Diversions	Indian Trail Improvement District, East-West Conveyance Improvements, Drainage	Structural Controls	0	4035432.00	2017
HMGP	205.8: Retrofitting Public Structures - Wind	City of W. Palm Beach, WTP Administrative & E. High Service Bldgs, Wind Retrofit	Property Protection	1	951000.00	2017
HMGP	403.3: Stormwater Management - Flapgates/Floodgates	Indian Trail Improvement District, Canal Reinforcement, Drainage	Structural Controls	0	383856.00	2017
HMGP	400.1: Utility Protective Measures (Electric, Gas, etc.)	Town of Palm Beach, Town Utility Undergrounding Project, Utility Protective Mea	Property Protection	0	14851500.00	2017
HMGP	601.2: Generators - Regular	Village of Wellington, Lift Stations, Generators	Emergency Management	0	250000.00	2017
HMGP	601.2: Generators - Regular	City of Greenacres, Public Works Facility, Generator	Emergency Management	0	235656.00	2017
HMGP	400.1: Utility Protective Measures (Electric, Gas, etc.)	Village of Golf, Residential Under-grounding Powerlines, Utility Mitigation	Property Protection	0	2201377.58	2017
HMGP	403.4: Stormwater Management - Detention/Retention Basins	Town of Lake Park, Lake Shore Drive, Drainage	Structural Controls	1	5545564.02	2017
HMGP	103.1: Feasibility, Engineering and Design Studies; 601.2: Generators - Regular	Village of Wellington, Public Works, Code Plus and Generator, Phase 1	Emergency Management	0	1214610.30	2017

A8 – Sarasota County, FL HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
FMA	202.1: Elevation of Private Structures - Riverine	Sarasota; 3254 Elliott St; FMA - Elevation	Acquisition & Elevation	1	175960.79	2007
SRL	202.1: Elevation of Private Structures - Riverine	Elevation 640 Dixon Road Venice	Acquisition & Elevation	1	88918.10	2008
SRL	202.2: Elevation of Private Structures - Coastal	Sarasota County Modified Elevation 330 Island Circle	Acquisition & Elevation	1	349198.48	2008
SRL	202.2: Elevation of Private Structures - Coastal	405 Island Circle Elevation	Acquisition & Elevation	1	208290.45	2008
HMGP	205.8: Retrofitting Public Structures - Wind	Sarasota County Public Hospital Board, Ctr for Behavioral Hlth, Wind Retrofit	Property Protection	1	217611.46	2008
SRL	202.1: Elevation of Private Structures - Riverine	Elevation 120 Palm Drive Venice	Acquisition & Elevation	1	163107.57	2008
LPDM	601.1: Generators	FY 2010 JES- PDM City of Venice Emergency Generation System	Emergency Management	0	337588.37	2010
HMGP	401.1: Water and Sanitary Sewer System Protective Measures; 403.2: Stormwater Management - Diversions	Sarasota County, City of Venice - West Gate Drainage Improvement Project	Structural Controls	0	279737.18	2012
HMGP	602.1: Other Equipment Purchase and Installation	Sarasota County Public Hospital Board, North Port Facility, Other Equipment	Other	0	307729.76	2017
HMGP	601.2: Generators - Regular	Sarasota County Public Hospital Board, West Bayside Behavioral Health - Generato	Emergency Management	0	618078.91	2017
HMGP	601.2: Generators - Regular	City of Sarasota, Robert L. Taylor Community Complex, Generator	Emergency Management	0	331490.72	2017
HMGP	601.2: Generators - Regular	City of Venice, City Hall, Generator	Emergency Management	0	1139004.00	2017
HMGP	601.2: Generators - Regular	City of North Port, North Port City Hall, Generator	Emergency Management	0	717080.00	2017
HMGP	402.1: Infrastructure Protective Measures (Roads and Bridges)	Sarasota County, South Casey Key, Flood Control	Property Protection	0	0.00	2017
HMGP	400.1: Utility Protective Measures (Electric, Gas, etc.)	City of Sarasota, MLK Way and Central Avenue, Mast Arm Upgrade	Property Protection	0	0.00	2017
HMGP	400.1: Utility Protective Measures (Electric, Gas, etc.)	City of Sarasota, MLK Way & Old Bradenton Rd, Mast Arm Upgrade, Utility Protecti	Property Protection	0	371723.00	2017
HMGP	400.1: Utility Protective Measures (Electric, Gas, etc.)	City of Sarasota, MLK Way & Cocoanut Ave., Mast Arm Upgrade, Utility Protective	Property Protection	0	322069.00	2017
HMGP	205.8: Retrofitting Public Structures - Wind; 601.2: Generators - Regular	Town of Longboat Key, Town Hall, Wind Retrofit & Generator	Multiple	1	940632.71	2017
HMGP	403.4: Stormwater Management - Detention/Retention Basins	Sarasota County BOCC, Ocean & Higel Stormwater Improvement, Drainage	Structural Controls	1	670591.55	2017

A9 – Brantley County, GA HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
HMGP	91.1: Local Multihazard Mitigation Plan	Brantley County Hazard Mitigation Plan Update	Development Regulation	0	12222.11	2009
HMGP	600.1: Warning Systems (as a Component of a Planned, Adopted, and Exercised Risk Reduction Plan)	Brantley County Severe Weather Stations	Emergency Management	0	18750.00	2017

A10 – Chatham County, GA HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
PDM	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of Savannah Acquisition Demolition '05 Project	Acquisition & Elevation	11	1314658.83	2005
FMA	95.1: FMA or CRS Plan	City of Savannah FMA Plan	Development Regulation	0	36702.85	2005
FMA	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Chatham County FMA 2006 Acquisition Application	Acquisition & Elevation	1	350010.31	2006
FMA	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of Savannah FMA '06 Acquisition & Demolition	Acquisition & Elevation	5	702643.45	2006
HMGP	206.2: Safe Room (Tornado and Severe Wind Shelter) - Public Structures	City of Savannah Hurricane and Tornado Safe Room	Structural Controls	1	4500983.46	2007
PDM	200.3: Acquisition of Public Real Property (Structures and Land) - Riverine	Chatham County Public Works Facility Acquisition	Acquisition & Elevation	1	2747011.77	2007
PDM	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of Savannah '07 Acquisition Project	Acquisition & Elevation	5	860068.85	2007
HMGP	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	City of Savannah East Acquisition Project	Acquisition & Elevation	9	992372.59	2007
HMGP	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	City of Savannah Acquisition of 13 Properties	Acquisition & Elevation	11	1679102.87	2008
LPDM	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Savannah L-PDM 2008 Acquisition Project	Acquisition & Elevation	3	322192.45	2008
FMA	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Chatham County FMA08 Acquistion Project	Acquisition & Elevation	1	663987.36	2008
FMA	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Savannah Northwood Rd Acquisition	Acquisition & Elevation	1	298864.49	2009
PDM	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Savannah PDM 09 Elm and Cloverdale Acquisition	Acquisition & Elevation	11	1746489.39	2009
PDM	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Savannah PDM11 Acquisition Application	Acquisition & Elevation	12	2717046.45	2011
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of Savannah Acquisition Project	Acquisition & Elevation	5	473877.89	2011
HMGP	91.3: Local Multihazard Mitigation Plan - UPDATE	Chatham County Hazard Mitigation Plan Update	Development Regulation	0	66958.06	2017

HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Chatham County Property Acquisition	Acquisition & Elevation	2	655083.31	2017
HMGP	202.2: Elevation of Private Structures - Coastal	City of Tybee Island Substantially Damaged Property Elevation	Acquisition & Elevation	12	1548318.00	2017
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Chatham County Property Acquisition	Acquisition & Elevation	0	566355.00	2017
HMGP	202.2: Elevation of Private Structures - Coastal	Chatham County Substantially Damaged Property Elevation	Acquisition & Elevation	1	172930.00	2017
HMGP	202.2: Elevation of Private Structures - Coastal	Chatham County Property Elevation	Acquisition & Elevation	8	1072025.66	2017

A11 – Glynn County, GA HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
FMA	95.1: FMA or CRS Plan	Glynn County FMA08 Plannng Application	Development Regulation	0	0.00	2008
HMGP	91.1: Local Multihazard Mitigation Plan	Glynn County Hazard Mitigation Plan Update	Development Regulation	0	24501.44	2007
PDM	601.2: Generators - Regular	Georgia PDMC18 Portable Generator Application	Emergency Management	0	725002.00	2018

A12 – Bertie County, NC HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Town Windsor: Residential Acquisition Program	Acquisition & Elevation	8	239587.03	2011
FMA	202.1: Elevation of Private Structures - Riverine	Town of Windsor: FMA SRL Priority 2 (100/0)	Acquisition & Elevation	2	235045.31	2015
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Town of Windsor: Acquisition of 34 Residential Structures	Acquisition & Elevation	33	4179740.14	2017
HMGP	202.1: Elevation of Private Structures - Riverine	Town of Windsor: Elevation of 11 Residential Structures	Acquisition & Elevation	11	1676717.97	2017

A13 – Craven County, NC HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
PDM	202.2: Elevation of Private Structures - Coastal	Craven County Elevation Project	Acquisition & Elevation	1	7521.68	2006
RFC	202.1: Elevation of Private Structures - Riverine	Craven County FY08 Elevation Project	Acquisition & Elevation	1	129285.52	2008
PDM	91.1: Local Multihazard Mitigation Plan	Craven County: Multi-Jurisdictional Hazard Mitigation Plan Update	Development Regulation	0	58092.87	2009
RFC	202.2: Elevation of Private Structures - Coastal	UHMA FY13	Acquisition & Elevation	3	386138.80	2011
HMGP	200.2: Acquisition of Private Real Property (Structures and Land) - Coastal	Craven County: Acquisition of 2 Residential Structures	Acquisition & Elevation	2	435045.27	2011
HMGP	91.1: Local Multihazard Mitigation Plan	Pamlico Sound Regional Hazard Mitigation Plan	Development Regulation	0	89307.23	2011

HMGP	202.2: Elevation of Private Structures - Coastal	Craven County: Elevation of 4 Residential Structures	Acquisition & Elevation	4	542755.80	2011
FMA	202.2: Elevation of Private Structures - Coastal	FY14 UHMA	Acquisition & Elevation	12	1997655.75	2013
PDM	205.8: Retrofitting Public Structures - Wind	Craven County: Wind Retrofit of Two Critical Facilities	Property Protection	2	85037.37	2014
FMA	202.2: Elevation of Private Structures - Coastal	Craven County: Elevation of 5 Residential Structures (100/0)	Acquisition & Elevation	5	607653.23	2014
FMA	202.2: Elevation of Private Structures - Coastal	Craven County: FMA SRL Priority 3 (90/10)	Acquisition & Elevation	6	864176.54	2015
FMA	202.2: Elevation of Private Structures - Coastal	Craven County: Elevation 2 Residentail Structures Priority 3	Acquisition & Elevation	2	364188.03	2016
PDM	205.8: Retrofitting Public Structures - Wind	Craven County: Wind Retrofit Project	Property Protection	1	84792.97	2016
FMA	202.2: Elevation of Private Structures - Coastal	Craven County: Elevation 3 Residential Structures Priority1	Acquisition & Elevation	3	525383.29	2016
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Craven County: Expedited Acquisition of 6 Residential Properties	Acquisition & Elevation	6	675549.16	2018
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of New Bern: Expedited Aquisition of 3 Residential Structures	Acquisition & Elevation	3	188006.36	2018

A14 – New Hanover County, NC HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
PDM	91.1: Local Multihazard Mitigation Plan; 96.1: Public Awareness and Education (Brochures, Workshops, Videos, etc.)	UNCW Mitigation Plan	Development Regulation	0	21299.93	2005
SRL	202.2: Elevation of Private Structures - Coastal	Carolina Beach: Elevation of One Residential Structure	Acquisition & Elevation	1	173065.43	2008
FMA	202.2: Elevation of Private Structures - Coastal	Town of Carolina Beach: SRL Elevation (100/0)	Acquisition & Elevation	7	1158586.66	2013
FMA	202.2: Elevation of Private Structures - Coastal	Town of Carolina Beach: Elevation of Six Residential Structures (100/0)	Acquisition & Elevation	6	752183.99	2014
FMA	202.2: Elevation of Private Structures - Coastal	Town of Carolina Beach: FMA SRL Priority 3 (90/10)	Acquisition & Elevation	4	572378.00	2015
FMA	202.2: Elevation of Private Structures - Coastal	Town of Wrightsville Beach: Elevation1 Residential Structure Priority 1	Acquisition & Elevation	1	182246.24	2016
FMA	202.2: Elevation of Private Structures - Coastal	Town of Carolina Beach: Elevation 2 Residential Structures Priority 3	Acquisition & Elevation	2	364527.63	2016
FMA	202.2: Elevation of Private Structures - Coastal	Town of Wrightsville Beach: Elevation 2 Residential Structures Priority 2	Acquisition & Elevation	2	365019.78	2016
FMA	207.2: Mitigation Reconstruction	Town of Carolina Beach: Reconstruction 1 Residential Structure Priority 3	Property Protection	1	3138.85	2016
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	New Hanover County: Acquisition of 11 Residential Properties	Acquisition & Elevation	11	2170588.14	2018

A15 – Onslow County, NC HMA Project Information

Program Area	*Project Type*	*Project Title*	*Mitigation Action*	*Number of Final Properties*	*Project Amount (2019$)*	*Program FY*
PDM	601.1: Generators	Town of North Topsail Beach: Generator Project	Emergency Management	0	62504.72	2015
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	City of Jacksonville: Acquisition of 16 Multifamily Residential Units	Acquisition & Elevation	16	1629281.40	2018
HMGP	200.1: Acquisition of Private Real Property (Structures and Land) - Riverine	Onslow County: Expedited Acquisition of 6 Residential Properties	Acquisition & Elevation	6	806267.55	2018

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