Rising Flood Levels and Affordable Housing: An Analysis of Mitigation Strategies using Actor Network Theory

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Instructor Comments and Peer Reviews

Professor Gorman has given me useful feedback with respect to the direction of my thesis. He suggested that I state my personal opinion on my topic in order to give the reader clarity on the lens with which I wrote the paper. He also suggested that I construct an approach that cities should take, and explore how different cities might be more or less successful at using that approach. While I was initially concerned on how persuasive or argumentative my paper might read, Professor Gorman encouraged me suggest a path forward.

When discussing my paper with my peer Annie Ross, she suggested that I expand my selection of cities to include Miami and southern Louisiana. Through thoughtful conversation, she helped me understand that these two cities could enrich the variety of reasons why cities are encountering increased flooding as well as the various mitigation strategies cities are taking. I was also very interested by adding cities from the deep south to the roster, as they have widely different topographies and socioeconomic conditions than the other cities I have chosen.

I received valuable feedback from my classmates Kiri Nicholson and Grayson Gatti on the scope of my paper as well as refining my argument. I was concerned with having either too little content to analyze or too much, and through discussions with them they helped me visualize how my paper would be framed. I asked them about their thoughts on my plan to structure my paper with case studies of the various cities first, and then end with a compare and contrast section on mitigation strategies and relief efforts by the cities, states, and federal government.

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In this research paper, I will be using Actor-Network Theory to develop an understanding of how the United States is coming to terms with increased flooding due to climate change. Actor Network Theory is applicable to this problem as how citizens and cities adapt to housing insecurity due to flooding can be described through various actors and their respective relationships (Cresswell et al., 2010). The actors that I will be analyzing will include local, state, and federal governments, flood insurance, and low-income citizens. To form a knowledge base on these actors, the paper will begin with case studies on the cities of Norfolk VA, Houston TX, Wilmington NC, Miami FL, and parts of Louisiana and how they are currently coping with increased flooding. In order to make sure that similar levels of knowledge are established for each city, I will use a standardized set of questions. These questions will cover climate (establishing what kind of flooding a city is experiencing), current mitigation strategies that have been deployed, income and housing statistics for lower-income citizens, and the location and operation of affordable housing communities.

Comparing and contrasting local and state responses to flooding across the case studies, pairing up cities with like causes of flooding, will help form a big-picture view of flooding responses across the United States. The paper will also cover how the federal government manages relief efforts, and will consider if states get a higher standard of treatment depending on their proportion of low-income citizens. I will also discuss incentive strategies for housing development in high-risk areas such as floodplains. How are banks, flood insurance companies, developers, and cities adapting to having more land become high-risk? Is it morally acceptable to have affordable housing developments in areas that are more susceptible to flooding, if that is the

only area the city can afford to build the units? What steps can be taken by the federal government to encourage development in higher-lying areas?

How Cities are Currently Coping with Increased Flooding

Case Study 1: Norfolk, Virginia

Norfolk, VA is experiencing the largest sea-level increase of the United States and globally at 1.5 feet (Hensley 2018). The city projects that an additional 1.5 feet of sea level rise could put 104 miles of roads underwater, and a 3 feet rise could raise the total to 269 miles of roads rendered unusable (Cuoto 2019). Sea level rise, paired with the fact that the area is sinking, pulls Norfolk's very existence into question. Norfolk does benefit from the full support of the U.S. Navy, however, as it is home to the largest naval station in the world (The Biggest Naval Bases, 2019). Understandably, a large proportion of Norfolk's population works in some way for the naval station. If the station is unreachable, citizens are out of a job. Norfolk also has nearly 20 percent of its population living in poverty, and the average per capita income roughly $28000, less than the U.S. average of $32000 (U.S. Census Bureau Quickfacts: Norfolk City, n.d.). For this city, adapting affordable housing for increased flood levels is of grave importance for its citizenry.

While Norfolk is in an existential crisis due to rising sea levels alone, flooding can make a bad situation worse. From 2008 to 2018, the Norfolk Naval Shipyard was severely flooded on nine separate occasions (Kusnetz 2018). This flooding was expensive due to the nature of the damage, but is indicative of what the region is experiencing. The U.S. Navy may be able to afford expensive repairs and efforts to mitigate impacts on the naval station, some of Norfolk's most vulnerable citizens are at risk of being left behind.

The development of Tidewater Gardens is one of Norfolk's oldest public housing units (Hall, 2019). The median annual household income of Tidewater Gardens is roughly $12,000 and more than 95 percent of its residents are black (Kusnetz 2019). As Norfolk plans to redevelop the area, its citizens are at risk of being forced out of the community through rising home prices and a greater cost of living. The city is planning on removing 65 percent of subsidized housing units in the area (Kusnetz 2018). What are residents to do when their homes no longer exist? They will face the option of entering the private rental market with vouchers or being transitioned out of assisted rental housing (Kusnetz 2018). Norfolk and other cities must pursue other options when fortifying their city against the effects of flooding to ensure that all of their citizens are included, not just the ones who can afford to move. Norfolk needs to redevelop its housing properties in order to become resilient to rising sea levels, but needs to reconsider its approach when it comes to affordable housing units. Vouchers do not provide the same stability as city assisted-housing programs, and it is clear that citizens with lower income cannot afford to enter the private market with short notice. The city of Norfolk needs to make room for equality by first developing new affordable housing units on higher ground, then asking residents to relocate.

Case Study #2: Houston, Texas

Houston, Texas was not known for being particularly vulnerable to flooding. Extreme weather events, such as Hurricane Harvey, have changed this perception. Houston is uniquely predisposed to flooding due to its flat terrain, high amounts of impervious surface cover, proximity to the Gulf Coast, and poor-drainage soil (Flood Hazard, n.d.). The city maintains great proximity to a network of bayous and is prone to extreme weather events such as tropical storms or hurricanes (Flood Hazard, n.d.). In terms of its residents, Houston's median income per

capita is roughly $31000 (U.S. Census Bureau Quickfacts: Houston City, n.d.). The city is undergoing extreme gentrification as rent prices rise and force lower income, typically black and brown citizens out into the suburbs (Kimble, 2020).

After Hurricane Harvey delivered severe flooding damage to the Houston area in 2017, the waiting list for affordable public housing increased from 14,000 to 112,000 (Wiltz 2019). This number includes not only those who are newly looking for affordable housing but also those who already lived in affordable housing that needs new accommodations due to damage from the hurricane. Extreme weather events like Hurricane Harvey only make existing shortages of affordable housing worse. Additionally, it was announced in October of 2019 that federal aid for Harvey recovery (a hefty $4.3 billion) would be under Texas state authority for dispersion, rather than counties and cities (Wallace 2019). A report by the U.S. Government Accountability Office concluded that, as of 2018, states were unable to manage disaster recovery housing programs when given money by the federal government (Wiltz 2019). The city of Houston will receive $60 million directly out of the $4 billion to put towards a detention pond, spillway gates, and additional stormwater infrastructure costs to ensure better preparation for severe weather events like Hurricane Harvey (Desk, 2019).

Unfortunately, the city does not have control over disbursing funds for housing relief without state approval. Citizens applying for relief must pass checks to ensure that they are eligible, and even then they must wait for the state to appropriate funds (Desk, 2019). Implementing red tape to prevent fraud may have been an effective method of disbursing relief in the past, but the need for affordable housing and the scale of crisis Hurricane Harvey wreaked on the city is overwhelming. To serve citizens of all socioeconomic statuses, the city of Houston and the state of Texas need to improve their relationship such that local governments gain the

power to approve housing relief on their own. This change would make disaster relief more efficient and make citizens feel secure knowing that their local officials have the power to take care of them in times of need.

Case Study 3: Wilmington, North Carolina

Hurricane Florence, a Category 3 Storm, was projected to wreak havoc up the East Coast in 2018 after making landfall in North Carolina. Instead of steadily moving up the coast, however, Florence stagnated in North Carolina, causing damage to many homes in the state's smaller cities (Kusisto 2018). The median income for Wilmington, N.C. is roughly $32000, the same as the national per capita income, however, approximately 23% of residents live below the poverty line (U.S. Census Bureau QuickFacts: Wilmington city, North Carolina, n.d.). As such, affordable housing is incredibly important to the city's residents.

In response to extreme flooding throughout Wilmington, FEMA has recommended that the city add upwards of 500 parcels to its record of housing in the 100-year floodplain (Still, 2018). Adding these housing units to the floodplain record will cause the property owners to experience an increase in their flood insurance, something that could price residents out of their homes. This new definition also presents a threat to the city, as if the city chooses not to comply, the relevant residents will lose eligibility from federal flood insurance subsidies (Still, 2018). Due to the presence of flood insurance subsidies, residents are not being disincentivized from living in low-lying areas.

According to the Wall Street Journal, the town of Wilmington, N.C. only had an apartment vacancy rate of 6.6% prior to the hurricane. As homes were destroyed, citizens left looking for temporary housing could not do so in their own towns, unable to find an apartment to rent. The high demand for rental units also increases the cost of living, making housing

inaccessible for the most vulnerable members of society. The problem is only exacerbated by the fact that towns like Wilmington and Fayetteville had fewer than 1,500 empty apartment units each (Kusisto 2018). Price and limited supply make housing inaccessible for lower-income victims of natural disasters like Hurricane Florence. The city is working to improve its affordable housing picture, however, by increasing urban density and changing building code to lowering the cost for affordable development (Praats, 2019).

Prior to Florence, North Carolina had a shortage of 190,000 affordable housing units, a figure which ballooned to 300,000 in the aftermath of the hurricane (Wiltz 2019). In addition, federal disaster relief is focused on homeowners rather than renters (Wiltz 2019). This, coupled with the issue that renters are "more likely than homeowners to be low-income and struggle with paying for basic needs" skews disaster relief towards those who are more economically secure (Wiltz 2019). The current disaster relief system is not inclusive of lower-income citizens.

Case Study 4: Miami, Florida

Miami, Florida has seen sea levels rise 6 inches in the since 1990, but is projected to experience another 6-inch increase in the next 15 years (SeaLevelRise.org, n.d.). The alarmingly fast rate of sea level rise is calling Miami's very existence into question. The city is also unique in that, in some areas, its groundwater levels are not higher than sea rise levels, causing saltwater to infiltrate the water table (SeaLevelRise.org, n.d.). Effects of this can mean that drinking water for residents is no longer safe, or that sewage systems are pushed out into the streets (SeaLevelRise.org, n.d.). Flooding isn't just affecting a small proportion of Miami's population. Approximately 85000 of the city's residents live three feet below sea level, roughly 20% of the city's overall population (Cappucci, 2019).

Miami's average per capita income is $27000, less than the national average (U.S. Census Bureau QuickFacts: Miami city, Florida, n.d.). Roughly 24% of its citizens live in poverty, and as such need assistance in obtaining affordable housing (U.S. Census Bureau QuickFacts: Miami city, Florida, n.d.). The city currently has roughly 250 affordable housing developments spanning across Federal Housing and Urban Development (HUD), Section 8, and city affordable housing (LowIncomeHousing, n.d.). These units, like other buildings in the city, are also at risk of flood damage due to climate change. Projections claim that, due to sea level rise and flooding, the City of Miami alone can expect to lose $5.7 billion in residential property value by 2050 (Cappucci, 2019).

The city has developed strategies for more resilient stormwater infrastructure and expanding affordable housing. To mitigate flood impacts, Miami has developed a Stormwater Master Plan that will create recommendations of improvements to stormwater infrastructure as well as develop new design standards for developments, transportation, and more (Stormwater Master Plan, n.d.). Strategies that have been considered include raising streets and water pumps. Street raising is not the ultimate solution, as simply raising the streets does not mean that buildings will automatically rise as well. In fact, street raising could cause buildings to experience more flooding as water could runoff the roads and directly into a building's ground floor. Raising the buildings in conjunction with the streets could work in theory, but is incredibly expensive. Additionally, there is uncertainty in the exact level of sea level rise projections. How can builders be sure that raising the streets by a couple of feet would be sufficient for the city's needs by the end of this century?

On the housing side, the city has developed the Miami Affordable Housing Master Plan (Viglucci, 2020). The plan seeks to expand availability of affordable housing by: creating a bank

to finance developments, streamline zoning and permits, and partner with small-to-medium sized developers to build 3200 units of affordable housing every year for 10 years (Viglucci, 2020). This plan is unprecedented in size and scope, and will serve to provide housing to the residents that make 80% or less of the area's median household income (Viglucci, 2020). Combining the two master plans (Stormwater and Affordable Housing) can create a holistic solution for the residents of Miami. Citizens will be incentivized to live in buildings that have been built to be resilient to increased flooding, allowing the city to keep its lower-income residents safe without forcing them to move further away from the city's epicenter. Miami's strategy is equitable in nature and it is commendable that the city considered its most vulnerable when developing a plan for its future.

Case Study 5: Southern Louisiana

Louisiana is home to the Mississippi River Delta, a network of tributaries that empties into the Gulf of Mexico. The river has long been an erosive force of nature, carving out the landscape as it seeks the fastest path to the ocean. Anthropogenic impacts, however, are causing the river's erosive capability to wreak havoc on Louisiana's coastline. The state is one of the most flood-prone in the nation, and has lost nearly 2000 square miles of land to the sea since the 1930s, with projections to lose another 4000 square miles by 2050 (Shankman, 2019). This loss of land is devastating to the coastal communities that thrive in these areas and are forced to move before their home is underwater. Louisiana's median per capita income is roughly $26000 (Louisiana Household Income, n.d.). Louisiana's residents are less able to adapt to sinking property than other Americans due to having a lower average income.

The Mississippi River picks up and drops sediment as it floods and flows through the delta and into the Gulf of Mexico. Naturally, the shifting sediment would cause land to disappear

in some spots and reappear in others, causing the overall square mileage of land to stay relatively constant even if the specific topography changed with time. Due to human intervention via engineering projects, the river is no longer allowed to flood its banks, causing precious sediment to wash away into the Gulf instead of replenishing the state's coast (Kolbert, 2019). The state is not only vulnerable due to losing land and rising sea levels, it is also at risk of severe weather events such as Hurricane Katrina. Hurricanes can overwhelm an already fragile stormwater infrastructure system. To add fuel to the fire, the state is also losing its wetland system due to flooding and erosion. Wetlands are a natural buffer against erosion and stormwater surge, but the state is losing their protection due to natural as well as human-caused effects, such as deforestation to clear waterways for offshore drilling projects (Louisiana's Disappearing Wetlands, n.d.).

To mitigate the effects of coastal land loss, Louisiana has developed one of the most extensive coastal monitoring projects in the world (Tucker, 2019). The state has also developed the Louisiana Coastal Master Plan, which has seen three iterations from 2007 to 2017. Louisiana has committed $50 billion to saving its coastal communities by raising homes, building flood barriers, and rebuild land (Yale Climate Connections, 2020). However, the success of this plan is drawn into question due to Louisiana's popularity with the gas, oil, and fishing industries. Conflicting interests will be at play here as the state vies protection while remaining economically dependent on the very industries that are destroying its coastline.

On the housing side, Louisiana is in need of expanding its affordable housing units. The Louisiana Housing Corporation found that nearly 30% of the state's renter occupied households are spending more than 50% of their household income on rent, far above the recommended 30% (Natt, 2019). Louisiana faces the fifth higher rate of rent stress in the country, following

metropolitan areas such as Chicago and Los Angeles (Natt, 2019). There is a huge gap for affordable housing in the state, especially since residents may need to be prepared to move from their home at short notice due to land loss. To help close the gap in affordable housing, Louisiana's Housing Corporation awarded $12 million to fund construction and rehabilitation of developments for affordable housing (Serlin 2015). Given that these funds were allocated in 2015 but the Housing Corporation still found gaps for affordable housing in 2019, it is safe to say that the state has more work to do in terms of providing affordable housing for its residents.

Comparing Strategies Across State Lines

Conducting case studies of the cities of Norfolk, Houston, Wilmington, Miami, and of the state of Louisiana has made it clear that a multitude of strategies to combat flooding and affordable housing shortages are being used in the void of federal guidance. States that anticipate only dealing with extreme weather events such as hurricanes, such as Texas or North Carolina, seem to have more reactionary rather then precautionary approaches to flood mitigation. The two states appear to be reacting to past damage rather than predicting future issues, and their housing strategies are in the same vein. The U.S. as a nation is facing a crisis of shortages of affordable housing, but planning for developments without considering how those new developments may be affected by increased flooding for the future creates a risky environment for low-income tenants.

Cities that are facing an existential crisis due to rising sea levels and/or land loss, such as Norfolk, Miami, and Southern Louisiana are taking a more proactive approach to mitigating damage from increased flooding. The cities have experienced rising sea levels in the past few decades and have dedicated portions of their budget to projecting how much more sea level rise they are to expect. Miami and Louisiana are writing into their building, transportation, zoning,

and other codes adaptation strategies for increased sea levels, setting up their city for success in the decades to come. Affordable housing units will have to follow the same building codes, ensuring safety and stability for those tenants. It seems that the greater the crisis a city is facing from rising sea levels, the more productive and proactive it is. If each city must wait for crisis to knock at its door before taking action, there will be needless property loss, displaced citizens, and even deaths in the years to come. Cities such as Norfolk or Miami need to be regarded as exemplars for adapting to rising sea levels, and other areas should use them as guides to build off of rather than starting from scratch when developing their own strategies.

Actor Network Theory

I believe the problem of affordable housing shortages in the face of increased flooding due to climate change can be framed by actor network theory. The actors in this network are the city governments, state governments, federal government, flood insurance, and low-income residents. There is a relationship between the state and federal governments as the states rely on the national government to provide flood relief, since the federal government has the ability to provide billions aid. In turn, the federal government depends on state governments to ensure that the relief is disbursed appropriately to avoid fraud. Local governments rely on the state governments to appropriate funds according to their requests, while they are also bound to state priorities. The federal government relates to flood insurance as it subsidizes flood insurance for citizens that live in low-lying floodplains. Residents rely on their local government to provide them with affordable housing and expect their state government to efficiently disburse funds in times of crisis.

Conclusion

The variety of strategies deployed by cities facing flooding due to climate change is both a testament to the multitude of geographic features the U.S. has as well as the void of guidance from the federal level. As seen in the case studies, it is apparent that the U.S. federal government is more hands-off and allows the states to deal with existential issues such as rising sea levels as they see fit. While this approach helps states maintain their liberty in the federalism system, it is concerning that the U.S. as a whole does not have a comprehensive strategy for adapting to increase flooding and combatting affordable housing shortages. Climate change is the greatest existential threat to the U.S., and the lack of federal acknowledgment of this threat leaves states void of guidance. Ideally, the federal government would outline a flood adaptation strategy for major geographic regions of the country (coastal terrain, river deltas, 100-year floodplains, etc.) as general guidance for states. This strategy would include building requirements that are in accordance with sea level rise projections, as well as detail how affordable housing units can be developed and maintained to keep residents safe. States should be able to tailor this strategy to their individual needs, but having a basic framework in place will lessen the financial burden on states to start from scratch with this problem.

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