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Barriers to Equity in Flood Mitigation Buyouts

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Introduction

The three costliest storms on record, in descending order, are Hurricane Katrina ($161 billion), Hurricane Harvey ($125 billion), and Hurricane Maria ($90 billion) (NOAA, 2019). Ranking in terms of deaths are Maria (2,900 deaths), Katrina (1,833 deaths), and Harvey (105 deaths). At landfall, all three storms hit populations that contained large segments in poverty and that were and are among the most diverse in the US. New Orleans Parish was 66.7% black, the Houston area was 69% non-white, and Puerto Rico was 99% Latino and approximately 30% non-white (US Census, 2016; NBC News, 2017). Recovery from disaster in the context of socioeconomic vulnerability and racial inequality has emerged as a critical yet understudied topic. This paper examines how inequity gets reproduced in the buyout process, a process that is being widely discussed among officials and experts in Houston as a leading mitigation solution for low-income residents. Such discussions lack caution in the potential for exploitation in a city known for housing segregation and disparities in fair housing (Kinder Institute, 2017; Houston Chronicle, 2017).

The Buyout Equity Problem

Mainstream disaster recovery theory emphasizes planning at all levels of government to achieve success in recovery. As the nation's largest non-zoned municipality, Houston has historically has not relied on formal planning and has not embraced the regulation of development through zoning, land use planning, and other governmental means. Houston has relied, famously, on free market forces to guide its physical development (Vojnovic, 2003a and 2003b). This approach is in direct conflict with mainstream recovery theory that emphasizes

good planning (Burby and Dalton, 1994; National Research Council, 2013). It also explains the stubborn stability of Houston's inequity. The question is, how has Houston navigated its recovery from Hurricane Harvey. We address this question from the specific perspective of housing buyouts.

Background

Houston's Flood Risk

The primary source of flood risk in Houston is riverine flooding from a system of 22 bayous, rivers, and tributaries. In general, riverine flooding is the overtopping of banks leading to a slowly rising flood. Every zip code in Houston and Harris County is within two miles of a demarcated flood zone (Nance, 2015) and is therefore subject to riverine flooding. Figure 1 is an image produced by FEMA showing Harris County's floodplains and warning that "Everyone Has a Flood Risk!" But there are other sources of flooding.

Even more pervasive than the risk of riverine flooding is the risk of urban flooding. Urban flooding is caused by rain which falls on impervious surfaces such as paving and roof tops and overwhelms the capacity of the stormwater management system. Houston's stormwater management system is made up of a network of storm drains, storm sewers, open ditches and detention ponds and other neighborhood scale infrastructure. Since the 1980's, new development has incorporated the City's streets as part of the drainage system. Modern streets are designed to convey storm water runoff from more extreme rain events that overwhelm storm drains and roadside ditches to receiving bayous, creeks and streams and away from structures. Unfortunately, the City is fighting an uphill battle to bring its stormwater system up to date since almost 80% of the City was constructed prior to the adoption of modern storm water

management regulations in the 1980's. Even with significant development and infrastructure reconstruction project projects since the 1980's, about 60% of the City's stormwater infrastructure does not meet the City's current standards.

Considering the legacy of inadequate storm water infrastructure, many areas of the City inside and outside of the designated floodplain are subject to urban flooding that can manifest as localized ponding or uncontrolled overland sheet flow. Localized ponding occurs in low areas when rainfall and runoff exceed the capacity of the storm drain or roadside ditch and there is no designated path for extreme event run off. Uncontrolled overland sheet flow occurs anywhere that the storm drains or roadside ditch is overwhelmed and there is no designated path for the excess storm water. At that point gravity takes over and anything downhill may be inundated. Other sources of flooding are the intentional release of floodwater from overfilled reservoirs to prevent catastrophic failure and the unexpected and catastrophic failure of flood control dams.

The increasing frequency and severity of storms as well as the rise in sea level—each an effect of climate change—are a major source of flood risk in the region. Finally, the increasing number of people and pavement in the flood plain—each the result of urban land use decisions—are additional major sources of flood risk. In a word, Houston's flood risk profile is complex.

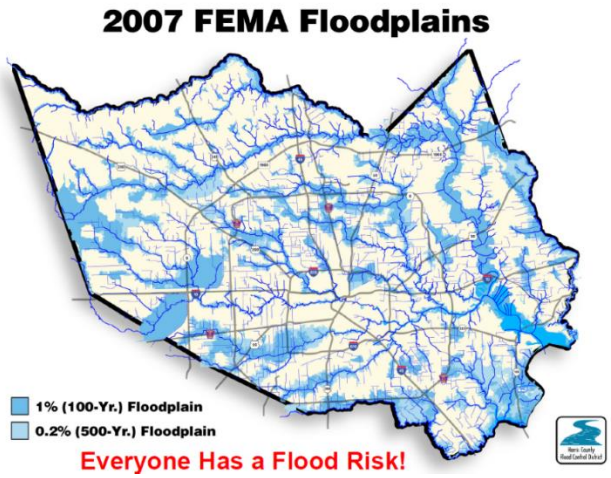

Figure 1. Most recent map of Harris County floodplains.

For three years in a row, Houston experienced a flood at or above the 0.2 percent annual exceedance probability (i.e., 500-year return interval). According to NOAA (2019), the 2015 "Memorial Day Flood" dropped 10 inches of peak rainfall, killed 31 people, and caused $2.7 Billion in damage. The 2016 "Tax Day Flood" dropped 23.5 inches of peak rainfall, killed 8 people, and caused $2.9 Billion in damage. In 2017 Hurricane Harvey dropped nearly 50 inches of peak rainfall in Houston, killed 89 people in Houston, and caused $16 Billion in residential damage along within city limits (Weather Underground, 2017; CityLab, 2018; and City of Houston 2019). NOAA has declared that all these events were significant climate anomalies.

The Greater Houston region has generally adhered to traditional approaches for flood control and stormwater management. Besides a small number of individual demonstration projects, flood control in the Houston region primarily consisted of conveyance through the bayou system, detention in detention facilities and retention in reservoirs. Likewise, stormwater management involved street gutters, open ditches, and drainage pipes discharging to the bayou system. These traditional approaches to flood control and stormwater management combined

with Houston's "longstanding tradition of minimal government" (Kiger, 2015) promoted nearly limitless land development over what used to be marshes, forests, and prairies. Substantial urban growth, limited regulation, and undersized infrastructure contributed to Houston's extreme vulnerability to flooding (Satija, et al, 2016). A worsening climate and Houston's flat landscape and heavy clay soil were also key contributors to Houston's flood risk.

Hurricane Harvey was a turning point. Starting on August 26, 2018, the Category 4 hurricane produced an historic peak rainfall of 60.58 inches over the southeastern Texas coast, resulting in catastrophic flooding (NOAA, 2018). According to the National Hurricane Center, Harvey was the second most costly in US history ($125 billion) and its effects caused 105 deaths across Texas (NOAA, 2019). Over half (about 59%) of all Harvey-flooded homes were located outside of the 500-year floodplain (CoreLogic 2017; Houston Chronicle 2018; City of Houston 2018). All systems for controlling and managing stormwater and flooding were overwhelmed by the storm; however, city and county government were able to remain functional throughout the event, thus preventing a catastrophe.

Hurricane Harvey impacted an estimated 208,532 homes in the Houston metro area (City of Houston, 2018). Post-Harvey analysis shows that 1.2 percent of Harvey impacted homes were in the floodway, 20.7 percent were in the 1 percent flood zone (100-year), and another 18.7 percent were in the 0.2 percent flood zone (500-year). All totaled, more than half of all flood damaged homes were located outside any demarcated flood zone (City of Houston, 2018), which means most people who flooded were not required to have flood insurance.

People most affected by Harvey were Hispanic and low-income households making less than $50,000 (Kinder Institute, 2017). Over 536,960 people in the Houston region live in areas of high social vulnerability and experienced over three feet of flooding during Hurricane Harvey.

The National Flood Insurance Program indicated there were 132,620 policies in force at the time of Harvey. According to the Houston Harvey Needs Assessment (2018) there were 814,600 total households in Houston, which equates to only 16.2% of households with flood insurance at the time of the storm. Many residents are still struggling to recover with few resources. Moreover, vast differences between very rich and very poor populations within Houston complicate the development of a strategy for removing the most at-risk structures from harm's way (Oxfam, 2017; Willison, et al, 2019; CityLab, 2018).

Houston renters were significantly impacted by Harvey. The majority, 57% of Houston households, are renters (City of Houston, 2019). African American and Hispanic Houstonians, 68% and 62% respectively, are more likely to be renters than Whites, 43% (City of Houston, 2019). Of all rental households, 23.1% were impacted by Harvey flooding. (City of Houston, 2018). African American and Hispanic renters were disproportionally impacted by Harvey but have no option for mitigation. Lack of affordable housing unit gives renters few options for self-relocation. Lack of viable federally funded mitigation programs for multifamily complexes further limit access to mitigation. Buyout programs provide few incentives for landlords of single-family residence as compared with the loss of rental income.

Known as "property acquisitions" or "structure buyouts," removing structures from the most flood prone locations can be controversial. Buy-outs are the most disruptive approach to flood mitigation because they involve displacing people from their homes and communities. Many people cannot afford to move and cannot be made whole with a traditional buy-out. Many depend on nearby family members, local churches, food pantries, and other critical community-based services that cannot be readily reproduced elsewhere.

Experts have commented on how Houston could be so vulnerable.

> Unfortunately, most of this drainage infrastructure was overwhelmed by our rampant urban expansion that began in the 1960s and continues to this day. No other large reservoirs have been built. Brays, Buffalo and White Oak bayous were lined with concrete to improve water flow, but that wasn't enough to handle the increased runoff from the city's urban sprawl. By the 1990s, most of the bayous that drain Houston were unable to contain a 100-year flood, much less the 500-year or 1,000-year variety.
>
> Bedient and Juan, 2017

Hurricane Harvey occurred in a global context of increasing flood severity and frequency that is projected to continue increasing (IPCC, 2018). With 16 disasters exceeding $1 billion each, the year 2017 was the costliest year ever for US weather and climate disasters. The National Oceanographic and Atmospheric Administration reported a total loss of $306 billion.

After Hurricane Harvey local leaders and decisionmakers immediately endeavored to change regulations and plans in response to mass failure of the existing system. The City's post-Harvey flood ordinance relies primarily on structure elevation to protect residences from flooding. The City's successful Proposition "A" proposed a variety of stormwater and drainage projects composed largely of street-scale gray infrastructure. The County's successful post-Harvey bond issue proposed 237 potential flood risk reduction projects covering all parts of the county.

As of this writing, 50 of these projects are already approved and underway. About half of the proposed projects (126) will be funded via partnership agreements with other jurisdictions (including federal agencies such as FEMA and the Army Corps), and bond funds will be used to provide the local match. The remaining 111 projects are local projects that can be fully funded from the bond. A wide variety of project types, from channel expansion to green infrastructure, have been included in the Bond. Tens of thousands of property buyouts are proposed to mitigate properties located deep in the floodplain. Many of these are in low-income areas. Removing

these homes from flood risk is an important goal of the Harris County Flood Control District, and many property owners want to be bought out. Many others likely will not receive enough to relocate under existing buyout terms. While the Bond measure required considerations of equity, it was not clear just how it would be accomplished.

The Success of Houston's Buyout Strategy

Buyouts are a key mitigation strategy for confronting the long-term risks and costs of living with flood risk. The City of Houston and Harris County Flood Control District pursue strategic buyouts every year, but especially in response to the major floods. Harris County Flood Control District (HCFCD) is renowned for the number of buyouts it has conducted. Since 1985, HCFCD has spent $342 million to purchase approximately 3,100 properties. Funding for these buyouts has come from FEMA, USACE, and HCFCD. This is one of the most successful voluntary buyout programs in the United States. Information on the demographics and exact locations of bought out properties is kept confidential; however, the District does provide a public map of the general buyout areas (see Figure 2).

HCFCD uses a clear set of criteria for buying out properties on a voluntary basis. HCFCD only buys properties whose sole source of flooding is riverine. The location and depth (>2 ft) within the floodplain must be such that structural solutions are not feasible. The buyout must be a cost-effective solution to the property's flooding problem. The buyout should expand the potential for future floodplain preservation and/or flood damage reduction projects, and the buyout must be compatible with community and natural values. (Harris County Flood Control District, 2019).

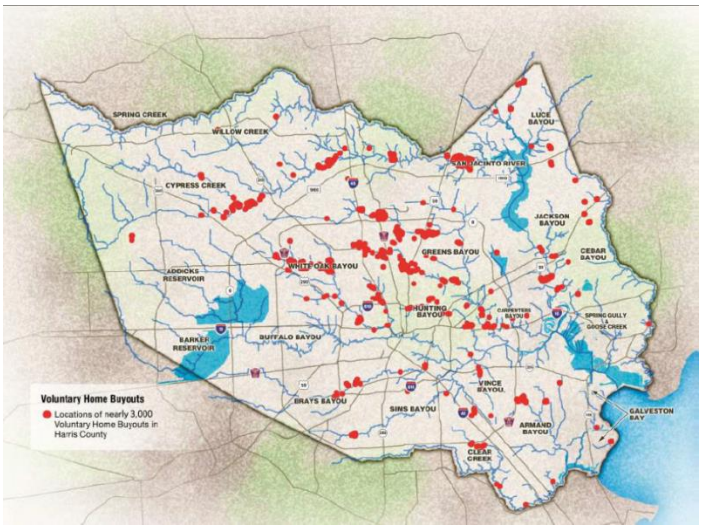

Figure 2. Buyouts in Harris County.

The home buyout approach to flood mitigation has several advantages. It relocates families to higher ground and out of harm's way. It eliminates future flood damage as well as future health and safety risks for owners and rescuers. Home buyouts reduce repetitive flood insurance and federal disaster assistance payments. They often restore the floodplain to its natural and beneficial function while creating open space for parks and other community amenities. In Harris County, FEMA estimates 1,000 restored acres and over 3,000 houses spared. People who volunteer for a buyout receive pre-storm value plus a $31,000 moving supplement. Many people in the Houston area want to be bought out. There are waiting lists and lotteries.

Nine months after Hurricane Harvey, FEMA approved $164M for the County's Home Buyout Program. This will buyout 1,000 additional homes. The first allocation consisted of 169 homes located primarily in the north and east areas of the county.

The Social Impacts of Buyouts

Research by Enarson and Fordham (2008:21-24) found that flood mitigation is, in fact, a social process rather than a technical accomplishment. They recommend that the process include people "whose life experiences reflect the vulnerabilities and strengths of those most at risk," especially women, people of color, low income, etc.; and that social vulnerability analysis be incorporated as a planning tool.

Despite the success of the current home buyout approach to flood mitigation, a broader perspective, based on the research results of Enarson and Fordham (2008), uncovers many disadvantages. Many low-income residents perceive buyouts as a "taking." For many low-income and poor people who struggled to acquire property, most of their wealth is in their home. In this case, a buyout is a transfer of wealth that, once gone, may never be able to be attained again. Furthermore, low-income residents cannot afford to relocate. Houston lacks affordable housing that is not already at high flood risk. Because there is not enough affordable housing in Houston and Harris County, buyouts could have negative socioeconomic impacts unless they are coordinated with increased access to affordable housing (Greater Houston Flood Mitigation Consortium, 2019). Relocation often means losing one's family, school, church, job, and transportation. These are irreplaceable resources for vulnerable residents. Relocation is therefore a critical part of a buyout. It must be included in the buyout package and it must be well-conceived based on actual needs. Social vulnerability must be understood and incorporated into program design.

Low cost housing often does not meet benefit-cost criteria that is required for all FEMA funding as a matter of national policy (many states and local jurisdictions also adopt a similar policy). Any programmatic decision based on economic valuation will value properties of the

wealthy more than those of the poor, which will produce subsequent demographic implications by race, ethnicity, age, gender, etc. Bias in the distribution of federal mitigation dollars for buyouts was recently analyzed by Hersher and Benincasa (2019). The study analyzed 40,000 FEMA-funded buyouts nationwide and found that "white communities nationwide have disproportionately received more federal buyouts after a disaster than communities of color"(Benincasa, 2019). Neighborhoods that were more than 85 percent non-Hispanic white received the most buyouts. The key reason lies in federal policy requiring the use of benefit-cost criteria that promotes wealth inequality by privileging those who own more expensive property. These forces are reinforced in the Houston context, which is characterized by housing segregation and pro-development. Current buyout policy is not need based.

Low-income residents are further impacted because low-cost housing is more likely to be deemed substantially damaged immediately after a flood, leaving them unable to afford to rebuild and therefore subject to an unwanted buyout, otherwise known as displacement. Renters can become displaced in the buyout of a multi-family unit. Moreover, unregulated real estate markets that result in the "flipping" and renting of unmitigated flooded homes after a disaster or that allow damaged multi-family units to re-open without mitigation create the next generation of at-risk housing. Buyout programs in general are hindered by checkerboard outcomes and insufficient interest from homeowners. The remainder of this paper will address the following research question: *What are the impacts of post-Harvey buyouts in vulnerable Houston communities?*

Methods

A mixed method approach was adopted. The methodology consisted of literature reviews of research articles about flood mitigation in the Houston region, and reviews of local and national

news articles. The methodology also included interviews with city and county officials involved in flood policy, and interviews with local advocacy groups. The third research method was a program evaluation to quantify the impacts of federal buy-out criteria on low and moderate income (LMI) households, because FEMA provides the most funding for buyouts. The fourth research method was a case study analysis of three neighborhood types that represent a variety of vulnerable situations: 1) low-income renters, 2) elderly homeowners, and 3) low-income homeowners.

Results

Case 1: Arbor Court Apartments

Houston has at least eight privately owned, federally subsidized multi-family housing complexes located inside the 100-year floodplain. They flooded during the 500-year floods of 2015 and 2016, and again during the 1000-year Harvey flood of 2017. Residents had to be rescued by boat and many lost their belongings, some multiple times. Multi-family structures that were not substantially damaged were not required to mitigate against flood risk before reopening.

One of these complexes, the Arbor Court Apartments in North Houston, suffered three years of devastation that caused mass displacement of its residents. Residents had no choice but to return to Arbor Court or they would have lost their HUD vouchers, which made the apartments affordable for low-income residents. Attempts by Harris County Flood Control District to buyout the apartments and remove them from the floodplain failed. The landlord would have had to be willing to voluntarily accept a buyout, and in doing so would have lost the $2.4 million per year the landlord receives from HUD (Texas Housers, 2018). Feeling trapped,

these low-income and predominately African American residents sued HUD (lawsuit in process as of this writing). Buyouts failed in this case because of the disincentives created by federal low-income housing policy, the lack of local land use controls, the unwillingness of the landlord to volunteer for a buyout, lack of alternative low income housing units and failure to incorporate the needs of low-income residents into the design of buyout policies.

Case 2: Sumpter Street

Sumpter Street (zip code 77026) is in a neighborhood with many elderly residents living in older homes. Because of their age and low-income status, many of the residents on Sumpter Street are not able to maintain their older homes. Many of the deeds are over 30 years old and some were issued before the streets were named. This is important because all disaster assistance must follow the deed. After Hurricane Harvey, one home on Sumpter was almost 50% damaged so the elderly man who lived there went to live with friends in the city of Spring, which is quite a distance away from the city center. He had received a notification that his home was designated as a dangerous building and that he was required to take corrective action, such as securing the structure, completing required repairs, and/or demolishing the structure. The home was rundown because it had been through three >500-year storms in three years with no rebuilding assistance. The elderly man had not been able to repair the home on his $500/month fixed income.

The dangerous building notification indicated that the floor and the roof were not of sufficient strength and that some portion of the building may collapse in violation of City Ordinances 10-371(a)(3) and 10-371(a)(4). Because the owner failed to take the required corrective actions, citations were issued. These Class C misdemeanors could be raised to felonies if the homeowner failed to appear in court or failed to repair the property. The owner

was late for one court date but was able to get it resolved; however, he was unable to appear for the second court date and this turned the citation into a felony.

FEMA then denied disaster assistance on the basis that the home was unsafe to occupy and that the home was no longer his primary residence, which prevented him from getting repair money and from getting temporary housing or a trailer. The home's damage was over $60,000. The remaining half of the home was not damaged, but the citations applied to the entire home. The elderly man had no offers for a buyout, and Community Development Block Grant disaster assistance was not scheduled to begin for years.

This resident and others like him were trapped, facing the eventual tear down of their homes even though they should have qualified for disaster assistance. Non-profit disaster assistance organizations (e.g., The Alliance, etc.) and volunteer lawyers (e.g., Lone Star Legal Aid, Asian American Bar Association of Houston, etc.) eventually stepped in to represent this man and many other residents who were trapped. This case did not meet the local buyout criteria because it was not located in a flood zone (yet it flooded three years in a row). Deferred maintenance had weakened the home and had made it more susceptible to flood damage from repeated storms. Traditional buyouts failed in this case because the home did not meet standard criteria, but the homeowner likely would have accepted a buyout to get out of the situation. This case exemplifies how vulnerable residents, including elderly and poor residents, slip through cracks in multiple programs and end up underserved and at-risk. Long delays in disaster aid, the lack of home repair programs, and lack of attention to the special needs of elderly low-income residents are the reasons for failure in this case.

Case 3: Fifth Ward

Residents of the Fifth Ward, predominantly Africa American and low income, received a high proportion of denials of assistance from FEMA after Harvey. Those who were approved experienced long delays in getting the funds they needed to repair the flood damage to their homes. The lack of support for their recovery created a sense of desperation and hopelessness among the residents, which made them more susceptible to either private or government buyouts.

A private buyout is another term for the post-Harvey situation whereby an army of speculators from around the country, including Wall Street, combed the city for flooded properties that could be flipped or converted to rental property. Damaged properties were bought for cents on the dollar, nominally repaired but not mitigated, and either converted to rentals or sold. Much of this activity took place before new ordinances could be passed that required mitigation. Large and small developers allocated over $1 billion to purchase flood-damaged properties, a process that interfered with buyouts planned by the government for the purposes of flood risk mitigation. One study documented that one in eight homes sold within six months after Harvey were flood-damaged and converted to rentals, which transformed some neighborhoods (Houston Chronicle, 2018). In this case, buyouts failed because they were perceived as predatory, private buyouts prioritized profit over flood mitigation, and there were no regulations to ensure that flooded structures would be mitigated.

Impacts of Federal Buyout Criteria

It is now widely known that the federal government's benefit-cost ratio (BCR), a required aspect of determining eligibility for FEMA disaster funds, creates inequity in the distribution of mitigation funding through its Flood Mitigation Assistance (FMA) and Hazard Mitigation Grant

Program (HMGP) programs, which provide the majority of buyout funding. BCR is the ratio of total project benefits to total project costs. BCRs greater than or equal to 1 are considered cost effective. Inequity arises because expensive homes are considered to have more benefits than less expensive homes, which leads to disproportionately more funds going to wealthier people.

To streamline the calculation of BCR, FEMA issued a 2013 memo providing pre-calculated benefits (FEMA, 2013). Based on analyzing 11,000 acquired or elevated structures, FEMA determined that acquisition of a structure in the 100-year floodplain is considered automatically cost effective if the acquisition costs less than or equal to $276,000, adjusted for location using standard construction cost guides. Substantially damaged structures are automatically deemed cost effective for acquisition. Acquisitions exceeding the above benchmark require the full BCR methodology.

Despite FEMA's pre-calculated benefits fix, there are still disproportionate impacts on low and moderate income (LMI) households in Houston. These impacts are summarized in Table 1. The table shows many reasons why fewer LMI properties qualify for mitigation assistance. In general, fewer can afford flood insurance or are aware they need it because they are outside the flood zone, and the lack of flood insurance makes them ineligible for an FMA funded buyout program. Lack of flood insurance means lack of acceptable FEMA documentation of the flood loss history. This means that it may not be possible to calculate a BCR for a property that has flooded multiple times but was not covered by flood insurance. Forty percent of flooded properties were LMI properties, but only 28% of flood insurance claims were from LMI properties. The next big factor contributing to the low buyout rate among LMI households is a lack of interest in volunteering for a buyout. While 74% of LMI flooded properties were in buyout areas, only 37% volunteered for a buyout.

Table 1. Barriers to Mitigation of LMI Households in Houston.

Descriptive Statistics for Houston	Impacts on LMI Households
LMI areas have lower flood insurance participation. LMI households were 28% of claims for Harvey.	Ineligible for FMA funding.
LMI areas often lack flood insurance and NFIP flood loss history. LMI properties were 40% of Harvey-flooded properties but only 28% of NFIP claims.	Lower FEMA benefit cost ratios, ineligible for FMA or HMGP funding unless substantially damaged.
LMI areas are impacted by substantial damage. 27% of Harvey-flooded LMI properties were substantially damaged.	Strong need for mitigation. Cost effective for buyout under HMGP or FMA (if insured). Low BCR, ineligible for elevation or mitigation reconstruction.
FEMA Individual Assistance payments to LMI properties averaged $10,877.	Inadequate to fund a mitigation project.
74% of flooded LMI properties are in potential buyout areas. LMI properties represent only 37% of voluntary buyouts.	LMI property owners are volunteering for buyout at a lower rate than the general population of flooded properties.
23.1% of renters were impacted by Harvey.	Needs of renters are not addressed in existing federal buyout programs.
LMI areas include properties with lack of clear title, non-traditional mortgages, heavily leveraged properties.	Buyout programs are not accessible to many LMI owners.

Discussion

As demonstrated in the case studies, the struggles of low-income people, especially people of color and the elderly, to keep their homes likely influences the decision not to give up what is often their only source of wealth. The buyout program itself can be viewed as a predatory attempt to take one's home. Buyouts can be interpreted as a sanctioned form of taking property from people who do not have the means to replace it, since buyouts do not include relocation. Renters on HUD subsidies have few options, even if they want to be bought out. And neighborhoods that feel they are for sale to the many investors looking for people desperate

to sell, perhaps because of delays in receiving disaster funds, become destabilized when there are too many buyouts.

Rental housing stock goes unmitigated with buyout programs. Buyout programs are not attractive to owners of single and multifamily rental properties because the buyout offers are too low to offset loss of rental income. The BCR methodology does not support buyout offers that are high enough to replace rental income. Benefits are based on avoided damages to the structure, and costs are based on the cost of acquiring the land and structures. The market value of rental properties is based in part on the rental income they produce, not just the value of the land and the depreciated replacement value of the structure as with owner-occupied dwellings. Considering that 57% of Houstonians are renters, buyout and other mitigation strategies that address rental properties must be developed to successfully mitigate flood loss in Houston.

Federally funded buyouts include the acquisition of the land and the structure, the demolition of the structure, and the addition of a deed restriction of the land to prevent future development. A more equitable alternative to the traditional land and structure buyout would be a "structure only" buyout. In a structure only buyout, federal funds would be used to acquire and demolish the structure, and the homeowner would maintain ownership of the land. The owner would have the ability to sell the land or rebuild on the land using the proceeds from the buyout. Any new structures built on the land would be mitigated because they would have to be built in compliance with the current local floodplain ordinance. Structure only buyouts allow for a more equitable distribution of available mitigation funds and address some of the negative impacts of traditional buyouts. FEMA should adopt structure only buyouts as an additional eligible project type under their Hazard Mitigation Assistance Program.

Buyouts can be more equitable in other ways, as demonstrated by the best practices of other cities. Chapel Hill, NC combined flexible local money with state money to expand the reach of buyouts to low-income residents. They created a comprehensive risk reduction strategy that included buyouts. The buyouts provided enough to buy a house outside of the flood plain and to relocate. They relocated infrastructure and schools as well as homes and people.

Mecklenburg County, NC used flexible local money to buyout properties every year instead of waiting for a disaster. They established a goal of no homes built in the floodplain. They devised risk scores for different areas of the county and were transparent about sharing the scores with the population. Mitigation options were selected under a community-based process so everyone had a say in how the county would mitigation flooding. Buyouts were implemented by area instead of by individual structure, and the buyouts covered all costs including moving, with professionals hired to help people find a new home.

Conclusions

Buyouts usually take place in the context of post-disaster circumstances, where the conditions of immediate survival and recovery are as relevant as long-term risk reduction. After Hurricane Harvey, low-income residents in Houston were often not interested in being bought out, despite considerable flood risk. Pre-existing vulnerabilities not considered in program design made it harder for buyout programs to reach low-income clients, who were often denied or not eligible for disaster programs. Under these circumstances the buyout program had the appearance of a taking. Programs that did reach vulnerable populations often did not provide enough funds to cover actual costs, and program delays induced some residents to drop out or not apply. There was not enough safe affordable housing to meet peoples' needs and there was no plan to address the lack of safe affordable housing, leaving vulnerable people with few

options but to stay in place even if current housing conditions were not safe. Buyout offers in these circumstances amount to potential homelessness or forced migration. Government buyouts could not keep up with private flipping, which was viewed as a form of unregulated exploitation.

Post-disaster recovery and mitigation should be designed to ensure that plans for rebuilding and resource allocation take into account the circumstances of vulnerable populations. Staff time and resources should be dedicated to identifying vulnerable populations and understanding their specific concerns and needs. The involvement of vulnerable people themselves, or their representatives, in the planning process might increase the likelihood that equitable recovery and mitigation outcomes are produced.

References

1. Oxfam. 2017. "Hurricane Harvey and Equitable Recovery." *Oxfam America.* https://www.oxfamamerica.org/explore/research-publications/hurricane-harvey-and-equitable-recovery/.

2. Willison CE, Singer PM, Creary MS, et al. "Quantifying inequities in US federal response to hurricane disaster in Texas and Florida compared with Puerto Rico." *BMJ Global Health* 2019;4: e001191. https://gh.bmj.com/content/4/1/e001191

3. Intergovernmental Panel on Climate Change (IPCC). 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. https://www.ipcc.ch/sr15/chapter/summary-for-policy-makers/.

4. Phil Bedient and Andrew Juan. 2017. "Lack of infrastructure, regulation made Houston vulnerable." Houston Chronicle. https://www.houstonchronicle.com/opinion/outlook/article/Lack-of-infrastructure-regulation-made-Houston-12185652.php.

5. Eric S. Blake and David A. Zelinsky. 2018. "National Hurricane Center Hurricane Harvey Report." No. AL092017. NOAA. https://www.nhc.noaa.gov/data/tcr/AL092017_Harvey.pdf

6. Satija, Neena. 2016. "Boomtown, Flood Town." The Texas Tribune. https://houston.texastribune.org/boomtown-floodtown/

7. Kiger, Patricia. 2015. "The City with (Almost) No Limits." *Urban Land*. https://urbanland.uli.org/industry-sectors/city-almost-no-limits/.

8. Burby, Raymond & Dalton, Linda. (1994). Plans Can Matter! The Role of Land Use Plans and State Planning Mandates in Limiting the Development of Hazardous Areas. *Public Administration Review*. 54. 229.

9. Rebecca Hersher. Minorities Likely to Receive Less Disaster Aid Than White Americans. March 5, 2019. National Public Radio. https://www.npr.org/2019/03/05/700289776/minorities-likely-to-receive-less-disaster-aid-than-white-americans.

10. Robert Benincasa, Search the Thousands of Disaster Buyouts FEMA Didn't Want You to See. March 5, 2019. National Public Radio. https://www.npr.org/2019/03/05/696995788/search-the-thousands-of-disaster-buyouts-fema-didnt-want-you-to-see.

11. Rebecca Hersher and Robert Benincasa. How Federal Disaster Money Favors the Rich. March 19, 2019. National Public Radio. https://www.npr.org/2019/03/05/688786177/how-federal-disaster-money-favors-the-rich.

12. National Research Council. 2013. Levees and the National Flood Insurance Program: Improving Policies and Practices. Washington, DC: *The National Academies Press*.

13. Greater Houston Flood Mitigation Consortium. 2019. Affordable Housing Report. https://www.houstonconsortium.com/.

14. NOAA National Centers for Environmental Information (NCEI). U.S. Billion-Dollar Weather and Climate Disasters (2019). https://www.ncdc.noaa.gov/billions/events/US/1980-2018. Accessed on June 21, 2018.

15. Nance, Earthea. 2015. "Exploring the Impacts of Flood Insurance Reform on Vulnerable Communities," *International Journal of Disaster Risk Reduction* 13:20-36.

16. David Hunn, Matt Dempsey, and Mihir Zaveri. Houston Chronicle, "Harvey's Floods: Most Homes Damages by Harvey were Outside Flood Plain, Data Show." March 30, 2018.

17. Dickerson, A. Michele. 2018. "Hurricane Harvey and the Houston Housing Market." *Texas Law Review Online*, Volume 96. https://texaslawreview.org/hurricane-harvey-and-the-houston-housing-market/

18. City of Houston Housing and Community Development Department. "Local Needs Assessment." October 5, 2018. http://houstontx.gov/housing/20181011.html.

19. NOAA, Fast Facts – Weather Disasters and Costs, 2019, https://coast.noaa.gov/states/fast-facts/hurricane-costs.html

20. Dante Chinni and Sally Bronston, 2017, NBC News, https://www.nbcnews.com/storyline/hurricane-harvey/houston-population-boom-made-harvey-s-damage-much-worse-n798391

21. Kinder Institute. 2017. Growing but Unequal: Mapping High Opportunity Areas and Implications for Affordable Housing. Rice University. https://kinder.rice.edu/research/growing-unequal-mapping-high-opportunity-areas-and-implications-affordable-housing.

22. Houston Chronicle. 2017. https://www.houstonchronicle.com/local/gray-matters/article/Why-Houston-remains-segregated-10935311.php.

23. US Census. 2016. https://www.puertoricoreport.com/puerto-ricans-in-the-united-states-a-statistical-profile/

24. Texas Housers. 2018. Tenants at Houston's flooded, distressed Arbor Court Apartments sue HUD for intentional racial discrimination. https://texashousers.net/2018/07/19/tenants-at-houstons-flooded-distressed-arbor-court-apartments-sue-hud-for-intentional-racial-discrimination/

25. Houston Chronicle. 2018. https://www.houstonchronicle.com/news/houston-texas/houston/article/houston-harvey-flood-homes-real-estate-investor-12901718.php

26. FEMA. 2013. Cost Effectiveness Determinations for Acquisitions and Elevations in Special Flood Hazard Areas Using Pre-Calculated Benefits. October 8, 2013. https://www.fema.gov/media-library/assets/documents/85014

27. Igor Vojnovic. 2003. "Laissez-faire Governance and the Archetype Laissez-faire City in the USA: Exploring Houston, Geografiska Annaler: Series B, *Human Geography*, 85:1, 19-38.

28. Igor Vojnovic. 2003. Governance in Houston: Growth Theories and Urban Pressures, *Journal of Urban Affairs*, 25:5, 589-624.

29. City of Houston Housing and Community Development Department. 2019. "Public Input for the Housing and Community Development Planning Process 2019-2020." www.houstontx.gov/housing

30. City of Houston. 2019. "Hurricane Harvey Recovery: A Progress Report." https://www.houstontx.gov/postharvey/…/11.28.2018_progress_report_updated.pdf.

31. Weather Underground. 2017. "Harvey in Houston: Most Extreme Rains Ever for a Major U.S. City." Bob Henson. https://www.wunderground.com/cat6/harvey-houston-most-extreme-rains-ever-major-us-city

32. CityLab. 2018. https://www.citylab.com/equity/2018/10/whos-losing-out-on-hurricane-harvey-aid-in-texas/571327/

33. Harris County Flood Control District. https://www.hcfcd.org/.