



The Storm That Changed Houston:

**Reflections on Houstonians'
Preparedness and Resiliency on
Hurricane Harvey's Fifth
Anniversary**

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Executive Summary

Late Friday evening on August 25, 2017, Hurricane Harvey made landfall along the Texas Gulf Coast as a category 4 storm, devastating everything in its path. Moving back and forth offshore and stalling over the Houston area, Harvey released over 40 inches of water over the course of five days and caused catastrophic flooding unlike any weather-related event this area had ever experienced.

Three months after Harvey made landfall, the Hobby School of Public Affairs at the University of Houston launched the first wave of surveys in a multi-year study to assess the impact of Harvey. We explored Houstonians' vulnerability, recovery, resiliency, and preparedness for future flooding and severe weather events. In the successive waves of the survey we requested respondents' support for policies to mitigate the effects of natural disasters, their assessment of how government officials handled these events, and what still needs to be done to ensure that vulnerable groups in the Greater Houston area are able to get back on their feet after natural disasters hit.

Over the last five years, the Greater Houston area has endured multiple flooding events, fires, extreme cold, and unusual heat. The findings from our studies suggest that Houstonians are a particularly resilient group of individuals who have continuously been able to endure and recover from various type of natural disasters. Nevertheless, there are still vulnerable groups of Houston residents who struggle to fully recover from severe weather events, like Hurricane Harvey, despite mitigation efforts by government agencies.

In this report, we present results describing who was affected by Hurricane Harvey as well as the type and extent of the damages they faced:

- 56.6% of respondents recently polled and living in the Greater Houston area said they were affected by Hurricane Harvey.
- Compared with other natural disasters affecting the Greater Houston Area since 2004, Hurricane Harvey resulted in the highest percentages of loss from damage to property (43.1%). Of those affected by Hurricane Harvey, 52.4% reported damage to their residence and 32.8% said they had to evacuate or relocate.
- The second and third most damaging storms to property were severe storms and flooding in 2019 (38.5%) and Winter Storm Uri in 2021 (38.2%).

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- Respondents from ethnic and racial minorities were affected by Hurricane Harvey in larger proportions than non-Hispanic white respondents: 50.5% of white, 57.3% of Black, 58% of Asians, and 64.4% of Hispanic respondents reported having been affected by Hurricane Harvey in 2017.

The impact of Hurricane Harvey in the Greater Houston area has been massive, and seems to have affected support for policies to mitigate flooding among all Houstonians, including those who did not report direct material losses from flooding. We further looked at differences in support for mitigation policies over time and across groups of respondents. Our analysis suggests that support for mitigation programs, except buy back of damaged homes, was slightly higher than among those who did not report direct losses:

- The policy interventions garnering the most support among respondents to our surveys were: the construction of a new reservoir to protect west Houston; new building codes requiring homes in flood-prone areas to be elevated; greater restrictions on construction in flood plains; and preventing development on native prairies and wetlands in western and northwestern portions of Harris County. More than 90% of respondents supported these four policies.
- The least supported policies were: a program to buy homes in areas that have repeatedly flooded using local state and federal money and denying federally financed flood insurance to homeowners whose homes have flooded three or more times since 2001.
- Respondents who suffered losses during Harvey were more likely to support buyback programs in flood prone areas, especially in the years immediately after the flooding. Only denying federally financed flood insurance received less than 50% support.
- There was little variation in the level of support for most policies across time.

Finally, we analyzed respondents' preparedness, recovery, and adaptive capacity strategies before and after Harvey, as well as the implication of these for future natural disasters and severe weather events:

- Five years after Hurricane Harvey, 81.6% of those affected report having completely or mostly recovered from the effects of the storm.
- Vulnerable populations lag behind non-vulnerable populations in terms of recovery rates from losses suffered due to Hurricane Harvey.
- Early on in our study we found that only one-in-four respondents reported having filed for FEMA assistance following Harvey; by 2022, the proportion of respondents seeking FEMA funds for losses and damages to their property caused by Harvey climbed to 46.4%.
- The racial-ethnic group that reported more FEMA assistance applications right after Hurricane Harvey was Black and African-American respondents with 40.1% followed by Hispanics with 28.2%.
- Five years later, in 2022, Black and African-Americans were still leading the percentage of applications with 62.6%.
- As of 2022, only 39.4% of respondents who applied for FEMA funds after Hurricane Harvey have received funding, 11.2% have received approval of their loan requests, but have not received funds, and about a quarter (24.5%) had their FEMA loan applications denied.

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- In terms of preparedness, the pattern of responses is mixed. Respondents who suffered damages during Harvey are more likely to report having taken measures to mitigate the impact of future natural disasters. Differences between those affected by Harvey and those not affected are larger when it comes to getting home damage protection (14.6 percentage point difference), alternative power supplies (13.6 percentage point difference), and learning evacuation plans for the area (10.2 percentage point difference).
 - Those who have completely or mostly recovered from the effects of Harvey are more likely to have flood insurance (31.1%) than those that have recovered a little or not at all (18.5%). We also observe an increase of nearly 10 percentage points in the proportion of respondents with flood insurance from 2017 (before Harvey) to 2020.

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Chapter 1: Introduction

Late Friday evening of August 25, 2017, Hurricane Harvey made landfall along the Texas Gulf Coast near Port Aransas as a category 4 storm and had devastating effects in its path up the coast and further inland. Hurricane Harvey continued movement near Victoria by the early morning of the 26th with rain bands moving into Fort Bend and Brazoria Counties by the evening before stalling over Harris County. The stalled storm front dropped nearly 40 inches of rain in the Houston area within 48 hours and resulted in extensive flooding throughout the region. Over the next two days, Harvey moved back and forth offshore and continued to drop several inches of rain intensifying the flooding of rivers, bayous, and reservoirs. Harvey moved offshore once more and made landfall near the Texas-Louisiana border on the morning of the 30th, devastating more communities along the Gulf Coast.¹

Three months after Hurricane Harvey made landfall, the Hobby School of Public Affairs at the University of Houston fielded the first survey in a five-year study to understand the long-term experiences of people impacted by Hurricane Harvey and other natural disasters. The goals of these studies were twofold.² First to better understand the needs and preparation of Houstonians and individuals in nearby counties impacted by these disasters. Second, to identify how these individuals, community organizations, private sector, and government leaders have developed and implemented ways to mitigate the damages caused by current and future severe weather events.

Over the last five years, the Hobby School conducted five surveys on the impacts of Hurricane Harvey, flood mitigation in Harris County, and how other natural disasters and severe weather related events have affected not only the Greater Houston area, but throughout Texas and the United States. In this report, we look at how individuals in Greater Houston were impacted by Hurricane Harvey and other natural disasters and how they have adapted, recovered, and prepared for future severe weather events five years after Harvey made landfall.³

The first survey (Wave 1) was conducted via telephone between November 20 and December 20, 2017 with a representative sample of 2,002 residents from Brazoria, Fort Bend, Harris, and Montgomery Counties who were at least 18 years old. The survey began as a panel survey design to be conducted over a five year period. This survey focused on understanding respondents' experiences during Hurricane Harvey and assesses their support for flood mitigation policies in their counties.⁴

¹For more information, see [Hurricane Harvey & Its Impacts on Southeast Texas](#).

²This project was funded by a National Science Foundation Rapid Grant NSF 1760292, and a seed grant from the University of Houston Hurricane Resilience Research Institute HuRRI SGP 2019.

³A list of reports from our five-year study can be found at: [The Impact of Hurricane Harvey](#).

⁴[Impact of Hurricane Harvey Report, 2017](#)

The following year, the Hobby School launched the second survey (Wave 2) conducted via telephone between June 25 and July 31, 2018 with 1,073 respondents living in the same counties as Wave 1. Slightly more than half of respondents had participated in Wave 1. The Wave 2 survey focused on a bond election regarding the mitigation of flooding in Harris County as well as respondents' support for other policies, regulations, and higher taxation to aid in the mitigation of severe flooding events.⁵ In addition, the survey asked respondents how they thought the government was handling these severe weather events and recovery.⁶

The Hobby School intended to field the third wave (Wave 3) of the survey in the fall of 2019, however Tropical Storm Imelda hit the Houston area that September. Additionally, there was a higher-than-expected attrition rate among the panel participants from Waves 1 and 2 which required revising the sampling protocol and survey mode to an online panel. Wave 3 was ultimately fielded between May 20 and June 23, 2020 with respondents living in the same four counties as the first two waves who were at least 18 years old. In total, 1,065 respondents answered questions about their experiences during Hurricane Harvey, how far they were in the recovery process, and their opinions on policies aimed to mitigate future impacts of severe weather events in the region.⁷

The fourth survey (Wave 4) was fielded online between December 22, 2021 and March 2, 2022. Since Harvey there were several natural disasters or severe storms that impacted Texas, especially, the nine-county Greater Houston area.⁸ In Wave 4, the Hobby School asked respondents not only about the ongoing impacts of Hurricane Harvey, but also about the affects of other natural disasters across the state of Texas. Moreover, Wave 4 looked at how natural disasters, like Hurricane Harvey, affected individuals with social vulnerabilities.⁹ A total of 2,587 respondents aged 18 and older living in the Greater Houston area and across Texas completed this wave of the study.

The fifth and final survey of this multi-year study (Wave 5) focused on the effects and recovery from natural disasters across the nation. There were 4,095 respondents in a representative sample of adults living in the Greater Houston area, across Texas, and the United States. In this sample, there were 1,087 living in the nine-county Greater Houston area. The survey asked questions about the experiences and recovery of individuals affected by natural disasters.

Our studies demonstrate that floods are one of the most impactful natural disasters in terms of displacement of residents along the Gulf Coast region leaving them in desperate conditions as a result of the material losses and damages to their homes. As expected, floods are among the disasters that are costliest to home owners. To that end, investigating the long-term impacts of Hurricane Harvey is important and has policy implications for the local authorities, particularly in the coastal areas.

This report focuses on individuals living within the Greater Houston area and their experiences, recovery, and resiliency five years after Hurricane Harvey. We examine how Houston residents have continued to recover and adapt five years after Hurricane Harvey caused mass devastation along Texas' Gulf Coast. We discuss the results from our five-year study during which time Houstonians experienced numerous natural

⁵Harris County Flood Control District Bond Election Survey Report, 2018

⁶The Impact of Hurricane Harvey One Year Later Report, 2018

⁷Hurricane Harvey: Three Years Later Report, 2020

⁸The nine counties in the Greater Houston area include: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller.

⁹Social Vulnerability & Natural Disasters: 5 Years After Hurricane Harvey Report, 2022

disasters.

In the next chapter, we discuss respondents experiences with Hurricane Harvey including who was affected and the damages they sustained. In Chapter 3, we compare support for policies aimed at mitigating flooding events in the Greater Houston area area over time. Finally, in Chapter 4, we examine how respondents in the Greater Houston area prepared, adapted, and recovered from Hurricane Harvey and other natural disasters.

Chapter 2: Experience with Hurricane Harvey

In this chapter we examine who was affected by Hurricane Harvey. Additionally, we look at the damages suffered by respondents to their property or residence, whether or not they had to evacuate or relocate, lost their job or income, or suffered any health problems as a result of severe weather events.

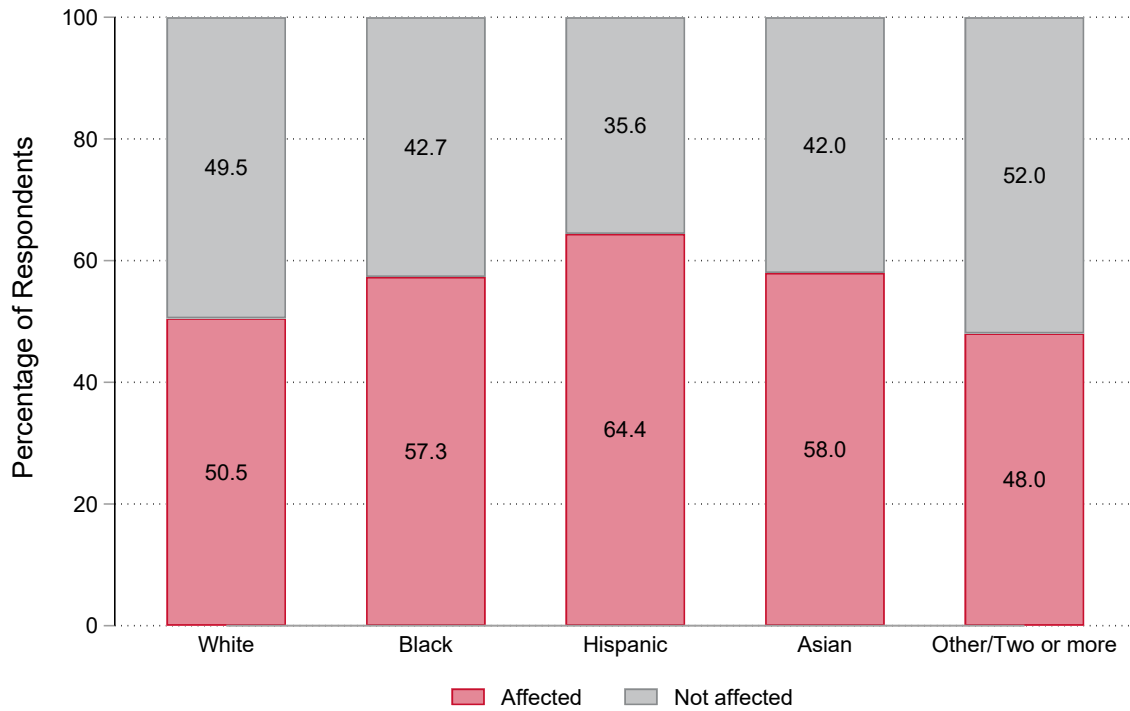
2.1 Who was affected by Hurricane Harvey?

In Wave 4 (fielded between December 21, 2021 and March 2, 2022), we found that 56.6% of our respondent pool living in the Greater Houston area had been affected by Hurricane Harvey. In Figures 2.1 and 2.2, we compare respondents affected by Hurricane Harvey with those not affected by race and ethnicity and income groups. Compared to non-Hispanic whites, respondents who said they belonged to an ethno-racial minority group were more likely to be affected by Harvey (Figure 2.1).¹⁰ Hispanics reported the highest percentage of respondents who had been affected by Harvey (64%), closely followed by Asians (58%), Black respondents (57.3%), and those who said they belonged to two or more groups (50.9%). Among non-Hispanic white respondents, slightly more than half (50.5%) indicated they were affected by Hurricane Harvey.

¹⁰Respondents who identified as "Other" were the group least affected by Harvey (44.5%).

2.1. Who was affected by Hurricane Harvey?

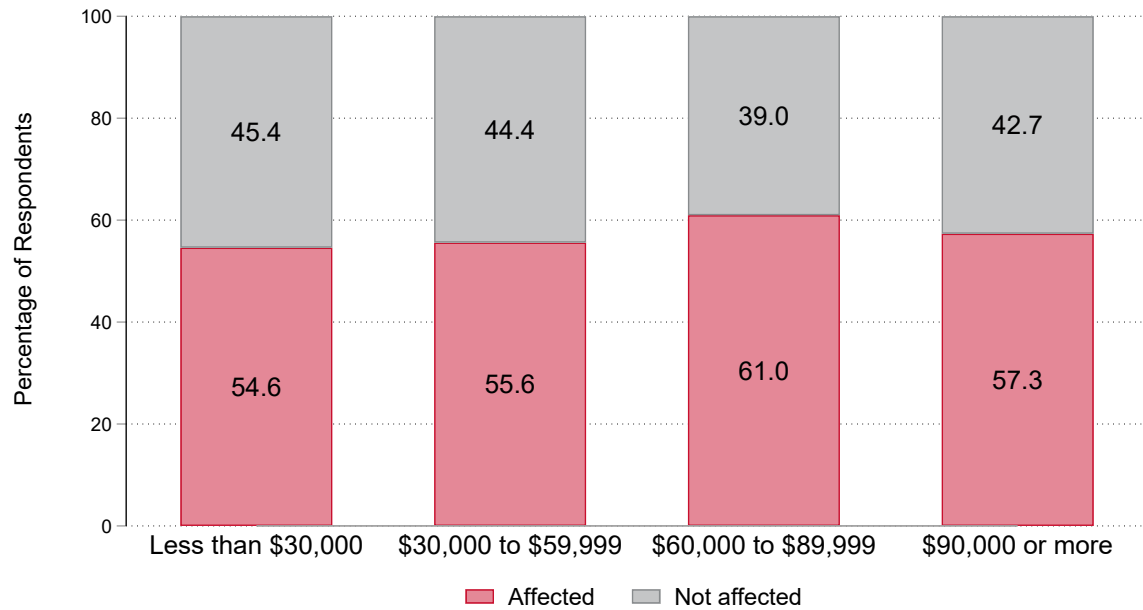
Figure 2.1: Percentage of respondents affected by Hurricane Harvey in the Greater Houston area by race and ethnicity



We also explored the relationship between income groups and those who were affected by Hurricane Harvey in the Greater Houston area. In Figure 2.2 we found that a majority of people in each income bracket had been affected by Hurricane Harvey. Over three-fifths of respondents household income between \$60,000 and \$89,999 (61%) said they were affected by Hurricane Harvey. Respondents in the lowest income group - those who had a household income less than \$30,000 - had the lowest percentage affected by Hurricane Harvey among all four income groups (56.6%).

2.1. Who was affected by Hurricane Harvey?

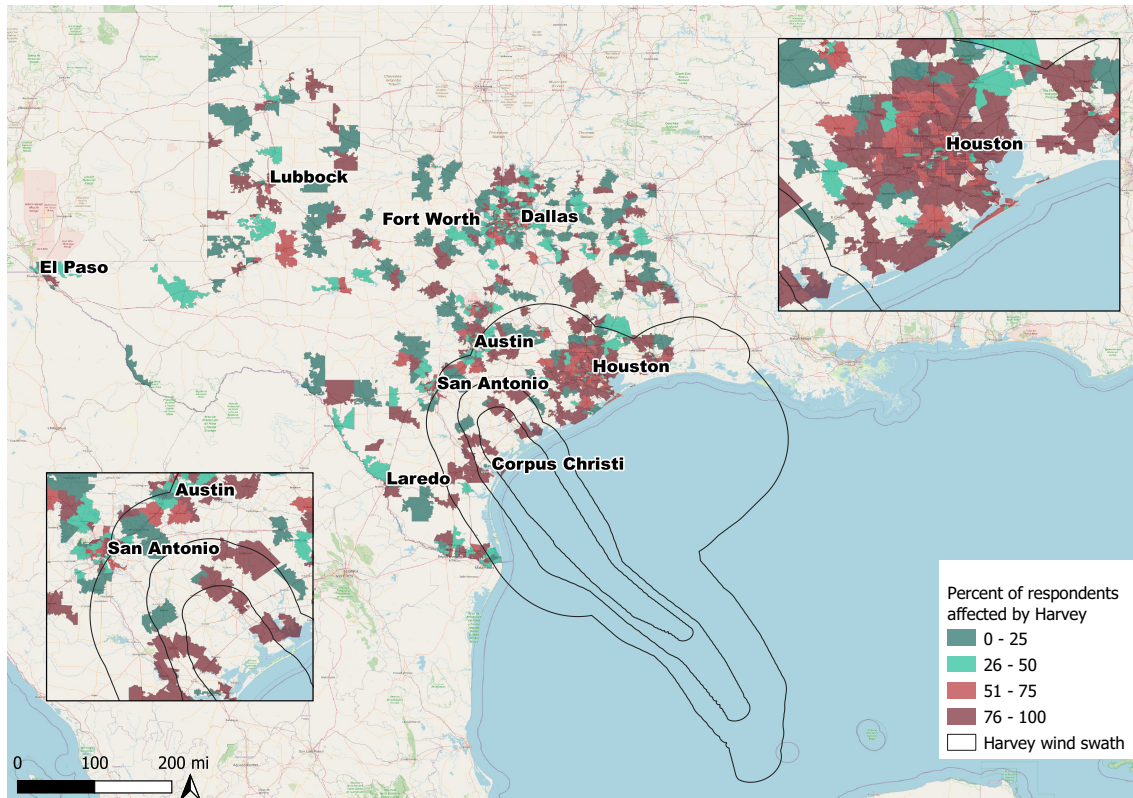
Figure 2.2: Percentage of respondents affected by Hurricane Harvey in the Greater Houston area by income group



In Figure 2.3, we map the percentage of survey respondents affected by Hurricane Harvey and its strong wind swath along the Texas' Gulf Coast. While the effects of Harvey were felt all over Texas, the Houston area and the Gulf Coast were disproportionately affected. The majority of the zip codes surveyed in the Houston area had over 50% of respondents affected by the storm. Few exceptions are in the periphery of Greater Houston as shown by the teal areas in Figure 2.3.¹¹

¹¹Ibid. fn. 9

Figure 2.3: Were you affected by Hurricane Harvey?



2.2 Losses and property damage

Next, we compare how respondents were affected with regard to types of damage suffered as a result of Hurricane Harvey in the Greater Houston area. The highest reported percentages were loss from damage to property (43.1%) and loss of income (26.8%) (see Table 2.1). Additionally, more than half of the Greater Houston area respondents who were affected by Hurricane Harvey said they had damage to their residence (52.4%) and nearly a third (32.8%) said they had to evacuate or relocate. In comparison to other natural disasters affecting the Houston area over the past two decades, a majority of respondents also reported damages to their residence during Hurricane Ike and the 2016 Tax Day floods.

2.2. Losses and property damage

Table 2.1: Percent affected by FEMA declared disasters in the past 20 years in the Greater Houston area

	Damage to property	Damage to residence	Evacuated or relocated	Lost job	Lost wages or income	Health problems
Hurricane Rita (Sept. 2005)	28.6	39.3	39.7	6.4	22.6	4.9
Hurricane Ike (Sept. 2008)	37.9	52.0	29.6	5.1	22.3	3.6
Memorial Day flood (May 2015)	34.3	43.3	18.0	7.7	16.5	4.0
Tax Day flood (Apr. 2016)	36.3	65.5	25.2	7.4	18.7	4.9
Hurricane Harvey (Aug. 2017)	43.1	52.4	32.8	8.5	26.8	6.4
Texas fires of 2018	29.5	33.5	27.6	18.7	13.7	5.4
Severe storms and flooding of 2018	33.7	42.1	23.4	5.8	19.7	5.9
Severe storms and flooding of 2019	38.5	34.0	18.7	8.1	19.6	4.6
Tropical Storm Imelda (Sept. 2019)	25.7	39.8	20.2	8.6	20.9	4.6
Hurricane Laura (Aug. 2020)	30.8	32.8	23.2	11.1	18.7	7.1
Winter Storm Uri (Feb. 2021)	38.2	49.9	15.8	4.9	26.4	11.9
Other disasters	25.3	30.0	12.2	16.2	19.3	18.0

Note: Percentages are of those who were affected by the respective storm and selected that option. Percentages are weighted and rounded to the nearest tenth.

Chapter 3: Policies to mitigate the impact of flooding

In this chapter, we compare the support for policies to mitigate flooding in the Great Houston area. First, we show respondents' support for eleven policies included during the five waves of our surveys. Second, for those policies included in at least four waves, we compare changes in respondents' support over time. Finally, we examine support for policies among those respondents who were directly affected by Hurricane Harvey with those who were not.

3.1 Policies to mitigate flooding

In four waves of the Hurricane Harvey study (Waves 1-4), respondents were asked about their support for different policies related to flood mitigation in the Great Houston area. Some of these policies were repeated across waves, while others were added or replaced. In total, we asked about support for eleven policies. Table 3.1 presents respondents' support for the eleven policies. The first column in Table 3.1 shows the policy, the middle column shows the years the policy was included in our questionnaire, and the right and last column shows the average support for that policy for all the years that policy appeared in the questionnaire. Policies are sorted from the most to the least supported.^{12,13}

Four policies received more than 90% of support among respondents. The most supported policy is *the construction of a new reservoir to protect west Houston* with 91.3% of respondents expressing support. This policy was followed by *new building codes that require homes built in flood-prone areas be elevated/raised to avoid flooding* with 91.1%. *Greater restrictions on construction in flood plains* and *preventing development/construction on native prairies and wetlands in western and northwestern portions of Harris County* also received more than 90% of support with 90.9% and 90.3%, respectively, of respondents supporting these two policies.

Among the least supported policies were the *establishment of a regional flood agency with taxing authority to plan for the prevention of regional flooding* with 78.2% of respondents in favor and a *program to buy homes in areas that have repeatedly flooded with local state and federal money* with 71.9% of respondents supporting the policy. Still, the vast majority of respondents supported all but one of the eleven policies. Far below, we can see the least supported policy was *denying federally financed flood insurance to homeowners whose homes that*

¹²The text used in the questionnaire was: *A number of policies have been proposed to protect the Houston area from the effects of severe weather. Which of these proposals would you support?*

¹³To calculate the support in this section we excluded the *Don't know* and *Unsure* responses.

3.2. Support for mitigation policies over time

have flooded three or more times since 2001. Respondents in our surveys reacted very negatively to this policy which obtained the support of just 45.5% of respondents.

Table 3.1: Average support for policies to mitigate flooding (2017-2022)

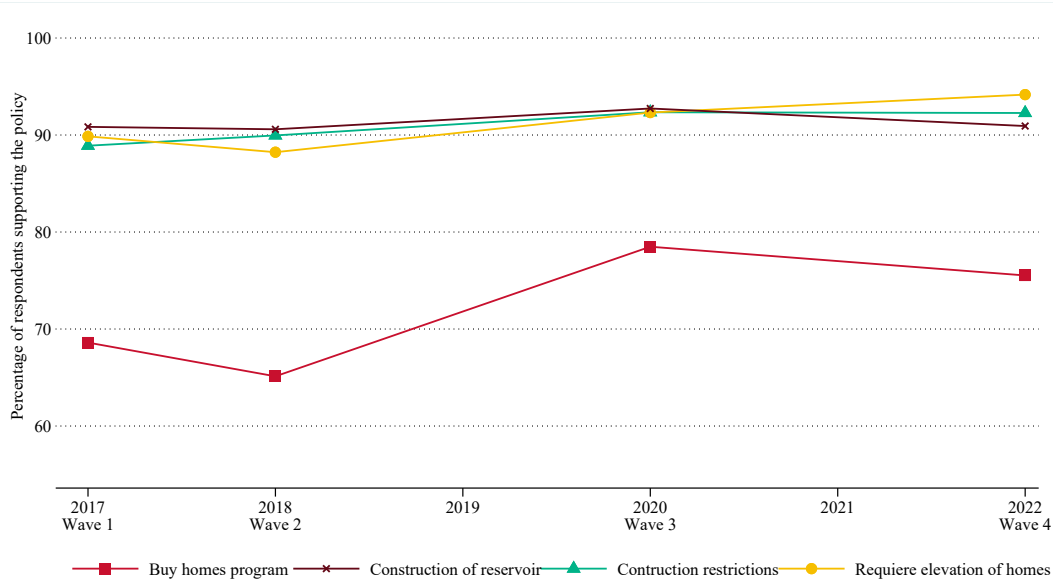
Policy	Years	Avg. support
1. The construction of a new reservoir to protect west Houston.	2017, 2018, 2020, 2022	91.3 %
2. New building codes that require homes built in flood-prone areas be elevated/raised to avoid flooding.	2017, 2018, 2020, 2022	91.1 %
3. Greater restrictions on construction in flood plains.	2017, 2018, 2020, 2022	90.9 %
4. Preventing development/construction on native prairies and wetlands in western and northwestern portions of Harris County.	2017, 2022	90.3 %
5. Widening bayous and channels.	2018, 2020, 2022	84.1 %
6. Require government compensation for homes that are flooded due to the release of water from local reservoirs.	2017, 2022	82.8 %
7. New building codes that require homes built in flood prone areas be elevated/raised to avoid flooding.	2017	82.5 %
8. Requiring sellers of homes to fully disclose prior flood damage to their homes and prior flooding in the surrounding neighborhood.	2017, 2022	79.0 %
9. Establishment of a regional flood agency with taxing authority to plan for the prevention of regional flooding.	2017, 2022	78.2 %
10. A program to buy homes in areas that have repeatedly flooded with local state and federal money.	2017, 2018, 2020, 2022	71.9 %
11. Denying federally financed flood insurance to homeowners whose homes that have flooded three or more times since 2001.	2017, 2022	45.5 %

3.2 Support for mitigation policies over time

In four waves of the Hurricane Harvey surveys, we consistently asked respondents about the extent of their support for four different policies: a) *a program to buy homes in areas that have repeatedly flooded with local state and federal money* (in red color); b) *the construction of a new reservoir to protect west Houston* (in brown); c) *greater restrictions on construction in flood plains* (in teal); and d) *new building codes that require homes built in flood-prone areas be elevated/raised to avoid flooding* (in yellow). Figure 3.1 shows the level of support for the four different policies across the four survey waves.

3.3. Support for policies by Harvey experience

Figure 3.1: Support for policies to mitigate flooding over time



The construction of a reservoir, the introduction of construction restrictions, and requiring certain homes to be elevated are the most supported policies over time. These three policies are continuously supported by at least 90% of respondents across the four survey waves. Constructing a reservoir received the support of 90.8% of respondents in 2017 (Wave 1), 90.6% in 2018 (Wave 2), 92.7% in 2020 (Wave 3), and 90.9% in 2021/22 (Wave 4). Nearly 90% supported the introduction of construction restrictions in 2017, 90.0% in 2018, 92.4% in 2020, and 92.3% of respondents in 2022. Finally, the home elevation program received the support of 89.9% of respondents in 2017, 88.2% in 2018, 92.3% in 2020, and 94.2 in 2022.

Among these four policies, the least supported was a program to buy homes in flooded areas. This policy also had the largest variation in support over the four survey waves. Just immediately after Hurricane Harvey in 2017, 68.6% of respondents supported the program. One year later, support decreased to 65.1% before increasing to 78.5% in 2020 and 75.5% in 2022.

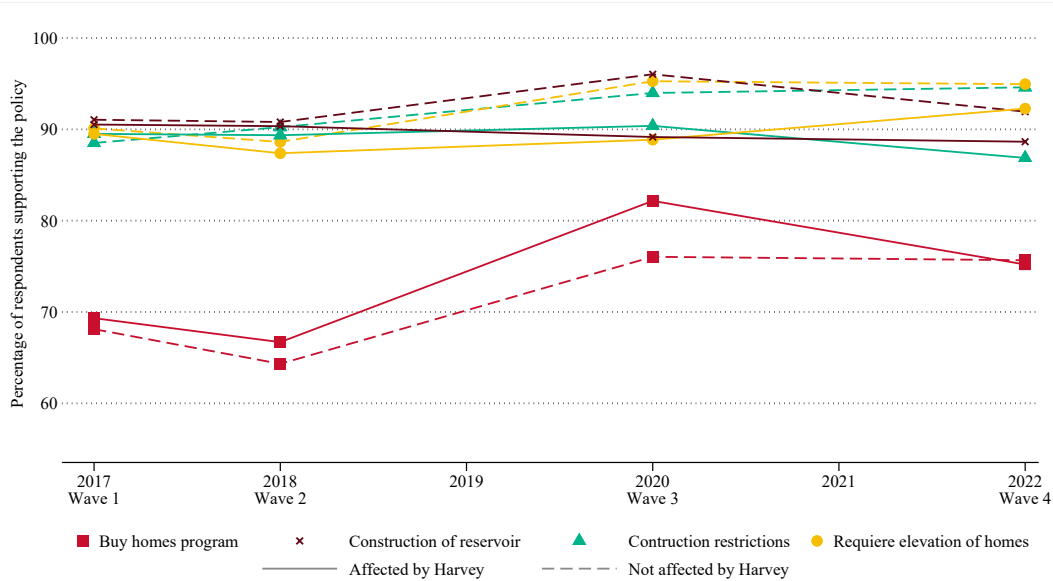
3.3 Support for policies by Harvey experience

Figure 3.2 shows support for policies by whether respondents were affected by Hurricane Harvey. The colors of Figure 3.2 are consistent with Figure 3.1. Solid lines show support for each policy among those respondents affected by Hurricane Harvey and dashed lines report the support among those who were not affected.

Figure 3.2 shows that the more time passed after Hurricane Harvey, the larger the differences between the respondents who were affected by Harvey and those who were not. In 2017, the largest difference was 1.2% for the buy homes program followed by construction restrictions (1%). For the construction of the reservoir and requiring homes to be elevated policies, the most supportive were those not affected by Hurricane Harvey. The differences were about 0.5% for reservoir construction and 0.6% for the elevation of homes requirement.

3.3. Support for policies by Harvey experience

Figure 3.2: Support for policies to mitigate flooding over time (affected vs. not affected)



In 2018, by contrast, the policy with the largest difference was the construction of the reservoir, with a 2.4% gap in favor of respondents affected by Hurricane Harvey. We also found that the respondents who were not affected were more supportive of the three other policies, though overall support remained high. The elevation of homes requirement received 1.2% more support from those not affected than from the affected respondents. The difference for construction restrictions was about 0.9% and 0.5% for the construction of a reservoir.

In Wave 3, the differences become even larger. The only policy supported by more respondents affected by Hurricane Harvey compared to those not affected was the buy homes program, with a 6.1% gap. All other policies compared were more supported by those who were not affected. The difference in support was about 6.9 percentage points for the construction of the reservoir, 6.4% for construction restrictions, and 3.6% for the elevation program.

Finally, in Wave 4 all four policies had higher support among respondents not affected by Hurricane Harvey. Respondents who were not affected by the hurricane were more supportive of the construction restrictions policy, by 7.7 percentage points, than those who were affected. This gap was the largest one in our series of comparisons. The three other policies show smaller gaps. For the buy homes programs, the difference was 0.5% and 3.3% and 2.7%, respectively, for the construction of the reservoir and the elevation of homes requirement policies.

Chapter 4: Harvey preparedness, recovery, and adaptive capacity

In this chapter, we explore how survey respondents from the Greater Houston area prepared for Hurricane Harvey and other natural disasters and how they recovered and adapted from the effects. We first discuss the precautionary measures respondents took to mitigate the impact of Hurricane Harvey in 2017. These measures included procuring and stockpiling supplies and coordinating with friends and family. We then look at recovery path of respondents and the strategies they have used to adapt in the long run, which included getting insurance and applying for FEMA funds.

4.1 Preparedness

Figure 4.1 shows the types of preparations that respondents took before Hurricane Harvey (Wave 1, 2017) and before the 2022 Hurricane season (Wave 4, 2022). Before Hurricane Harvey hit, 49.6% of respondents coordinated plans while five years later, 91.5% of respondents made preparations for next hurricane season. We found that for both moments in time, respondents from the Greater Houston area prepared mostly by stockpiling (71.3% in Wave 1 and 62.5% in Wave 4).

Before Harvey, 45.3% of respondents prepared by coordinating plans with family, 40.2% prepared by removing household items from areas that might flood, and 4.8% by buying a generator. In contrast, 41.0% of respondents from Wave 4 got alternative power supplies such as generators and 23.5% got home damage protection, but only 13.5% coordinated plans with others.

Figure 4.1: Types of preparation before Hurricane Harvey vs. types of preparation for the 2021 hurricane season for Brazoria, Fort Bend, Harris, and Montgomery counties

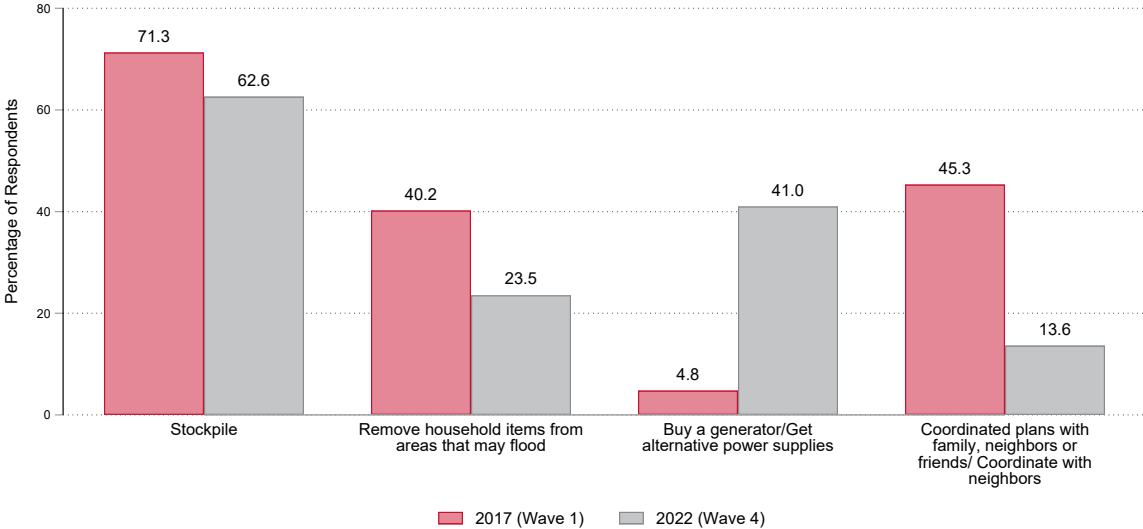
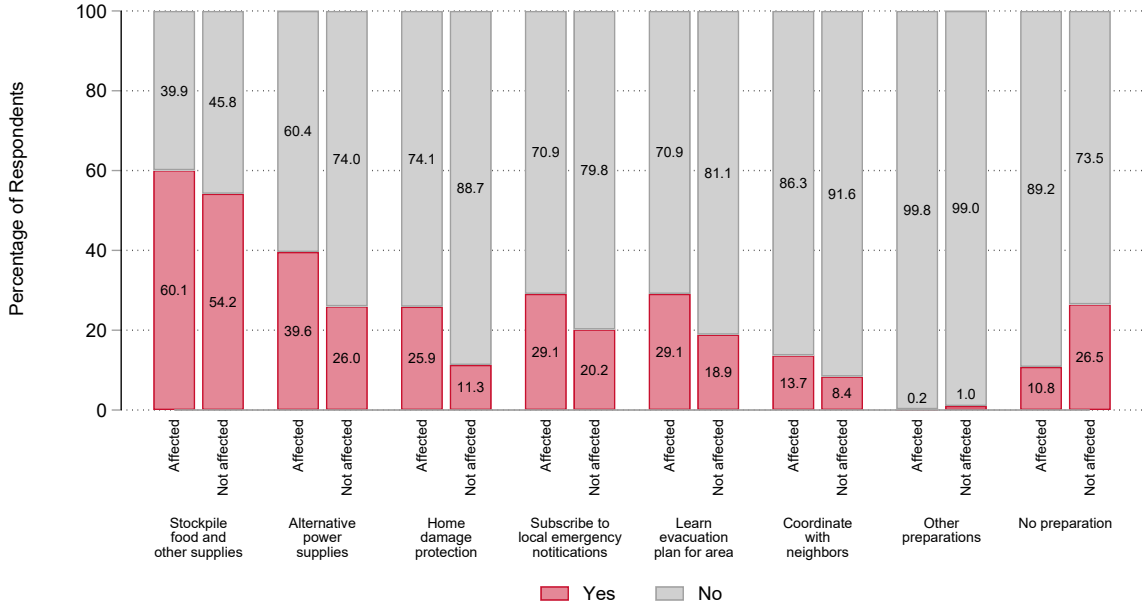


Figure 4.2: Types of preparation for the 2021 hurricane season in the Greater Houston area by those affected by Hurricane Harvey

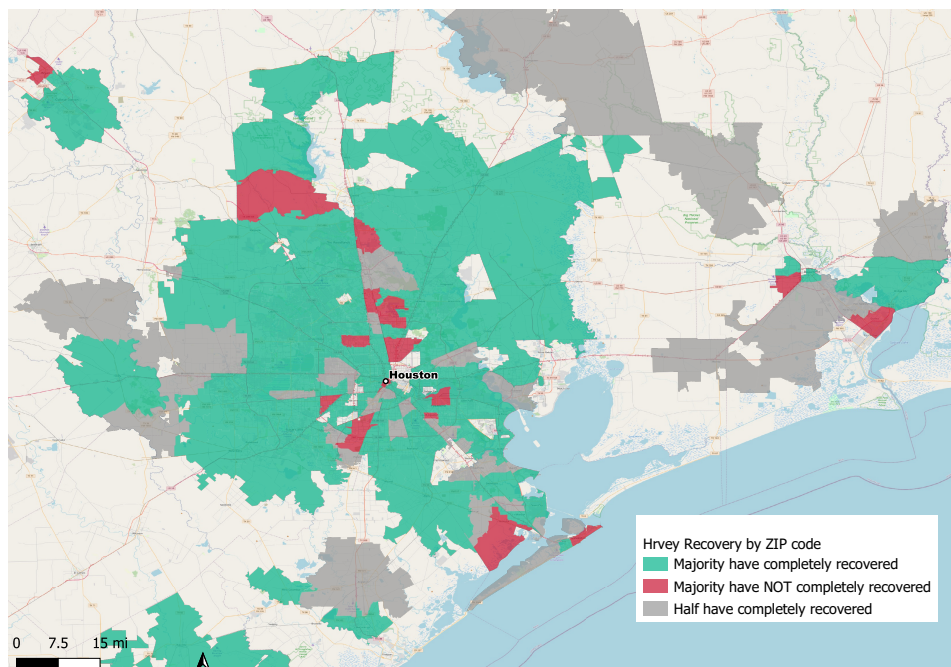


In terms of preparation for natural disasters, we found some differences between those affected by Hurricane Harvey and those who were not affected. As shown by Figure 4.2, the majority of respondents did not make preparations for future natural disasters, except for stockpiling. In general, those affected by Harvey prepared more for the 2021 hurricane season than those respondents that were not affected by it in 2017. While 10.8% of those affected by Hurricane Harvey did not prepare for the 2021 hurricane season, 26.5% of those who were not affected by Harvey did not make any type of preparation for it. The largest differences in preparation between both groups were for home damage protection (around 15 percent points difference), alternative power supplies (nearly 14 percent points difference), and evacuation plans (over a 10 percentage point difference).

4.2 Recovery

Almost five years after Hurricane Harvey initially made landfall in 2017, we asked respondents across Greater Houston about their recovery. First, we look at the recovery status of those living in Greater Houston compared to respondents that were affected by Hurricane Harvey in other parts of the state.

Figure 4.3: Recovery after Hurricane Harvey by ZIP code



As shown in Figure 4.3, the majority of respondents in several areas of the Greater Houston area have completely recovered from Hurricane Harvey (teal areas). However, a majority of respondents in a few areas, such as those near the coastline and Galveston, have not fully recovered (red and gray areas). The areas where the majority of respondents have not recovered (red areas in Figure 4.3) are predominantly vulnerable.¹⁴

¹⁴Ibid. fn. 9

Five years after Hurricane Harvey, we found that 57.9% of those affected have completely recovered, 23% have mostly recovered, 10.2% have recovered about half way, 5.7% have recovered only a little, and 2.5% have not recovered at all (Figure 4.4).

Figure 4.4: Household recovery after Hurricane Harvey for the Greater Houston area

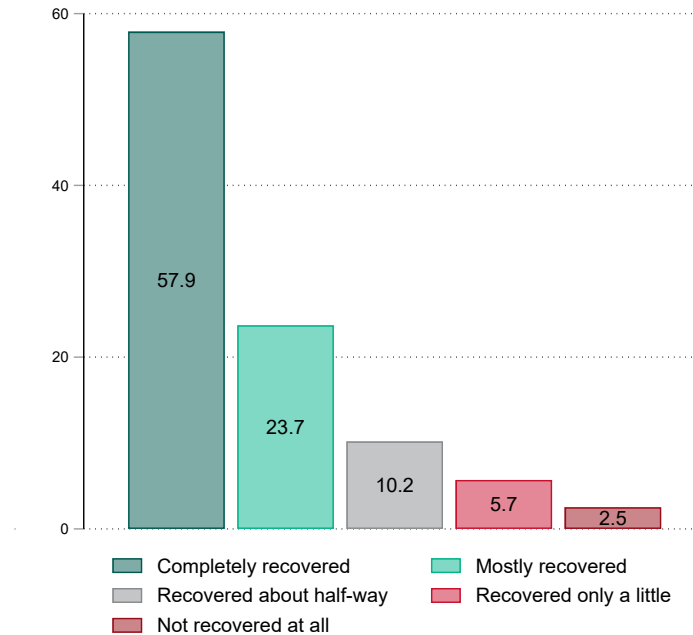
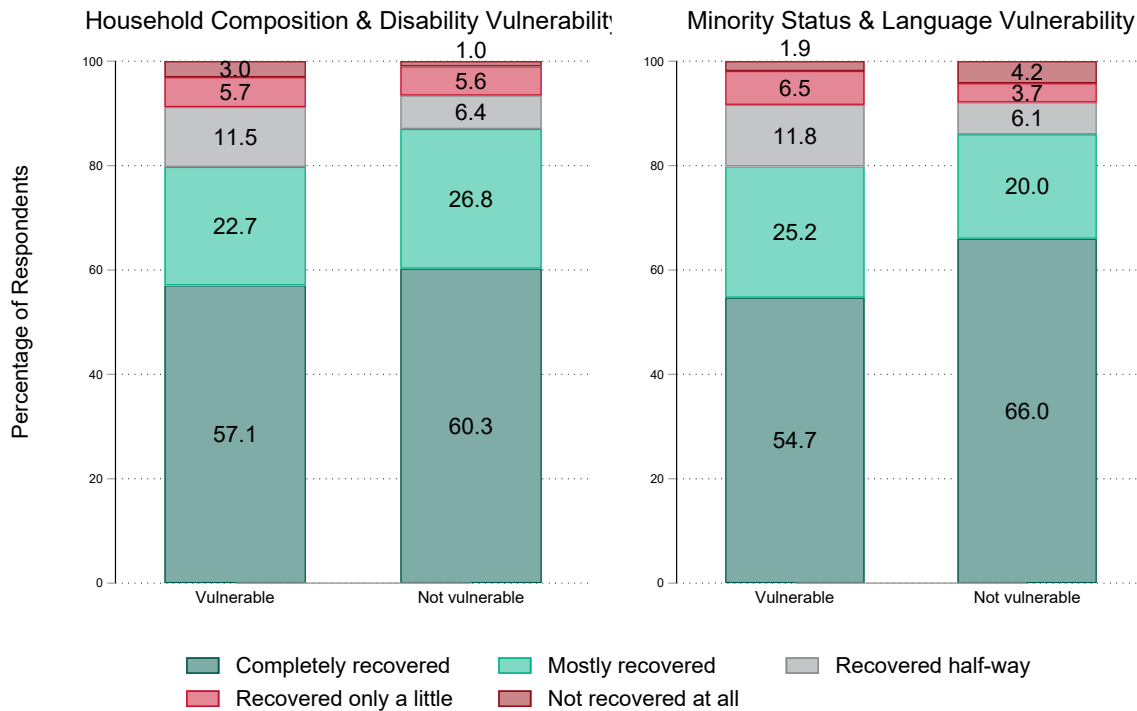


Figure 4.5 explores the recovery status from Hurricane Harvey of respondents from Greater Houston for two of the major vulnerabilities in Texas (according to the CDC-SVI): Household Composition & Disability Vulnerability (HCDV) and Minority Status & Language Vulnerability (MSLV).¹⁵

Overall, among those affected by Hurricane Harvey, non-vulnerable populations in the Greater Houston area had higher percentages of complete recovery (60.3% HCDV and 66% MSLV) compared to vulnerable populations (57.1% HCDV and 54.7% MSLV). Similarly, for both vulnerability types the percentage of respondents that have recovered either a little or not at all is higher for those that are vulnerable than for those that are not.

¹⁵Ibid. fn. 9

Figure 4.5: Recovery status from Hurricane Harvey in the Greater Houston area

4.3 Adaptive capacity

Insurance and assistance from agencies like FEMA play a key role in explaining the adaptive capacity of those affected by natural disasters. In this section, we discuss how insurance attainment and FEMA assistance have changed over time and how adaptive capacity correlates with recovery outcomes for those affected by Hurricane Harvey.

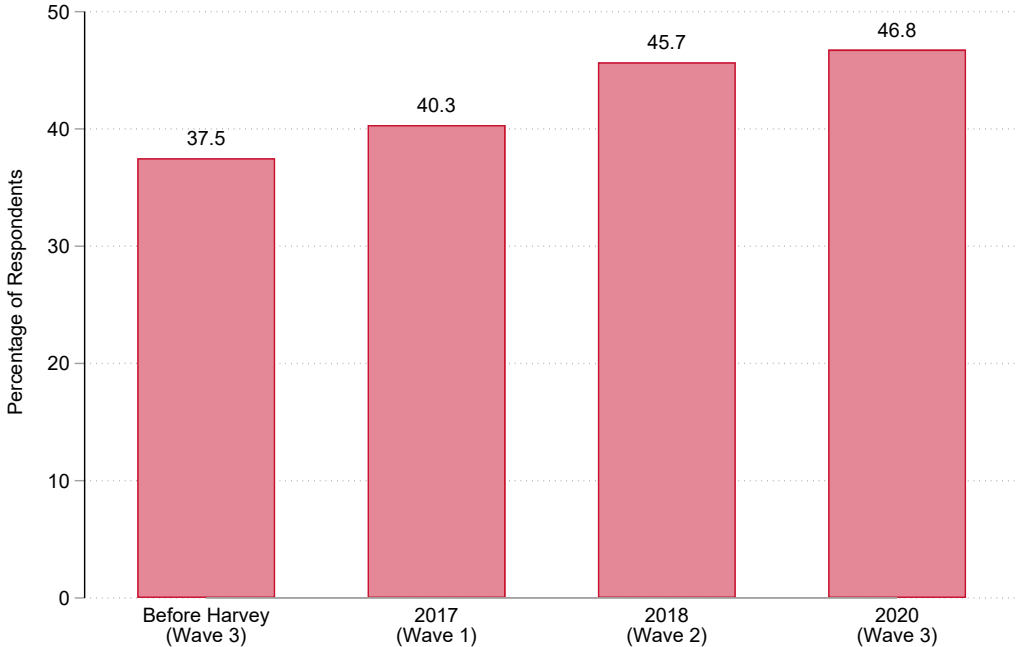
Changes in insurance coverage

Insurance can potentially help recoup losses after a natural disaster. In a Hobby School's previous report ¹⁶, it was found that 12% of survey respondents did not have any type of insurance. However, when we looked at those respondents who were specifically affected by Hurricane Harvey in the Greater Houston area, fewer respondents (10.4%) said they did not have any listed insurance.

Since Harvey we observe a systematic increase in home insurance among respondents. Figure 4.6 shows the percentage of respondents with flood insurance increased by nearly 10% from 2017 (before Hurricane Harvey hit) to 2020. When respondents were asked if they had flood insurance before Hurricane Harvey hit, 37.5% said they had compared to 46% who said they had flood insurance in 2020.

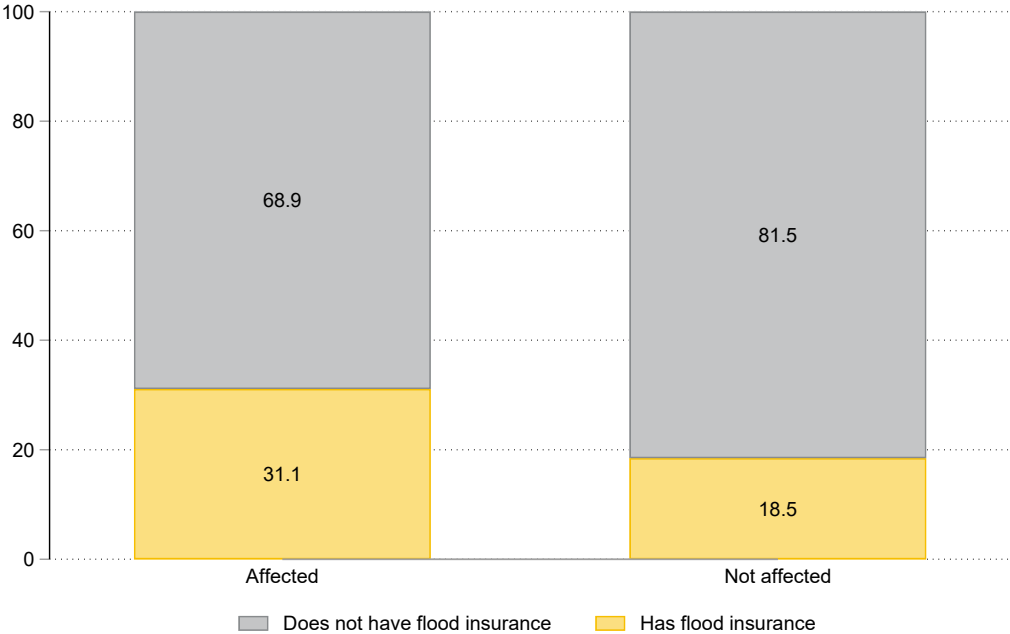
¹⁶See [Social Vulnerability & Natural Disasters: 5 Years after Hurricane Harvey \(July, 2022\)](#)

Figure 4.6: Percentage of respondents with flood insurance in Brazoria, Fort Bend, Harris, and Montgomery Counties

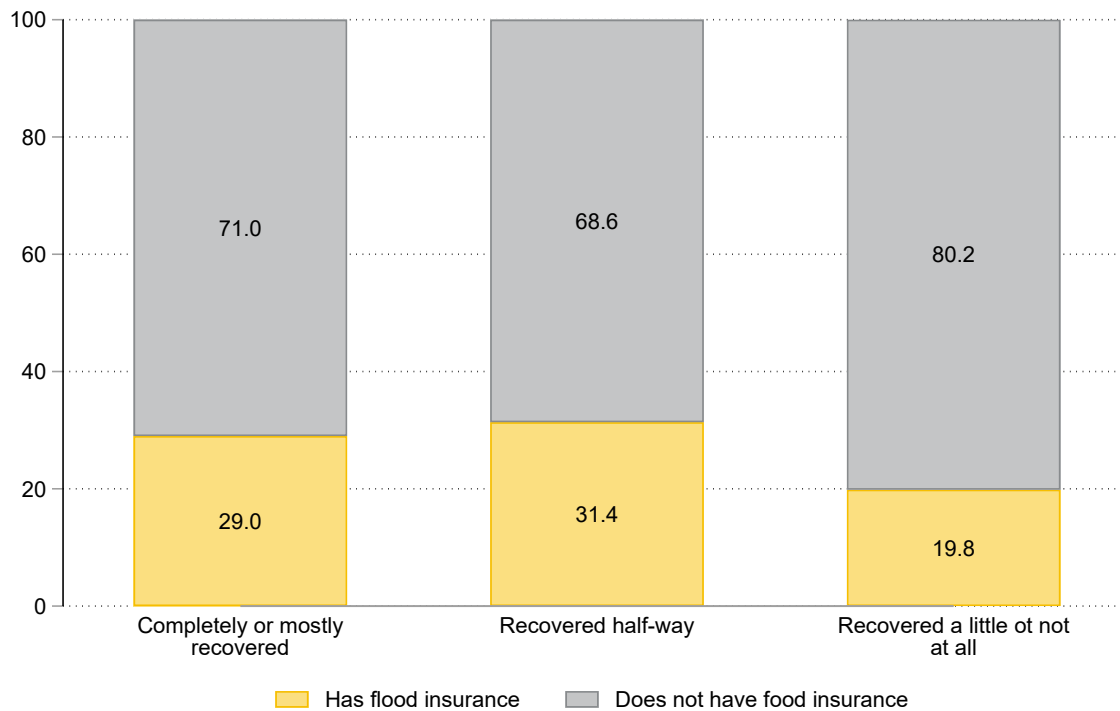


Looking at flood insurance by whether respondents were affected by Hurricane Harvey, we find higher flood insurance attainment rates for those that were affected by Harvey (31.1%) than for those that were not affected by Harvey (18.5%) (Figure 4.7). The more than ten percentage point difference might reflect those affected by Harvey more likely to reside in flood-prone areas.

Figure 4.7: Flood insurance attainment in the Greater Houston area by whether affected by Hurricane Harvey (Wave 4)



When we look at recovery from Harvey for the flood insured respondents (Figure 4.8), we find that access to insurance is associated with higher rates of recovery. Those that have completely or mostly recovered from the effects of Harvey are more likely to have flood insurance (29%) than those that have recovered a little or not at all (19.8%). Almost a third of respondents indicated they had recovered about half-way (31.4%).

Figure 4.8: Flood insurance in the Greater Houston area by recovery status after Harvey (Wave 4)

FEMA assistance

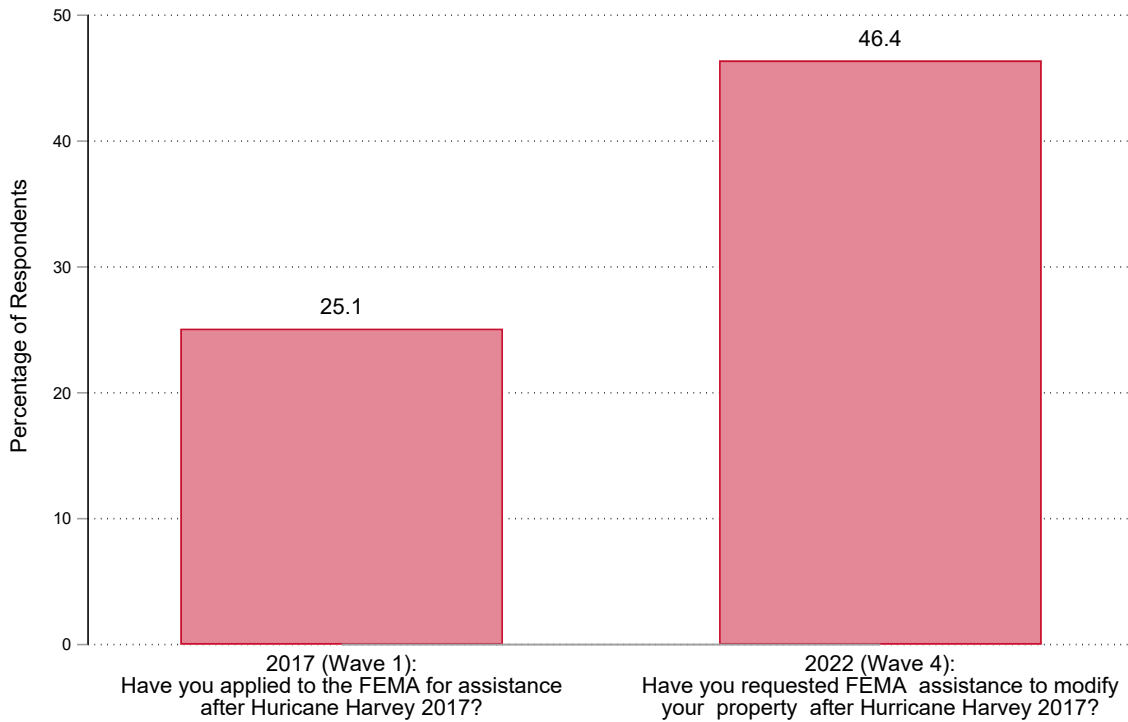
Once a federal declaration of disaster has been made, the Federal Emergency Management Agency (FEMA) can offer various assistance programs to families and individuals, non-profit organizations, and the government. These funds provide extra resources for emergency clean-up, mitigation and restoration, and the means for households to lessen the impact of natural disasters and severe weather events.¹⁷ In terms of FEMA applications, we find that five years after Hurricane Harvey, 46.4% of respondents stated they had requested FEMA assistance to modify their property.¹⁸ However, when we first surveyed area respondents in December 2017 (Wave 1) - a few months after Harvey hit - only 25.1% of respondents had applied for FEMA funds (Figure 4.9).¹⁹

¹⁷See the [FEMA Assistance after Disasters](#) website and [FEMA Assistance after Disaster Fact Sheet](#)

¹⁸While there is no official count of the percent of FEMA applicants out of all individuals affected by Harvey, another survey from [Hamel et al. \(2017\)](#) found this percentage to be around 44% in 2017.

¹⁹Respondents who answered "Don't know" or did not answer the question were not included in the percentages for Wave 1.

Figure 4.9: Percentage of respondents in Brazoria, Fort Bend, Harris, and Montgomery Counties who applied for FEMA assistance



In Table 4.1, we look at who applied for FEMA assistance right after Hurricane Harvey and who did so five years later in 2022. We compare three demographic characteristics of respondents: gender, age, and race. The third column presents the percentages for 2017, immediately after Hurricane Harvey (Wave 1), while the fourth column shows the responses in 2022 (Wave 4). Finally, the last column shows the increase in the percentage of applicants from 2017 to 2022. The intensity in the grey scale highlights the magnitude of the increase.

Table 4.1 shows that immediately after Hurricane Harvey, 29.3% of surveyed women responded that they had applied for FEMA assistance, while only 20.3% of the men in our sample did so. Five years later, the difference disappeared: 47.6% of men and 46.4% of women replied that they had applied for FEMA assistance. Regarding the age of the applicants to FEMA, the age groups *30 to 44* and *45 to 64* years old present the most significant increase in the percentage of applicants to FEMA across the two survey waves (24.1% and 27.6% increase, respectively).

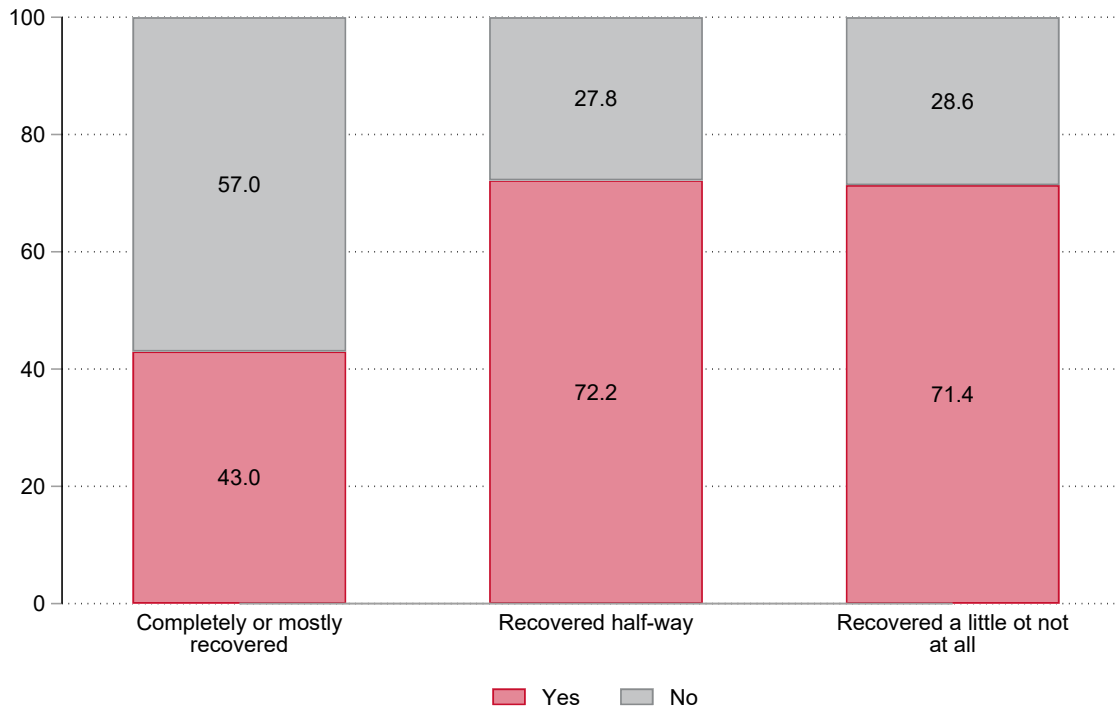
Table 4.1: Profile of respondents affected by Harvey who applied for FEMA assistance

Year		2017	2022	Increase
Gender	Male	20.3	47.6	27.3
	Female	29.2	47.4	18.2
Age	18-29	25.5	34.8	9.4
	30-44	27.9	52.1	24.1
	45-64	26.9	54.5	27.6
	65 or older	22.4	40.2	17.8
Race	White	18.0	44.2	26.2
	Black	40.1	62.6	22.5
	Hispanic	28.2	43.8	15.5
	Asian	27.7	33.6	5.9
	Other	22.6	58.9	36.3
Total		25.1	46.4	21.4

Finally, Black and African American respondents reported more FEMA assistance applications in 2017 and 2022. In 2017, 40.1% of Black and African American respondents said that they have applied for assistance, followed by Latino-Hispanics with 28.2%. In 2022, 62.6% of Black and African-Americans respondents reported doing so, followed by those in the Other group (58.9%) which includes two-or more races, Indian or Alaska Native, Asian, and Native Hawaiian or Other Pacific Islander respondents. We observe the most significant increase in applications between 2017 among those in the Other group with a 36.3% increase.

We did not find a clear relationship between recovery status of respondents and FEMA applications. Figure 4.10 shows that among those that have either completely or mostly recovered, 43% applied to FEMA after Harvey, compared to 72.2% of those who have recovered half way and 71.4% of those who have recovered at little or not at all. This association might be a function of the severity of damage suffered by households which have not fully recovered and are in need of FEMA support, reflecting a harder path to recovery in that group.

Figure 4.10: Requested FEMA assistance to modify property after Hurricane Harvey by recovery status in the Greater Houston area



Finally, we wanted to know whether respondents who applied for a FEMA loan to repair their property in the aftermath of Harvey had received the funds (Table 4.2). By 2022, only about two-fifths of respondents (39.4%) living in the four most affected counties in the Greater Houston area (Brazoria, Fort Bend, Harris, and Montgomery) had received the funds from their FEMA loan application(s). Nearly a quarter (24.5%) had their loan application rejected, and slightly more than a fifth (21.5%) were still waiting on their application approval.

Among women who applied for a FEMA loan, 48.2% said they had received funds from their loan, whereas 28.5% had their loan rejected. Similarly, among male applicants, 31.5% received their funds, 31.1% were still waiting on their loan approval, and 21% had their loan application(s) denied. When we compare age categories, millennials had the highest percentage of funds received (54.6%) followed by those who were 65 years or older (47%). On the other hand, when we compared age groups and loan application rejections, those who were elderly (65 and older) had the highest percentage of denials (45.4%) compared to other groups.

Last, we looked at FEMA loan application approval status by race and ethnicity. Asians (75%) were most likely to receive funds from their loan application(s) followed by Hispanics (43%).²⁰ Over a quarter of Hispanics (27.8%) were still waiting on their loan approval followed by 22.1% of whites. Black (36.9%) and white (29.8%) respondents had the highest loan rejection rates compared to Hispanic, Asian, and Other groups. Very low

²⁰While Asian respondents who applied for a FEMA loan had the highest percentage of funds received, the total number of Asian respondents was $n = 7$ in Wave 4.

percentages of each group were still trying to find a bank to accept their loan; however, among respondents who fell into the "Other" racial/ethnic category, the proportion still looking was significantly higher than any other category (21.9%).

Table 4.2: Harvey FEMA loan application status by demographics

	Received funds %	Loan approved, not received funds %	Waiting on loan approval %	Loan rejected %	Looking for a bank to accept loan %
Wave 4 (2022): Which of the following best describes the current status of your FEMA application?*					
<i>All respondents</i>					
	39.4	11.2	21.5	24.5	3.4
<i>Gender</i>					
Female	48.2	10.3	10.5	28.5	2.4
Male	31.5	12.0	31.1	21.0	4.3
<i>Age</i>					
18 to 29	41.6	21.5	22.9	7.3	6.7
30 to 44	54.6	5.6	8.9	25.8	5.0
45 to 64	24.9	11.6	33.1	30.3	0.0
65 or older	47.0	0.0	0.0	45.4	7.6
<i>Race and Ethnicity**</i>					
White	35.1	10.0	22.1	29.8	3.1
Black	25.0	23.9	12.5	36.9	1.6
Hispanic	43.0	6.3	27.8	19.2	3.8
Asian	75.0	16.8	0.0	8.3	0.0
Other	31.9	10.0	10.6	25.7	21.9

Note: Percentages are weighted to the nearest tenth. Percentages in Wave 4 are of respondents from Brazoria, Fort Bend, Harris, and Montgomery Counties.

*Does not include those who said they "preferred to self-describe" or chose not to answer gender question.

**Combined those in the "Two or more" category with "Other".

Conclusion

The devastation and flooding caused by Hurricane Harvey was catastrophic. Nearly 780,000 Texans had to leave their homes to evacuate to safety, over 120,000 people and over 5,000 pets had to be rescued from the flood waters, and 88 people lost their lives.^{21,22} Houston and surrounding areas received the brunt of damages as Harvey dropped over 48 inches of water in some areas. The Greater Houston area experienced the largest amount of rainfall that has ever been recorded in the United States from a single storm. At least 18 inches of water inundated nearly 80,000 homes in Texas as a result of Harvey, with about 23,000 of those homes having more than five feet of water inside.²³

After analyzing the effects that Hurricane Harvey had on Houstonians over the past five years, our studies found that Hurricane Harvey affected over half of respondents living in the Greater Houston area. The most affected areas were clustered near the Texas Gulf Coast. Within Houston, where for most ZIP codes, over half of respondents were affected. Five years later, individuals in the Greater Houston area are still trying to recover from the damages wrought by Harvey. We find that this is especially true for those respondents that are vulnerable according to the CDC's 2018 Social Vulnerability Index (SVI). Ethnoracial majorities, specifically Hispanics, were the most affected, regardless of their income.

Moreover, we found that the impact of Hurricane Harvey changed the trajectory of how respondents think and act when it comes to natural disasters. Respondents affected by Harvey prepare more for hurricanes in every type of way than those who were not affected by Harvey; they are also more likely to have flood insurance. Floods have proven to be one of the most dangerous natural disasters that affect individuals living along Texas' Gulf Coast. Access to insurance was found to be associated with recovery, even more than FEMA assistance. Strategies aimed at prevention and mitigation of flooding should target those that do not have insurance. Additionally those in areas with a high percentage of minorities and more vulnerable groups should be prioritized when designing hazard reduction policies.

Though policymakers and other local government agencies have enacted policies and programs to help mitigate the effects of natural disasters like Hurricane Harvey, vulnerable populations continue to be affected by these disasters and severe weather events at disproportionate rates.²⁴ Policies aimed at lessening these effects on a city- or state-wide level is an important step to prepare for future weather-related events. Indeed, our studies over the past five years have repeatedly shown that the vast majority of respondents support

²¹See Afiune, Giulia. (2017). "Harvey's Death Toll Reaches 88, State Says" *Houston Public Media*, October 13, 2017.

²²See FEMA's [Historic Disaster Response to Hurricane Harvey in Texas](#)

²³Ibid. fn. 22

²⁴Ibid. fn. 9

myriad policies aimed at mitigating flooding.