

INFORMED DECISIONS ON CATASTROPHE RISK

Understanding Individual Flood Risk Perceptions and Flood Insurance Choices to Build More Resilient Communities: A Survey of New York City Residents

Six months after Hurricane Sandy, we surveyed homeowners in New York City who live in a flood-prone area about their flood risk perceptions and flood insurance purchases.

- The survey is part of a research program in conjunction with the Zurich flood resilience alliance that seeks to improve community flood resilience. The survey was completed by 1,035 people who own a home with a ground floor in a flood-prone area of New York City.
- All respondents should have an interest in flood insurance if they perceive the flood risk accurately.

FLOOD RISK PERCEPTION: Most respondents perceive the flood risk to be high: 86% of the respondents believe that they live in a flood-prone area. However, most underestimate the damage a flood could cause.

- Only 9% of responders correctly assess the risk compared to experts' estimates (within a 25% margin of error).
- People tend to overestimate their flood probability and underestimate the flood damage they would suffer.

IMPACT OF CLIMATE CHANGE: Over 40% of respondents expect that climate change will not increase their flood risk in the future.

- This finding suggests that many people are not in line with the scientific consensus about the projected climate change impact of increased storm surge and sea level rise on flood risk in New York City.

FLOOD INSURANCE PURCHASE: 44% of respondents stated they purchased flood insurance because it was mandatory. Only 21% bought flood insurance voluntarily, 33% did not have coverage, and 2% did not know whether they had flood coverage.

- Compared with uninsured homeowners, those who voluntarily purchased flood insurance worry more about flooding.
- On average, these insured homeowners have higher expectations of both the flood probability and flood damage relative to the uninsured respondents.

We suggest **two measures** to correct individuals' risk perception and encourage them to purchase insurance protection when needed:

- Instead of framing the chances of a flood as 1-in-100 in any given year, inform residents that the chances are greater than 1-in-5 (20%) of flooding in the next 25 years.
- Highlight the financial consequences if a flood occurs and the homeowner is uninsured.
- Homeowners might be more likely take protective actions if they realize how bad a flood would be, rather than focusing only on probability.
- FEMA flood maps currently depict only the likelihood of a flood without depicting the resulting damage should a flood occur.

Introduction

In May 2014 the U.S. government released its Third National Climate Assessment report that outlines mitigation and adaptation strategies to limit otherwise potentially severe impacts of climate change. It calls for proactive adaptation strategies, which are in practice mostly designed and implemented at the local or regional levels. One of the highlighted messages from the report is that *“To be effective, decision support processes need to take account of the values and goals of the key stakeholders, evolving scientific information, and the perceptions of risk.”* (U.S. Global Change Research Program, 2014).

This Issue Brief focuses on better understanding individual flood risk perceptions and flood insurance purchase decisions by homeowners in New York City (NYC). Floods have been the most costly natural hazard in the U.S. and are a major cause of worldwide natural disaster losses. Losses from future flood disasters are likely to increase in the coming years due to further development in hazard-prone areas and climate change impacts such as sea level rise. In a forthcoming brief, we will examine individuals’ decisions with respect to investing in individual physical loss reduction measures.

Choosing New York City

We selected NYC as a case study for several reasons. First NYC is one of the world’s largest coastal megacities with close to 10 million people. The city has had significant construction and development in flood-prone areas in recent years. For example, the (inflation adjusted) value of buildings in the 1-in-100 year flood zone has approximately doubled over the last 30 years. NYC is also of national and international importance as a large economic hub. Second, two severe storms recently hit the area: Hurricane Irene in 2011 and Hurricane Sandy in 2012. Each event required significant evacuation from the city: 300,000 residents during Irene and 375,000 during Sandy. While Irene resulted in relatively limited damage, Sandy triggered \$19 billion in losses to NYC alone, the majority of which were caused by storm surge flooding. Third, because of its location on the Atlantic Ocean and its topography, NYC is concerned about the possible impact of sea level rise and stronger storm surge on potential damage in the coming decades if adaptation measures are not undertaken. These combined factors has led city and state governments to focus on improving flood risk awareness to encourage residents in the floodplain to undertake protective measures now to be adequately protected financially against future flood-related losses.

We used modern high-resolution flood risk modeling techniques to undertake a comprehensive quantification of the flood hazard and exposure for the entire NYC area. This analysis, recently published in the magazine *Science* (Aerts et al., 2014), complements publicly available flood maps from the U.S. Federal Emergency Management Agency (FEMA) which tend to be outdated and are aggregated at a low-resolution level. We then examined how individual flood risk perceptions compare with two estimates of flood risk (probability and damage) and we find a significant divergence. We also studied homeowners’ flood insurance choices.

Detailed Household Survey

To gain insight into how those residing in flood-prone areas in NYC perceive the risk of flood damage from hurricanes, six months after NYC was inundated by Hurricane Sandy we implemented a detailed phone survey of more than 1,400 homeowners in the floodplain with a ground floor. One would thus expect all the respondents to be highly aware of the flood risks that they face. Respondents were asked over 100 questions on the following topics: flood risk perceptions, motivations for flood preparedness activities, flood insurance purchases, flood risk mitigation measures implemented and their socio-demographic characteristics. The completion rate of the survey was 73%, resulting in 1,035 completed questionnaires.

Comparing flood risk perceptions with experts' estimates

The risk perception variables encompass both quantitative metrics, such as the perceived flood probability and expected damage should a flood occur, and emotionally driven indicators such as worry. Flood risk perceptions among survey respondents were found to be generally high with 86% of the respondents indicating that they believe or are certain that they live in a flood-prone area. On average, homeowners perceive a relatively high expected flood frequency of 1-in-72 years (or 1.34% chance of flood every year) and a high expected mean flood damage relative to the house value of 39%. The majority of homeowners are highly worried about experiencing future flooding. But somewhat surprisingly, only 59% of the respondents expect climate change to increase their flood risk in the future, implying that the perceptions of many people are not in line with scientific consensus about projected climate change impacts, such as sea level rise, on flood risk in NYC.

Data from the probabilistic flood damage model used here enabled us to compare expert estimates of the flood risk with homeowners' risk perceptions. This probabilistic model estimates flood risk for NYC at a census tract level using 549 storm surge simulations. While only experts know the results of the flood risk model, the public can gain insight into their own risk by examining official FEMA flood maps of NYC. By examining publicly available flood risk information from Geographic Information Systems (GIS)'s analyses of respondent locations together with the FEMA flood maps, we can assess homeowners' flood risk perceptions relative to flood probabilities of the FEMA flood zones.

Table 1 shows that **the perceptions of a substantial number of homeowners do not match up well with the FEMA flood zone classification in which the respondents live. About 60% of the respondents who think that they have a flood probability lower than 1-in-100 actually live in the FEMA 1-in-100 year flood zone.**

TABLE 1. RELATION BETWEEN PERCEPTIONS OF LIVING IN THE 1/100 YEAR FLOOD ZONE AS PERCENTAGE OF THE FEMA CLASSIFICATION OF THE RESPONDENT'S HOME

Respondent lives in:	Perceived flood probability			Not sure
	Higher than 1/100	Equal to 1/100	Lower than 1/100	
FEMA 1/100 zone	58%	55%	60%	58%
FEMA 1/500 zone	32%	34%	32%	33%
FEMA X zone	11%	10%	9%	9%

Note: percentages are rounded and might not add up to 100%

We then determine how the perceived flood *probability* and perceived flood *damage* relate to the experts' probabilistic flood risk assessment we used as a second baseline ("experts risk estimates"). Table 2 shows the results of this analysis. Even when we allow for a large margin of error of 50% between individual perceptions of flood risk and experts risk estimates, we find that **very few individual estimates are correct in estimating their flood risk**, which is in line with other studies (Kunreuther et al., 2001; Botzen et al., 2009). **People tend to overestimate their flood probability and underestimate their potential flood damage.** The combined effect of misguided expectations of flood probability and damage is that more people overestimate than underestimate their expected flood risk. Nevertheless, underestimation of flood risk remains a problem for a large group of respondents (24-42% depending on the error margin).

TABLE 2. THE % OF RESPONDENTS WHO CORRECTLY ESTIMATE, UNDERESTIMATE OR OVERESTIMATE THE FLOOD PROBABILITY, FLOOD DAMAGE, AND FLOOD RISK (PROBABILITY × DAMAGE), BASED ON THE ALLOWANCE OF DIFFERENT ERROR MARGINS

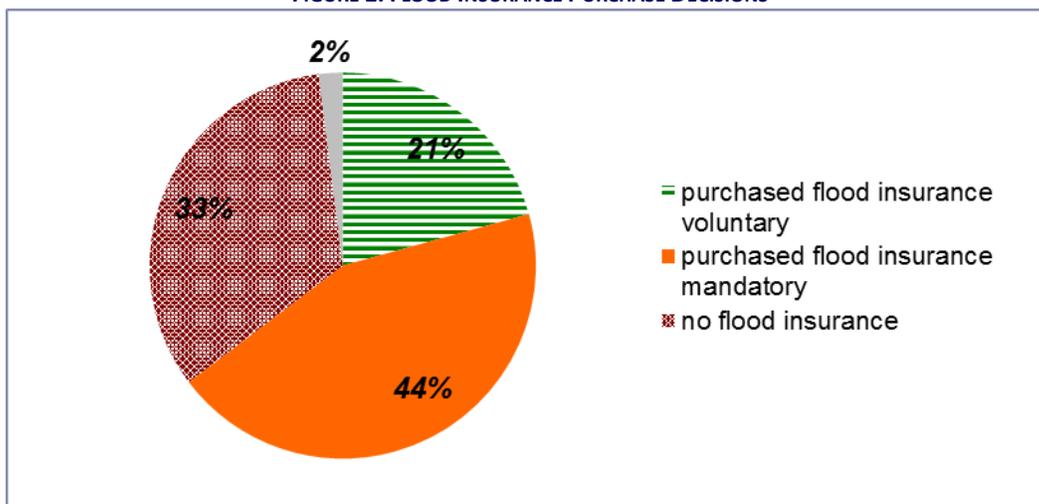
	Correct	Underestimate	Overestimate
Perceived flood probability			
25% error margin	14%	28%	58%
50% error margin	24%	25%	51%
75% error margin	36%	13%	50%
Perceived flood damage			
25% error margin	16%	63%	22%
50% error margin	33%	47%	19%
75% error margin	63%	20%	17%
Perceived flood risk (probability × damage)			
25% error margin	9%	42%	50%
50% error margin	18%	35%	48%
75% error margin	31%	24%	46%

Note: percentages are rounded and might not add up to 100%

Flood insurance purchases and risk perceptions

We were also interested in flood insurance purchase decisions. To comply with federal law, lenders require homeowners with a federally backed mortgage in a high-risk flood area to purchase coverage. Approximately 44% of the respondents purchased flood insurance because it was mandatory. **Only 21% of the homeowners surveyed bought flood insurance voluntarily, 33% did not have coverage** and 2% did not know whether they had flood coverage (Figure 1).

FIGURE 1. FLOOD INSURANCE PURCHASE DECISIONS



In total, a majority (65%) of the survey respondents have flood coverage. This relatively high percentage (compared to about 50% of homeowners in 1/100 flood zones in the United States) can be explained by two factors: our survey sample includes only homeowners with a ground floor vulnerable to flooding who, thus, face a relatively high flood risk, and the fact that the survey was taken six months after Hurricane Sandy so more homeowners may have purchased insurance (59 respondents or about 6% of our sample of 1,035 responders did just that). One could argue that all respondents in our sample should want to have flood insurance coverage, given their high flood risk and the availability of coverage, often at subsidized premiums, through the National Flood Insurance Program (NFIP).

Another interesting finding is that **of the uninsured people in the survey, 29% had actually purchased coverage in the past but cancelled their policy**. This is consistent with other evidence showing that many homeowners who purchased flood insurance let their policy lapse after only a few years (3 to 4 years on average nationally; Michel-Kerjan et al., 2012).

Table 3 shows that flood risk perceptions differ between individuals who purchased flood insurance voluntarily (that is, who are not required to purchase coverage) and individuals without flood coverage. Compared with uninsured homeowners, those who purchased flood insurance voluntarily worry more about flooding, and on average they have higher expectations of the flood probability and expected flood damage relative to the value of their property exposed to flooding. Compared with the uninsured group, respondents with flood insurance coverage have a higher average flood probability, but do not differ with respect to their mean flood damage relative to the value of their property.

TABLE 3. FLOOD RISK PERCEPTIONS AND OBJECTIVE FLOOD RISK FOR RESPONDENTS WHO PURCHASED FLOOD INSURANCE VOLUNTARILY AND THOSE WHO HAVE NOT PURCHASED FLOOD INSURANCE

Variable	Respondents who voluntarily purchased flood insurance	Respondents who have not purchased flood insurance
<u>Individual risk perceptions:</u>		
Worried about flooding	81%	68%
Mean expected flood return period	Every 42 years	Every 86 years
Expected flood damage/value property	0.52	0.37
<u>Objective flood risks:</u>		
Mean flood return period	Every 51 years	Every 61 years
Mean flood damage/value property	0.33	0.33

Among respondents *who purchased flood insurance voluntarily* and those *who have not purchased flood insurance*, Table 4 shows the percentage who correctly estimated, underestimated, or overestimated the flood probability and flood damage when allowing an error margin of 25% (see Table 2). The following insights emerge from this table. First, respondents who have not purchased flood insurance are less likely to correctly estimate flood damage and flood probability compared with people who have flood coverage. Of those without flood coverage, most overestimate the flood frequency but underestimate flood damage they would suffer. This is especially troublesome because it implies that uninsured people are likely to experience flood damage more severe than they expect. Individuals who wrongly perceive that flood damage will be minor may believe that buying insurance coverage is not worthwhile. Self-insurance will likely be ineffective if the individual has insufficient savings to repair damage. **About 56% of the respondents who do not have flood insurance overestimate their flood risks. One would have expected these homeowners to have flood insurance in instances where premiums are subsidized or actuarially fair based on objective risk estimates.**

TABLE 4. PERCENTAGE OF RESPONDENTS WHO CORRECTLY ESTIMATE, UNDERESTIMATE OR OVERESTIMATE THE FLOOD DAMAGE, FLOOD PROBABILITY, AND COMBINED FLOOD RISK (EXPECTED LOSS) FOR RESPONDENTS WHO VOLUNTARILY PURCHASED FLOOD INSURANCE AND THOSE WHO HAVE NOT PURCHASED FLOOD INSURANCE

	Respondents who voluntarily purchased flood insurance	Respondents who have not purchased flood insurance
Correctly estimate of flood probability*	17%	12%
Underestimate flood probability	28%	21%
Overestimate of flood probability	55%	67%
Correctly estimate flood damage*	18%	9%
Underestimate flood damage	58%	69%
Overestimate flood damage	24%	22%
Correctly estimate of flood risk*	3%	10%
Underestimate flood risk	44%	34%
Overestimate flood risk	53%	56%

* A correct estimate is assumed to be within 25% of experts' estimate.

Policy Recommendations

This survey provides new insights on flood risk perception and insurance purchasing decisions in one of the most affected areas of the United States after major flood losses in 2012.

As improving resilience to floods and other disasters is becoming more and more important, how can we improve individuals' perception of the risks they face – both the probability and the consequences – and encourage them to purchase insurance protection when needed?

Two ways to improve the way risk information is presented

First, research shows that simply **lengthening the time frame** about the likelihood of flooding can have a significant impact on the perception of the risk. Property owners in a flood-prone area are far more likely to take flood risk seriously if instead of being told the chance of a flood is 1 in 100 in any given year, they are told that property owners have a greater than 1-in-5 chance of flooding in the next 25 years. This reframing could assist those who tend to disregard the consequences of flooding because they underestimate its likelihood.

Second, our survey reveals that the majority of residents underestimate the damage to their residences if flooded. Risk perception about flood risk has historically been about the probability of a flood (as defined by FEMA flood maps) without providing data on the resulting damage should a flood occur. Providing **data on both probability and damage** is critically important.

Insurers, real estate brokers, and/or local, state, and federal organizations concerned with reducing losses from disasters should provide reframed risk information. Even with these framing changes, it may be difficult to convince individuals to purchase insurance coverage; therefore, it may be prudent to require all homeowners (not just those with federally-backed mortgages) in flood-prone areas to purchase insurance. This requirement, coupled with well-enforced land-use regulations and building codes could avoid large public sector expenditures following these types of events (Michel-Kerjan and Kunreuther, 2011; Kunreuther et al., 2013).

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