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Improving the National Flood Insurance Program

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Abstract: This paper highlights factors that need to be considered for improving the National Flood Insurance Program in the USA to address the biases that lead individuals to not protect themselves against low-probability, high-consequence flood events. The errors that individuals exhibit in deciding not to purchase insurance or invest in loss reduction measures prior to a disaster can be traced to the effects of six biases: myopia, amnesia, optimism, inertia, simplification and herding. Along with two guiding principles for insurance, a behavioral risk audit can assist in designing a strategy using concepts from choice architecture coupled with economic incentives to encourage property owners in hazard-prone areas to purchase insurance and invest in cost-effective adaptation measures to protect themselves against future disaster losses.

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Introduction

The massive damage and disruption from Hurricanes Harvey, Irma and Maria in the fall of 2017 highlighted once again the importance of protection against future damage from flooding. Few individuals had protected themselves against damage from these weather disasters either by investing in mitigation measures or purchasing flood insurance. More specifically, the Federal Emergency Management Agency (FEMA) estimated that prior to Harvey, only 15% of residents in Harris County, Texas, had flood insurance,[1] and fewer than half of homeowners in Florida were protected against the losses they experienced from Irma (Long, 2017). Fewer than 1% of households in Puerto Rico had flood insurance when Hurricane Maria devastated the island, so it is not surprising that there have been only $125,000 in National

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1 https://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=3d76edf9bd0642109b60ffaceead76fd

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Flood Insurance Program (NFIP) claims for flood insurance-related damage, even though property losses there are estimated to be $20 billion.

These recent catastrophes came as the US Congress and concerned stakeholders are discussing the future of the NFIP.[2] To improve the program, there is an opportunity to re-examine the role that it can play in partnership with the private sector to encourage the purchase of flood insurance and investment in cost-effective adaptation measures.

When the NFIP was created in 1968, participating communities had to agree to develop flood insurance rate maps (FIRMs) and specify building codes and land-use regulations that would reduce future water-related damage. Flood insurance premiums for homes built prior to flood mapping of the community were highly discounted to maintain property values and to encourage residents to purchase coverage; properties constructed after the FIRMs were in place were charged risk-based premiums. Today, all properties located in a mapped 100-year floodplain, designated as a Special Flood Hazard Area (SFHA), are required to purchase flood insurance if they have a mortgage or loan from a federally backed or regulated lender, but some lending institutions have not enforced this regulation.

In July 2012 (three months before Hurricane Sandy), Congress passed the Biggert–Waters Flood Insurance Reform Act of 2012 that required the NFIP to gradually remove insurance subsidies for certain properties and eventually charge premiums that reflected the flood risk. Soon after becoming law, however, the Biggert–Waters Act faced significant challenges from many homeowners who felt that their risk-based premium increases were unjustified and unfair because they could not afford the increased cost that they would be forced to pay. Hence, in March 2014, Congress passed the Homeowner Flood Insurance Affordability Act, which slowed some rate increases, halted others altogether and also led to two reports by the National Research Council on how to deal with issues of affordability (National Research Council, 2015a, 2016).

Although flooding and tropical cyclones have caused nearly $200 billion in damage in the USA over the last decade,[3] the national penetration rate for flood insurance in high-risk zones remains surprisingly low – only 49% of homes in these areas are insured against damage from floods despite mandates to purchase coverage. In areas of the country where flood insurance is not required but flood maps exist, the purchase rate is only 18% (Dixon *et al.*, 2006).

Not only do few homeowners in flood-prone areas purchase insurance, but also they do not invest in cost-effective measures to reduce future losses

2 See Kousky (2018) for a detailed characterization of the NFIP and its current financial status.
3 For more information, see http://www.ncdc.noaa.gov

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(Kunreuther *et al.*, 2013a, 2013b). In a survey of 893 residents in coastal counties along the mid-Atlantic region from Virginia to northeastern New Jersey during Hurricane Sandy in 2012, a large majority of respondents indicated undertaking at least one storm preparation activity, but these were mainly short-term preparation actions such as buying batteries and food and water reserves that required limited effort. Only slightly more than half of storm shutter owners in the New York City area who responded to the survey actually installed them to protect their windows before the hurricane (Meyer *et al.*, 2013).

This paper highlights factors that need to be considered to communicate the flood risk effectively and overcome the biases that lead individuals not to invest in cost-effective loss reduction measures. Along with two guiding principles for insurance, a behavioral risk audit can assist in designing strategies to incentivize individuals to purchase flood insurance and invest in cost-effective mitigation measures to protect themselves against future losses.

Why we do not undertake protective measures until it is too late

A large body of cognitive psychology and behavioral decision research over the past 50 years has revealed that decision-makers are often guided by emotional reactions and simple rules of thumb that have been acquired through personal experience. These processes do not work well for making choices with respect to undertaking protective measures for extreme events such as floods where the homeowner has limited or no past experience. The errors that individuals exhibit in deciding whether to purchase insurance or invest in cost-effective adaptation measures can be traced to the effects of six biases summarized in Box 1 (Meyer & Kunreuther, 2017).

Myopia

One of our greatest weaknesses as decision-makers is that our intuitive planning horizons are typically shorter than those that are needed to see the long-run value of protective investments. Controlled experiments and field surveys with respect to investment decisions reveal this behavior can be explained either by *myopic loss aversion*, that is, that people are short-term oriented in evaluating outcomes and are more sensitive to losses than to gains (Gneezy & Potters, 1997; Thaler *et al.*, 1997) or *narrow framing*, isolating the current decision from future opportunities to make similar decisions (Redelmeier & Tversky, 1992; Kahneman & Lovello, 1993). While we might appreciate the need for a safer home, the immediate upfront costs of investments loom large compared to the potential for reduced losses in the future. We either do not see the value of the investments or procrastinate in adopting them.

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Box 1. Biases that characterize intuitive thinking

1. **Myopia – the tendency to focus on overly short future time horizons when appraising immediate costs and the potential benefits of protective investments**
2. **Amnesia – the tendency to forget too quickly the lessons of past disasters**
3. **Optimism – the tendency to underestimate the likelihood that losses will occur from future hazards**
4. **Inertia – the tendency to maintain the status quo or adopt a default option when there is uncertainty about the potential benefits of investing in alternative protective measures**
5. **Simplification – the tendency to selectively attend to only a subset of the relevant facts to consider when making choices involving risk**
6. **Herding – the tendency to base choices on the observed actions of others**

Amnesia

Emotions such as worry or anxiety are often stimulated by experiencing a disaster and may lead to investment in protective measures during the immediate post-event period, but these feelings tend to fade quickly over time. Many homeowners voluntarily purchase flood insurance after suffering damage, but then may decide not to renew their policy if they have not experienced another disaster because they feel they have wasted the money they spent on their premium. They treat insurance as an investment rather than as a protective measure (Slovic *et al.*, 1977). Individuals would rather invest in a new TV where they will experience immediate pleasure once they connect the appliance.

Optimism

People tend to believe that they are immune from threats with severe impacts that have a low probability of occurrence. We perceive the likelihood of a specific event based on our own personal experiences rather than on statistical data (Slovic, 2000). It is hard to imagine a flood inundating our home or having our roof detached by strong winds until after we have experienced such a disaster. There is thus a tendency to underweight the probability of a disaster if one has not recently experienced the event (Hertwig et al., 2004). This

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behavior, due to the *availability bias*, has been observed and tested in a large number of controlled experiments and field studies (Tversky & Kahneman, 1973).

Inertia

A principal reason why we do not undertake protective measures to reduce future losses is that we often prefer to stick with the status quo rather than forging new paths of action. It saves us both time and energy by not having to collect information on the costs and benefits of new alternatives (Samuelson & Zeckhauser, 1988). Sticking with the current state of affairs is the easy option in situations of uncertainty, as illustrated by such aphorisms as 'better the devil you know than the devil you don't' and 'when in doubt, do nothing'.

Simplification

Individuals are likely to make choices by focusing on either the low probability of a disaster occurring or its potential consequences. There is a tendency for some to view the event's likelihood as below their threshold level of concern; others focus on the consequences without considering the probability of its occurrence. With respect to insurance purchase, McClelland *et al.* (1993) in a controlled experiment found a bi-modal distribution with respect to the willingness to pay for coverage when the probability of a loss was 1 in 100. Most individuals (88%) either dismissed the likelihood of the event occurring, by either bidding zero dollars for insurance or bidding considerably more than the expected loss because they were worried about the consequences of the disaster.

Herding

Individuals' choices are often influenced by other people's behavior, especially under conditions of uncertainty. The instinct to follow the herd goes awry when the collective crowd is no better informed than the least informed of its individual members. To illustrate how herding plays a role in protection against adverse events, several studies provide insights into the decision not to purchase disaster insurance. A 2013 study of the factors that caused Queenslanders to buy flood insurance found that ownership was unrelated to perceptions of the probability of floods, but highly correlated with whether residents believed there was a social norm for the insurance (Lo, 2013). In an earlier survey of homeowners in flood- and earthquake-prone areas, one of the most important factors determining whether a homeowner purchased earthquake or flood insurance was discussions with friends and

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neighbors rather than considering the perceived likelihood and consequences of a future disaster occurring (Kunreuther *et al.*, 1978).

Guiding principles for insurance to encourage protective measures

Insurance is designed to spread risk across all policyholders, each of whom pays a relatively small premium so insurers can cover the large losses suffered by a few. Policyholders who invest in adaptation measures should be rewarded with lower premiums because their expected claims payments are lower than they would be if they had not invested in such measures. In this regard, some states require companies to offer premium discounts for certain hazard-mitigation measures or have state insurance programs that offer such discounts (Multihazard Mitigation Council, 2015; Office of Management and Budget, 2016).

While risk-based insurance premiums can provide transparent information to those residing in hazard-prone areas as to the risks they face, there is a need to deal with issues of fairness and affordability issues should the premiums charged by insurers cause economic hardship for some individuals. Thus, the following two guiding principles deserve consideration.

Principle 1 – premiums should reflect risk

Insurance premiums should be based on risk in order to provide individuals with accurate signals as to the degree of hazard they face and to encourage them to engage in cost-effective adaptation measures to reduce their vulnerability.

Catastrophe models developed and improved over the past 25 years can accurately assess the likelihood of and damages resulting from disasters of different magnitudes and intensities. Insurers and reinsurers can utilize the estimates from these models to determine risk-based premiums and how much coverage to offer in hazard-prone areas.

Principle 2 – dealing with fairness and affordability issues

Any special financial assistance given to low-income and other individuals currently residing in hazard-prone areas should come from general public funding and not through insurance premium cross-subsidies.

Funding could be obtained from several different sources such as general taxpayer revenue, state government or taxes on insurance policyholders. It is important to note that financial assistance should apply only to those individuals who currently reside in hazard-prone areas. Those who decide to locate in these regions in the future would be charged premiums that reflect the risk.

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Improving the National Flood Insurance Program

The NFIP can be modified by recognizing the biases discussed above and adhering to the above two insurance principles – so that residents in hazard-prone areas will want to purchase coverage and invest in protective measures prior to a disaster. Funding is needed for accurate flood maps; low-interest loans may be necessary for homeowners to undertake flood-mitigation projects; well-enforced building codes can encourage adoption of cost-effective loss reduction measures; and means-tested vouchers will provide financial assistance to low-income families to purchase insurance and invest in mitigation measures. Private insurers can play a role in increasing the take-up rate of flood insurance if regulators allow them to price coverage so that it reflects the flood-related risk. Each of these proposals are now discussed.

Accurate mapping

The need for better flood maps in the USA was noted by Congress in 2012 when it formed a second Technical Mapping Advisory Council (TMAC) to address stakeholder experience with flood maps, the mapping program's credibility and its efficiency, and to present their findings to the Federal Emergency Management Agency (FEMA). In its December 2015 annual report, the TMAC recommended that "FEMA should transition from identifying the 1-percent-annual-chance floodplain and associated base flood elevation as the basis for insurance rating purposes to a structure-specific flood frequency determination" (TMAC, 2015).

This recommendation is in line with a June 2015 report by the National Research Council on pricing negatively elevated structures in the NFIP. It concluded that "current NFIP methods for setting risk-based rates do not accurately and precisely describe critical hazard and vulnerability conditions that affect flood risk for negatively elevated structures" (National Research Council, 2015b).

Coupled with estimates of the resulting damage to the property from floods of different magnitudes, actuaries can determine flood insurance premiums that reflect risk. Premiums based on risk, in turn, would enable FEMA, private insurers and other interested parties to communicate the flood risk to property owners, along with an explanation as to how the flood insurance premiums are determined.

Accurate flood maps are needed not only for the highest-risk areas, but also for areas outside those normally considered to be flood-prone. Such maps, coupled with elevation data on individual structures, provide information on the likelihood of floods of different depths that could cause damage to

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the structure, contents and mechanical systems like air conditioning and heating units. State-of-the-art technology such as LIDAR (light detection and ranging) and advanced engineering could be used to determine the likely damage to the different structures from each of the potential floods. A recent analysis of three counties in North Carolina compared current actual NFIP premiums against the implied risk-based premiums calculated using LIDAR technology and found significant differences (Kunreuther *et al.*, 2017).[4]

Long-term loans

The upfront costs of investing in loss reduction measures are normally perceived by homeowners to be much higher than the expected benefits of investing in loss reduction, due to myopia and optimism. If the cost to elevate one's property to reduce future flood losses is $25,000 and the family learns that the annual benefits will be a reduction in their risk-based premium from $10,000 to $6000, they will have little interest in investing in this measure, particularly if the family perceives the likelihood of future flood damage to their house to be beneath their threshold level of concern.

Connecticut's Shore Up CT program, initiated in July 2014, helps residential and business property-owners elevate buildings and retrofit properties with additional flood protection by enabling them to obtain a 15-year loan ranging from $10,000 to $300,000 at an annual interest rate of 2.75%. A 15-year loan for $25,000 at an annual interest rate of 2.75% would cost the homeowner $2040 annually. If the annual reduction in insurance premiums from elevating the house were $4000, the savings to the homeowner each year from taking the loan and investing in mitigation would be $1960 (that is, $4000 – $2040).

Well-enforced building codes

Localities can help protect homeowners against damages by enforcing cost-effective building codes. Following Hurricane Andrew in 1992, Florida re-evaluated its standards and enacted the Florida Building Code (FBC) in 2001, the strongest statewide building code in the USA. A study of the difference in realized damage from hurricanes in Florida during the period 2001–2010 found that homes built to FBC standards suffered 53% less damage than homes built prior to the enactment of the FBC. A comparison of the increased costs

4 Cost estimates by the Association for State Flood Plain Managers for developing accurate flood maps for the entire country are in the range of $4.5–7.5 billion, with an annual maintenance costs of $116–275 million (ASFPM, 2013).

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to meet the FBC standards in relation to the expected reduction in windstorm damage across the life of the home reveals that there is $2–8 in expected damage reduction (benefit) for every dollar of increased construction costs (Simmons *et al.*, 2017).

Means-tested vouchers

One way to maintain the transparent risk communication provided by risk-based premiums while at the same time addressing issues of fairness and affordability (Principle 2) is to offer means-tested vouchers that cover part of the cost of insurance. Several existing programs could serve as models for developing such a voucher system: the Food Stamp Program, the Low Income Home Energy Assistance Program and the Universal Service Fund. A recent RAND study recommends that those whose total housing costs, including flood insurance premiums, exceed a certain percentage of their income be provided with financial assistance. Means-testing would ensure that taxpayers are not subsidizing high-income individuals (Dixon *et al.*, 2017).

As a condition for the voucher, the property owner could be required to invest in cost-effective adaptation measures. If property owners were also offered a multi-year loan to invest in mitigation measures, the voucher could cover not only a portion of the resulting risk-based insurance premium, but also the annual loan cost to make the package affordable. An empirical study of homeowners in Ocean County, NJ, reveals that the amount of the voucher is likely to be reduced significantly from what it would have been had the structure not been mitigated, as shown in Figure 1 for properties in a high-hazard flood area (the V zone) and a lower-hazard area (the A zone) (Kousky & Kunreuther, 2014).

Private sector flood insurance

The Swiss Re Institute estimates that of the $15 billion in flood damages expected annually in the USA, only $5 billion is insured today (Swiss Re Institute, 2017). A nationwide survey from roughly a decade ago found that, on average, about half of properties in mapped 100-year floodplains had flood insurance, although there was substantial geographic variation, with take-up rates higher in coastal areas of the South and East. In areas of the country where flood insurance is not required but flood maps exist, the purchase rate is only 18% (Dixon *et al.*, 2006).

The private sector could complement the NFIP in providing flood coverage in flood-prone areas. Today, private insurance is provided by small companies to high-valued homes above the NFIP cap of $250,000 on the structure (a

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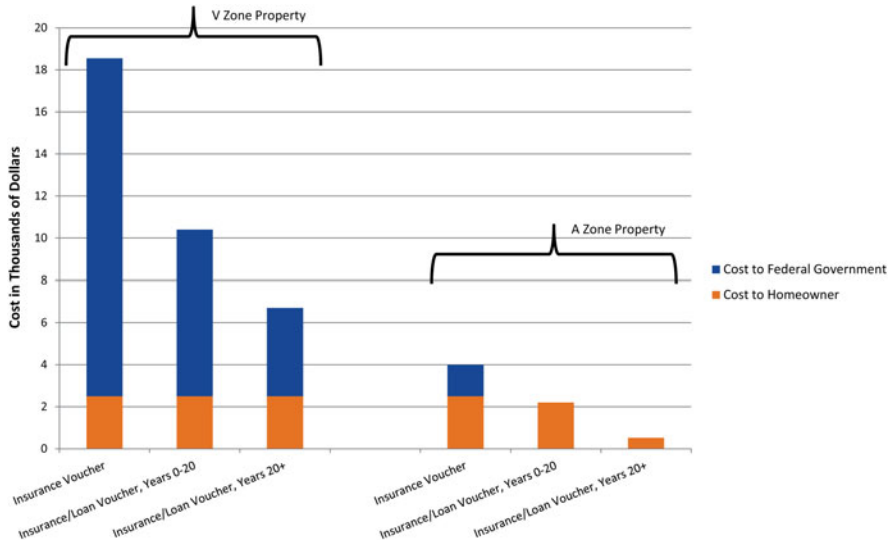


Figure 1. Cost of the program to the federal government and a hypothetical homeowner.
Source: Kousky and Kunreuther (2014)

so-called 'excess' flood policy). These private insurers also target areas where they can offer coverage more cheaply than the NFIP. The majority of private flood policies are in the surplus lines market that are not licensed in the state so that they have the freedom to charge premiums without their being approved by state insurance commissioners. The largest private provider of flood insurance, Private Market Flood, announced on its website that it now has 18,000 policies in force across 37 states.[5] While this is more private insurance than was in place just a few years ago, it is only a fraction of the five million NFIP policies in force.

Large insurers that are subject to state regulation are unlikely to have an interest in marketing flood insurance unless they are allowed to charge premiums that reflect risk. Even if they are permitted to charge risk-based premiums, insurers will still have to consider ways that they can protect themselves against unusually large losses to reduce the chance of insolvency. Here, the public sector may play a role by providing protection against catastrophic losses that cannot be covered by the private sector through reinsurance and other risk-transfer mechanisms.

5 See http://www.privatemarketflood.com

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Behavioral risk audit

The above recommendations for improving features of the NFIP are important steps in encouraging individuals to protect themselves against possible damage from future storms and hurricanes, but there is still a need to address the biases that lead individuals to ignore these potential disasters until it is too late. A behavioral risk audit provides a way to deal with each of the biases so that individuals are willing to pay attention to these low-probability events.

The behavioral audit starts by characterizing how individuals are likely to perceive risks and why they might not focus on the probability and consequences of the risk in the same way that an expert would. Strategies are then proposed that work *with* rather than *against* people's risk perceptions and natural decision biases by drawing on the principles of *choice architecture* proposed in the book, *Nudge* (Thaler & Sunstein, 2008). Choice architecture refers to presenting choices in ways that lead individuals to pay attention to the risk. When combined with short-term economic incentives, individuals are likely to consider investing in protective measures that reduce the potential consequences of future catastrophic events (Meyer & Kunreuther, 2017). Below are proposed ways to address each of the six biases in Box 1 in order to motivate those at risk to undertake protective measures in advance of the next disaster.

Myopia

Provide low-interest loans coupled with a reduction in insurance premiums to reflect the lower expected claims. This incentive can provide net economic benefits to the homeowner annually and will overcome the concern that the upfront cost of investing in mitigation is too expensive to justify the measure. If the reduction in the annual insurance premium is greater than the yearly cost of the loan, there will be financial savings to the property immediately after the protective measures is implemented.

Amnesia

Offer multi-year insurance (MYI) policies tied to the property to avoid the tendency for homeowners to cancel their insurance after not experiencing a claim for a few years. The insurance policy would carry an annual risk-based premium that would remain stable over the length of the contract. Insurers should have an interest in offering multi-year policies to reduce their marketing costs and provide homeowners with a guarantee that their policy would not be canceled should the insurer suffer losses from a severe disaster. The insurance company Private Market Flood gives homeowners the option of selecting a

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one-, two- or three-year flood insurance policy at a premium that is constant over the length of the contract. The insurer would have the option of increasing their premiums should there be an increase in the risk at the end of the contract. Combining MYI with long-term loans would encourage investments in cost-effective adaptation measures. Insurers would also have an economic incentive to inspect the property over time to make sure that building codes are enforced, something they would be less likely to do with annual contracts.[6]

Optimism

Stretching the time horizon when presenting information on the likelihood of a flood occurring will reduce the tendency for individuals to treat the likelihood of a disaster next year as below their threshold level of concern. Years ago, when few individuals were voluntarily wearing seatbelts, people were more willing to buckle up if they were told they had a 0.33 chance of a serious car accident over a 50-year lifetime of driving rather than a 0.00001 chance each trip (Slovic *et al.*, 1978). FEMA has recently recognized the importance of communicating the flood risk in this manner by indicating that the chances of a homeowner experiencing a flood with a 100-year return period sometime in the next 30 years is greater than one in four.[7]

Inertia

Add flood coverage to a standard homeowners' policy, which is normally required as a condition for a mortgage. The reluctance to move from the status quo when making financial decisions implies that default options can play an important role in influencing choices. Property owners in flood-prone areas could be provided with a flood insurance rider to their homeowners' policy and informed that they can opt out of this coverage. Residents who were under the misimpression that their standard homeowners' policy covered water-related damage would likely want to maintain this coverage, as would others concerned with their flood risk. If lenders and real estate agents indicate that this coverage will give residents full protection against both wind and water damage from hurricanes, there is a good chance that many individuals will decide to maintain the flood insurance rider to their homeowners' policy.

Empirical evidence on insurance decision-making suggests that this strategy is likely to work. In the early 1990s, New Jersey and Pennsylvania offered car

6 See Kunreuther (2015) for more details on the challenges and opportunities of multi-year flood insurance.

7 http://floodsafety.com/national/property/risk/index.htm

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owners the opportunity to buy either lower-priced policies that carried a limited right to sue in the case of an accident or a higher-priced policy that had no such restriction. In New Jersey, the default was the plan with the limited right to sue, while in Pennsylvania, the opposite held. This difference had a huge effect on policy preferences; in Pennsylvania, only 30% of drivers opted to restrict their right to sue, but in New Jersey, where such an option was the default, 79% maintained the status quo (Johnson *et al.*, 1993).

Simplification

As there is a tendency to focus on the low probability of a flood and hence ignore its consequences, one could present property owners with scenarios as to the financial impact of experiencing severe damage from a disaster if they were insured or had not invested in loss-reduction measures. By switching their attention to the outcome, people may consider investing in protective measures rather than treating the flood as below their threshold level of concern.

Herding

Protection could become a social norm if homeowners that adopt protective measures are given a seal of approval based on a certified inspection; others may then follow suit. A July 1994 telephone survey of 1241 residents in six hurricane-prone areas on the Atlantic and Gulf Coasts provides supporting evidence for some type of seal of approval. Over 90% of the respondents felt that local home builders should be required to adhere to building codes, and 85% considered it very important that local building departments conduct inspections of new residential construction (Insurance Institute for Property Loss Reduction, 1995).

Conclusions

It is essential that residents in flood-prone areas be provided with accurate information on the degree of risk they face, the steps they can take to reduce their future losses and an understanding of how insurance can protect them should they suffer severe damage. Thus, it is important that Congress furnish adequate funding to produce more accurate flood maps.

The recommendations proposed in the behavioral risk audit reinforce the need to prepare now for future flood-related disasters. For this strategy to be implemented requires the support and interest of the key stakeholders who deal with property-related matters, such as real estate agents, banks and

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financial institutions, builders, developers, contractors and local officials concerned with the safety of their communities.

If government leaders recognize the importance of adhering to the guiding principles for insurance and use choice architecture and economic incentives to encourage investment in cost-effective adaptation measures, future flood-related losses are likely to be reduced and property owners will be financially protected should they suffer severe damage.

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