

**Encouraging Adaptation to Climate Change:
The Need for Long-Term Flood Insurance**

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Encouraging Adaptation to Climate Change: The Need for Long-Term Flood Insurance

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Summary

The severe hurricanes in Florida in 2004, Hurricane Katrina in 2005 and Hurricane Ike in 2008 clearly demonstrate that the United States is highly vulnerable to large-scale risks from storm surge and flooding. Given the possibility of sea level rise due to global warming, we are entering a new era of catastrophes unless the increasing number of property owners located in coastal areas invest more heavily in risk-reduction measures (adaptation measures) than they do today. In this context, the current debate about how best to adapt to a changing climate raises an important policy question: *how can the United States sustain itself against more devastating climate-related natural disasters in the future?* Focusing on the flood risk, we recommend that Congress and the Administration revise the 1968-established National Flood Insurance Program (NFIP), which covers more than \$1.2 trillion of assets today, by moving from annual insurance contracts to long-term insurance policies tied to property. Such a change will encourage people in high risk areas to think more about the long-term and invest in cost-effective adaptation measures that reduce losses from future floods and hurricanes.

Losses from Future Climate-Related Disasters: What Can We Expect?

Between 1970 and 2004, storms and floods were responsible for over 90 percent of the total economic costs of extreme weather related events worldwide. Hurricane Katrina, which hit Louisiana and Mississippi at the end of August 2005, killed 1,300 people and forced 1.5 million people to evacuate the affected area—a historic record for the country. Insured losses to the

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private sector from this hurricane have been estimated at \$48 billion² with an additional \$17 billion dollars from the federally-run National Flood Insurance Program—another record.³

A series of hurricanes in 2008 caused billions of dollars in direct economic losses along the Caribbean basin and in the United States. Hurricane Ike was the most expensive individual event in 2008, with an estimated privately insured loss of \$17.6 billion in addition to \$2.4 billion in claims paid by the U.S. National Flood Insurance Program (NFIP) for storm surge water damage resulting from this hurricane.⁴

Of the 25 most costly insured catastrophes that occurred in the world since 1970, 16 of these occurred here in the United States. Fourteen occurred since 2001, thirteen of these in the United States. Given all of this, it is hard to believe that 20 years ago, when Hurricane Hugo hit South Carolina, it was the first catastrophe to inflict more than \$1 billion of insured losses.

Several elements explain this increase in the costs of disasters in recent years. They include urbanization of the population, an increase in the value at risk and density of insurance coverage and the possible impact of global warming on the frequency and severity of hurricanes.

For evidence as to why losses from natural disasters have increased so rapidly, one only needs to look at the state of Florida. The 1,200 miles of coastline that make it an attractive destination for tourists and retirees also make it vulnerable to impacts by hurricanes from the Atlantic, Gulf of Mexico, and Caribbean. While the threat of such hurricanes has long been a part of life in the state, their economic impact was historically limited by the sparseness of the population. As late as 1950 the state was only the 20th largest in the United States with a population of 2.8 million. But the years since then have witnessed a migration boom, with the state now being the country's fourth largest with a projected 2010 population of 19.3 million (a 600 percent increase since 1950).

One consequence of this trend is clear: hurricanes, which in the past inflicted a small amount of property damage, are now potential sources of catastrophe. It has been conjectured, for example, that if the intense hurricane that hit Miami in 1926 were to make landfall in the same area today, it would induce economic losses that would dwarf those the country recently saw from Hurricane Katrina.⁵ But this increased exposure is not unique to Florida. As of December 2007, Florida and New York each had nearly \$2.5 trillion of insured values located on the coast. The coastal insured value for the top ten states combined accounts for more than \$8.3 trillion.⁶ Such huge concentrations of insured value in highly exposed areas almost guarantees that any major storm that hits these regions could inflict hundreds of billion dollars of economic losses, unless the

² Kunreuther and Michel-Kerjan (2009); in 2008 prices.

³ Michel-Kerjan and Kousky (forthcoming)

⁴ Swiss Re (2009)

⁵ Pielke et al. (2008)

⁶ Kunreuther and Michel-Kerjan (2009)

residential construction and infrastructures are properly protected by effective adaptation measures.

There have also been numerous discussions and scientific debates as to whether the series of major hurricanes that occurred in 2004 and 2005 could have been intensified due to climate change (higher sea surface temperature than usual). One of the expected effects of global warming substantiated by empirical data is indeed an increase in hurricane intensity.⁷ Higher ocean temperatures lead to an exponentially higher evaporation rate in the atmosphere, which increases the intensity of cyclones and precipitation. Still, scientific knowledge is continuously evolving. For instance, a recent study suggests that El Nino, rather than sea surface temperature, might be the primary driver of more intense hurricane activity.⁸ An increase in the number of major hurricanes for a given time period is likely to translate into a greater number of storms hitting the coasts and more severe damage to residences and commercial buildings.

Residents in High Hazard Areas Do Not Invest in Adaptation Measures

The combination of increasing urbanization, concentration of value in high-risk areas, and the potential impact of a change in weather-patterns highlights the importance of investment in adaptation measures by those in harm's way. Yet the empirical evidence suggests that property owners are reluctant to incur these costs.

A 1974 survey of more than 1,000 California homeowners in earthquake-prone areas, for example, revealed that only 12 percent of the respondents had adopted any protective measure.⁹ Fifteen years later, there was little change despite the increased public awareness of the earthquake hazard. In a 1989 survey of 3,500 homeowners in four California counties at risk from earthquakes, only 5 to 9 percent of the respondents in these areas reported adopting any loss reduction measures.¹⁰ There has been a similar reluctance by residents in flood-prone areas to invest in adaptation measures.¹¹

Even after hurricanes caused extensive damage to large parts of the U.S. Atlantic and Gulf coastlines during the 2004 and 2005 hurricane seasons, a large number of residents had still not invested in relatively inexpensive loss reduction measures with respect to their property, nor had they undertaken emergency preparedness measures. A survey of 1,100 adults living along the Atlantic and Gulf Coasts undertaken in May 2006—10 months after Hurricane Katrina—revealed that 83 percent of the responders had taken no steps to fortify their home, 68 percent had no hurricane survival kit and 60 percent had no family disaster plan.¹²

⁷ For more details on this point see Emmanuel, Sundarajan and Williams (2008) and Emmanuel (2008).

⁸ Mann et al.(2009)

⁹ Kunreuther et al. (1978)

¹⁰ Palm et al. (1990)

¹¹ Burby et al. (1988) and Laska (1991)

¹² Goodnough (2006)

This lack of interest in loss reduction even after the most devastating hurricane in the history of the country is puzzling, because we know that the expected benefits of many of these measures justify the investment costs. An analysis of the potential reduction in damage from future hurricanes in four states (Florida, New York, South Carolina and Texas) reveals that if current building codes were applied to all residential property in coastal areas, loss reductions range from 61 percent in Florida for a hundred-year return-period loss to 31 percent in New York for a five-hundred-year return-period loss. In Florida alone, mitigation reduces losses by \$51 billion for a hundred-year event and \$83 billion for a five-hundred-year event.¹³

Why do property owners not invest in these measures? Prior to a disaster, many individuals perceive the likelihood of a flood or hurricane to be sufficiently low that they contend it will not happen to them. They thus see no need to protect their home through insurance or adaptation measures. Individuals also tend to be highly myopic and hence focus only on the expected benefits from an adaptation measure over the next couple of years even though the average life of their property is 30-50 years. By not incorporating the long-term rewards from investing in a loss-reduction measure, the upfront costs are likely to appear unattractive. In fact, if one plans to move within the next few years, then this behavior makes economic sense if the value of the property does not reflect the investment in adaptation measures.

The Need for Long-Term Flood Insurance

When searching for sustainable solutions to make the nation safer with respect to future large-scale disasters, one needs to consider the behavioral elements in order to create policies that achieve the desired effect. As a solution to overcoming the “*it cannot happen to me*” and *myopia* problems that make insurance appear unattractive and discourages investment in adaptation measures, we propose the development of long-term insurance tied to the property rather than the current one-year insurance policy tied to the property owner. Flood insurance is an appropriate starting point as it is a national program with a single insurer (the federal government) designed to reduce future damage while providing financial protection to disaster victims.

The National Flood Insurance Program (NFIP) was created in 1968 because private insurers viewed flood risk as uninsurable and refused to provide coverage against water damage from disasters. The NFIP has expanded over the years and in July 2009 covered more than 5.5 million flood policies nationwide with a total exposure of \$1.2 trillion. Flood insurance is currently sold on an annual basis and is required as a condition for a federally insured mortgage.

One-year flood policies are problematic because many people buy the coverage when they get a mortgage or right after a flood, but do not keep the coverage for the long term. For instance, a recent study that tracked over time the one million residential NFIP flood insurance policies in

¹³ Kunreuther and Michel-Kerjan (2009)

place in Florida in 2000, revealed one third had been cancelled by 2002 and about two thirds had been cancelled by 2005.¹⁴

After the next disaster strikes, there are thus likely to be a large number of uninsured victims. Consider the flood in August 1998 that damaged property in northern Vermont. Of the 1,549 victims of this disaster, FEMA found 84 percent of the homeowners in Special Flood Hazard Areas (SFHAs) did not have insurance, even though 45 percent of these individuals were required to purchase this coverage.¹⁵ These individuals viewed insurance as a poor investment failing to realize that the best return on a policy is no return at all.

With the NFIP up for renewal in Congress, we propose that consideration be given to long-term flood insurance. By tying policies to the length of the mortgage (10, 20, 30 years), insurance will be directly linked to the property. One should also consider requiring all property in flood prone areas to have coverage, just as auto insurance is required on all vehicles. When a resident moves to another location, the flood insurance policy would remain with the property.

A long-term flood insurance program would offer homeowners currently residing in flood-prone areas a fixed *annual premium* for coverage over a specified period of time (e.g. 5, 10 or 20 years). If the homeowner moved before the end of the policy period, then the insurance contract would automatically be transferred to the new owner at the same cost. Homeowners with property constructed prior to the time their community joined the NFIP would continue to be charged their current subsidized premium for the length of the policy period. Those whose homes were built after the date their community joined the NFIP would be charged risk-based premiums using accurate maps provided by the Federal Emergency Management Agency (FEMA) This would require a national effort since many of the FEMA maps have been shown to be outdated¹⁶. Private insurers currently participating in the write-your-own-program would now offer a menu of these long-term flood insurance contracts on behalf of the NFIP, as they are currently doing for one-year contracts.

Advantages of Long-term Flood Insurance over Annual Policies

A long-term flood insurance policy would be a significant improvement over the current annual policies from the perspective of all the relevant stakeholders: homeowners, banks, FEMA and the general taxpayer. Furthermore, it does not require a radical modification of the National Flood Insurance Program. Here are some of the features that a long-term policy provides.

Financial stability for homeowner Fixed insurance rates for a long period of time would provide homeowners with financial stability. Those residing in coastal area would also know that they are protected against water damage from floods and hurricanes.

¹⁴ Michel-Kerjan and Kousky (forthcoming).

¹⁵ Tobin and Calfee (2005)

¹⁶ General Accountability Office (2008)

Avoiding Cancellation of Policies A long-term flood policy would ensure that people would not cancel their coverage after two or three years as many do today when they have not suffered losses. Homeowners would also be more likely to make a claim during the life of the policy since the chances of a flood during a 20 year period is much higher than the annual probability. For example, if a homeowner lives in a high hazard area where the likelihood of flooding next year is 1 in 100, the chances that the property will experience at least one flood during a 25 year period are greater than 1 in 5.

Time and Geographical Spread of Risk If insurance were required of all homeowners residing in flood-prone areas, then the risk would be spread over time and space. Additionally, expanding the policyholder base over what it is today by having all such properties covered would provide much needed financial revenue for the NFIP.

Encouraging Investment in Adaptation Measures Today, many residents do not invest in risk reduction measures (e.g. elevating their house) because the upfront cost is too high compared to the annual premium reduction they could expect from the NFIP. To complement a long-term flood insurance policy we recommend that long-term home improvement loans be made available to spread the cost of the adaptation measure over time. For example, a homeowner with a 20-year mortgage and a 20-year flood insurance policy should be able to obtain a 20-year *home improvement loan*. For cost-effective adaptation measures and risk-based premiums, the financial arrangement would be such that the annual loan payments would be smaller than the rebate the property owner could obtain from the NFIP in the form of an annual premium reduction because her house is less exposed to flood damage. These risk reduction measures would likely have the added benefit of increasing property values.

Reducing Costs to all Interested Parties Long-term flood insurance coupled with long-term loans should provide benefits to all the interested parties. Homeowners are better protected and pay less by investing in risk reduction measures, the NFIP would be less exposed to damage, the bank has safer mortgages and the general public will have less of its taxes going to disaster relief.

Guiding Principles for Long-Term Flood Insurance

If Congress and the Administration decide to move forward on this concept the following two principles should guide the development of long-term flood insurance.

Principle 1: Premiums should reflect risk. Insurance premiums should be based on risk in order to provide signals to individuals about the hazards they face and to encourage them to engage in cost-effective mitigation measures that reduce their vulnerability to catastrophes.

The application of Principle 1 provides a clear signal of likely damage to those currently residing in flood-prone areas as well as those considering locating there. Risk-based premiums would legitimize providing discounts to policyholders investing in cost-effective adaptation measures.

Principle 2: Equity and affordability issues should be addressed. Any special treatment given to homeowners currently residing in hazard-prone areas (e.g., low-income uninsured or inadequately insured homeowners) should be funded through general public funding and not through artificial insurance premium subsidies. This principle reflects a concern for some residents in high-hazard areas who will be faced with large premium increases if the NFIP adheres to Principle 1.

Note that Principle 2 applies only to individuals who currently reside in a flood-prone area. Those who are being charged subsidized premiums would still pay this cost, but it would consist of two components: an annual premium reflecting risk based on updated FEMA maps, and an insurance voucher (similar in concept to food stamps for groceries) reflecting the difference between the risk-based premium and their subsidized premium today. Those who decide to move to the area in the future should be charged premiums that reflect the risk.

Impact of Climate Change on Pricing Long-Term Flood Insurance

Pricing a long-term flood insurance policy so that premiums reflect risk requires one to take into account the impacts of global warming (intensity of future hurricanes and sea level rise). There is considerable uncertainty surrounding the estimates of what the risks associated with losses from hurricanes and flooding may be 10, 20 or 30 years from now. There is thus a need to update FEMA maps regularly with respect to flood damage to reflect these long-term changes and define a pricing formula that evolves over time as maps are revised.

To understand more fully how climate change is likely to affect flood risk in the United States in the coming years and decades, there is a need to construct a set of realistic scenarios with respect to losses from inland flooding and storm surge from hurricanes that reflect scientists' best estimates regarding climate change. To be of maximum utility to insurers and the federal, state and local governments, these estimates must be informed by answers from experts regarding the following questions:

- How many major hurricanes (Category 3 or greater) are estimated to form in the Atlantic Ocean in the next 6 to 18 months (short-term) versus in the next 10 to 30 years (long-term)?
- Of those hurricanes, how many are estimated to make landfall?
- How far inland is damage likely to extend, and how closely can the storm tracks be predicted?
- Will climate change alter the number and types of storms that strike land? Do today's topological maps accurately reflect risk of inundation?

- How much will sea level rise and how will natural environmental protection (e.g. wetlands) change over the next half-century in 5-year intervals in specific parts of our coasts? What effect will these changes have on flooding and storm surges from hurricanes?

Recent analyses by insurers and modeling firms using the latest scientific estimates by scientists studying climate change enable one to undertake simulations as to how alternative scenarios with respect to global warming impact on the price of flood insurance for long-term policies.¹⁷ A recent study by Lloyd's of London¹⁸ in conjunction with Risk Management Solutions indicated that risk from sea level rise could double the average annual losses from storm surge by 2030. A study by the Association of British Insurers (ABI)¹⁹ concluded that with a six percent increase in wind speeds, average annual losses from hurricane damage in the U.S. would increase from \$5.5 billion to \$9.5 billion and losses from hurricanes with a 1/200 chance of occurring would increase from \$85 billion to \$150 billion based on existing properties.

One of the principal findings from these studies is that adaptation measures can reduce the losses from future disasters significantly. For example, the Lloyd's' study showed that adaptation could reduce annual losses from storm surge for properties in high-risk coastal communities in the 2030s to below present-day levels. This suggests that long-term flood insurance coupled with long-term home improvement loans that incentivize homeowners to invest in loss reduction measures will make a significant difference in reducing the damage from future floods and hurricanes.

Conclusion: Moving from the Status Quo

The evidence on increasing losses from disasters, notably floods and hurricanes indicates that the current structure of the National Flood Insurance Program is not adequate to face truly catastrophic floods. It is also somewhat limited in achieving its twin objectives of reducing property losses from future disasters and providing protection to those who suffer severe water damage because many of these residents do not invest in risk-reduction measures voluntarily and cancel their flood insurance coverage if they haven't suffered a loss for several years.

On a complementary note, we need bold innovative programs that are transparent so that people can understand the nature of the contract. Those who purchase insurance policies often have a difficult time understanding what risks are covered, what risks are not, and the basis for being charged a specific rate. The problem is likely to be compounded for a long-term insurance contract. There is an opportunity to educate consumers as to the basis for the premiums they are being charged by providing more detail on the nature of the risk that is covered and the amount charged for different levels of protection. It would be very useful for the NFIP to reveal this

¹⁷ Heweijer et al. (2009)

¹⁸ Lloyd's of London (2008)

¹⁹ ABI (2005)

information in a much clearer way so that homeowners will be able to make tradeoffs between costs and expected benefits – impossible for them to do today. Thaler and Sunstein (2008) argue for this type of information disclosure by proposing a form of government regulation termed RECAP (Record, Evaluate and Compare Alternative Prices). They recommend that the government require disclosure practices, not in a long, unintelligible document, but in a spreadsheet-like format that includes all relevant formulas.²⁰

The flood insurance program should combine the strengths of the public and private sectors and take into account how people make decisions so that proposed solutions will be considered as win-win situations by a large number of different stakeholders. In designing these programs, one needs to understand how a long-term insurance policy with rates reflecting risk can lead property owners to invest in loss reduction measures when this insurance is coupled with long-term home improvement loans and building codes. Real estate developers, the construction industry and financial institutions have to play an important role in promoting this concept. There will also be a need for third party inspectors to certify that the adaptation measures are in place and that building codes are enforced.

Whether decision makers view long-term flood insurance as an attractive alternative depends on how the program is designed and presented to key interested parties in relation to the current structure of the NFIP. If the stakeholders have a common understanding of the goals and objectives of an innovative and comprehensive disaster management program, we may be able to move away from the status quo which encourages myopic thinking, to a long-term strategy for reducing losses in this new era of catastrophes.

²⁰ Thaler and Sunstein (2008)

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REFORMING INSTITUTIONS AND MANAGING EXTREMES: U.S. POLICY APPROACHES FOR ADAPTING TO A CHANGING CLIMATE

To date, little research has addressed public policy to frame the nation's approach to adapt to a changing climate. As defined by the Intergovernmental Panel on Climate Change, adaptation includes a set of actions to moderate harm or exploit beneficial opportunities in response to climate change. The lack of policy research and discussion may indicate a presumption that climate change is gradual rather than abrupt—and variability of day-to-day or seasonal effects is predictable—and that households and businesses may be able to adapt readily. However, in light of scientific evidence of extreme and unpredictable climate change, prudent policy requires consideration of what to do if markets and people fail to anticipate these changes, or are constrained in their ability to react.

RFF's domestic adaptation research seeks to fill this gap. Our approach is proceeding in two parts. First, we have summarized the scientific understanding of the effects of a changing climate on US natural and environmental resources, built infrastructure, and public health. We are now developing a set of high-priority policy recommendations.

Part One: The Effects a Changing Climate

During 2008-2009, RFF focused on synthesizing scientific understanding of the effects of a changing climate on terrestrial ecosystems, marine ecosystems, fresh water resources, agriculture, human health and built infrastructure. In six commissioned papers, experts in these fields tracked the likely impacts of climate change on the continental US over the next 50-100 years and the strategies that might be employed to cope with and reduce these impacts. The papers were presented at a two-day workshop in October 2008 and are available from RFF:

- *Adapting to Climate Change: The Public Policy Response – Public Infrastructure* -- James E. Neumann and Jason C. Price, Industrial Economics, Inc.
- *Agriculture and the Food System: Adaptation to Climate Change* -- John M. Antle, Montana State University
- *An Adaptation Portfolio for the United States Coastal and Marine Environment* -- David Kling and James N. Sanchirico, University of California, Davis
- *Emerging Climate Change Impacts on Freshwater Resources: A Perspective on Transformed Watersheds* -- Alan P. Covich, University of Georgia
- *Terrestrial Ecosystem Adaptation* -- Steven W. Running and L. Scott Mills, University of Montana
- *Adapting to Climate Change: Public Health* -- Jonathan M. Samet, University of Southern California

These scientific assessments led to three findings that are relevant for the design of adaptation policy:

- **Finding 1: Many climate-related impacts are not new.** These already-experienced effects include loss of freshwater resources and terrestrial and marine species, droughts, climate-induced variability of agricultural yields, heat waves, and coastal and inland flooding. So, what's new? In addition to pointing out these existing problems, the scientific assessments identify two new concerns. The first is new types of impacts, such as increased acidification of the oceans. The second is types of impacts that are less likely than what we have experienced before, but that could be much more extreme in their effects in the future.
- **Finding 2: Our existing public and private institutions have had very mixed success in preparing us to deal with the impacts we've already been experiencing.** For example, the public health policy response to heat waves and the private agricultural response to shifting agro-ecological zones have been quite good. However, in many areas the private and public response has been poor. Marine fisheries and freshwater resources are being depleted. People and infrastructure have long been at risk due to extreme weather events, yet our emergency response policies seem inadequate and our political institutions have failed to develop forward-looking policies.

This finding indicates that there will be poor performance of existing public policies and institutions in dealing with the impacts from climate change.

- **Finding 3: Science assessments suggest climate change will lead to a combination of more severe impacts and greater frequency of these impacts.** Uncertainty surrounds how much more severe and frequent, but taken together, these changes suggest that the losses to society due to impacts will, on average, be larger. This implication reinforces the need for reform of existing policy as well as underscores the need for some wholly new policy approaches to address the increasing probability of extreme and possibly costly events.

Part Two: The Domestic Policy Response

RFF is now spearheading development of a series of *RFF Issue Briefs* to address the most compelling and urgent of policy actions that could frame US climate adaptation policy. The *Briefs* are primarily intended for decisionmakers although they often have a wider audience, including scholars and the general public. Below is a list of briefs in preparation:

Reforming Institutions: Getting Prices Right

Adaptation Policy: Role of Better Defined Rights and Responsibilities in the Marine Environment – James N. Sanchirico, University of California, Davis

Encouraging Adaptation to Climate Change: The Need for Long-Term Flood Insurance - Howard Kunreuther and Erwann Michel-Kerjan, University of Pennsylvania

Agricultural Subsidies and Livestock Management– John Antle, Montana State University

Water and Adaptation – Ray Kopp, Resources for the Future

Reforming Institutions: Improving Regulation and Management

Public Health: Adapting to Climate Change - Jonathan Samet, University of Southern California

Terrestrial Ecosystem Services – Jim Boyd, Resources for the Future

Adaptation and Land Use –Brent Sohngen, Ohio State University

Reforming Public Land Management – Joel Smith, Stratus Consulting and Bill Travis, University of Colorado, Boulder

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Federal Mega Disaster Policy: Lessons from Katrina - Marc Landy, Boston College

Managing Extremes: Understanding the Extremes

Adapting to Extreme Events: Managing Fat Tails - Carolyn Kousky and Roger Cooke, Resources for the Future

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Pre-Positioned Policy as Public Adaptation to Climate Change - V. Kerry Smith, Arizona State University

Information, Early Warning, and Decisionmaking under Uncertainty –Molly Macauley, Resources for the Future

Managing Extremes: Thinking the Unthinkable

Priority Setting and Federalism –Winston Harrington, Resources for the Future

Adapting Water Resources Investment and Management to the Uncertain Prospects of Climate Change – Len Shabman, Resources for the Future

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