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Lessons for Wildfire from Federal Flood Risk Management Programs

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ABOUT HEADWATERS ECONOMICS

Headwaters Economics is an independent, nonprofit research group whose mission is to improve community development and land management decisions in the West.

AUTHOR CONTACT INFORMATION

Carolyn Kousky, Ph.D. | Resources for the Future | kousky@rff.org | 202-328-5188

Ray Rasker, Ph.D. | Headwaters Economics | ray@headwaterseconomics.org | 406-570-7044

P.O. Box 7059
Bozeman, MT 59771
http://headwaterseconomics.org

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INTRODUCTION

This paper reviews the experience, both positive and negative, of national floodplain management programs in order to draw lessons for potential new approaches to reduce the costs and risks posed by wildfire to properties in the Wildland-Urban Interface (WUI).[1]

Wildfires have become more expensive and dangerous over the last several decades. Wildland firefighting costs the Forest Service and Bureau of Land Management an average of $3 billion per year; triple the amount from a decade ago (Gorte 2013). At least a third of the bill goes to defend private homes, although some put the estimate higher, at 50 to 95 percent (Headwaters Economics 2014; U.S. Department of Agriculture 2006).

Since 1990, the average number of structures burned has more than tripled and firefighter fatalities have risen fourfold. Over the last 10 years, the acres burned per fire have doubled and the average fire burns twice as long. These trends are only expected to worsen due to the combined forces of climate change, past management practices, and continued homebuilding on fire-prone lands. In the West, for example, 84 percent of the Wildland-Urban Interface, the forested areas where housing borders undeveloped lands, is not yet developed, but land conversion is projected to continue (Headwaters Economics 2013). The increasing need to defend homes from fires has contributed to agencies continually shifting money from other departments to pay for the rising costs of fire suppression. As a result, a number of programs, including fuels reduction efforts, which could help reduce fire risk, are not funded.[2]

There is a growing consensus that more must be done to manage wildfire risks and control the range of escalating costs. Solutions to date have largely focused on landowner education to encourage voluntary adoption of fire-resistant building materials and landscaping, as well fuels reduction efforts on forested lands. Both of these are important measures, but likely insufficient—particularly at current levels—to curb the escalating risks and costs.

This paper explores whether lessons learned from federal flood risk management programs could be applied to reducing risks from wildfire. The policy objective is to find ways to change the pace, scale, and pattern of home development on the as-yet undeveloped portion of the Wildland-Urban Interface.

Parallels Between Flood and Wildfire

There are several parallels between wildfires and floods. Both are natural disasters that have been altered by human interventions in natural systems. Both can be devastating and the costs associated with each have been increasing over the last several decades. The bulk of the costs of both types of disasters are borne in large part by the federal government, potentially introducing a disincentive for local governments to invest in risk reduction. Both flood and wildfire, therefore, could have an element of moral hazard; since a significant portion of the costs associated with building in hazardous areas are not borne by the local governments or homeowners, there may be a reduced incentive to build on safer lands.

[1] We define the Wildland-Urban Interface as private land within 500 meters of forested federal land: http://headwaterseconomics.org/wphw/wp-content/uploads/PGude_2008_Forestry.pdf. Other definitions exist, including a broader definition of WUI consisting simply of land where homes are at risk from wildfire. An exact definition of WUI is less important than an acknowledgment that the majority of land where wildfire can pose a risk to property is not yet developed.

[2] For a state-by-state description of programs not funded because of "fire transfers," see: http://www.fs.fed.us/publications/forest-service-fire-transfer-state-impacts.pdf. For a description of wildfire-related trends, see: http://headwaterseconomics.org/wildfire/reducing-wildfire-risk.

Given the growing federal cost for both types of events, there could be significant financial benefits to risk reduction programs. For wildfire, reduced costs would also benefit local communities, which although they benefit from federal firefighting expenditures, often incur significant firefighting costs themselves.

Finally, both floods and wildfires can be managed through essentially two types of activities: altering the hazard event or reducing exposure to the event (Donovan and Brown 2007). Historically, both federal wildfire policy and flood were focused on the former through, respectively, suppression of fires and structural flood control measures, such as levees. For floods, there has been a shift in the past several decades away from an exclusive focus on structural protection to a broader risk management approach.

While federal flood policy has not been perfect and is sometimes controversial, it has also produced tangible benefits. Floodplain regulations have avoided an estimated $1 billion in losses annually (NFIP 2002; Sarmiento and Miller 2006). Communities at risk of flooding have hazard maps delineating areas of highest risk. Around 5.5 million homeowners have financial protection from flood events. Hazard mitigation grants have produced benefits of avoided disaster damages an estimated four times greater than costs (Rose *et al.* 2007). Federal flood risk management policies have now been in place for a substantial amount of time, enabling an evaluation of both the benefits and drawbacks to inform wildfire policy.

Differences Between Flood and Wildfire

There have been multiple goals of federal flood policy over the last few decades, including reducing the costs of post-disaster aid, providing financial protection to homeowners for flood events, increasing investments in hazard mitigation, and encouraging sound floodplain management. The wildfire policy challenge discussed in this report, which is distinct from these, is: to reduce the costs and risks posed by wildfire to private properties by altering the pace, scale, and pattern of development in the un-built portion of the Wildland-Urban Interface (i.e., the 84% of the WUI in the West that is not yet developed). This focus on as-of-yet undeveloped lands stands in contrast to flood policy, which is focused on developed floodplain lands. This leads to a couple key points that underlie our analysis in this report.

Insurance Is Not the Main Driver

Insurance may not be the strongest tool for altering the pace and nature of development on undeveloped lands. While homeowner premiums may be higher in the WUI, reflecting the higher wildfire risk, it appears unlikely that they are high enough currently to be an actual deterrent to development. Carole Walker of the Rocky Mountain Insurance Information Association put the situation succinctly: "A homeowner's insurance premium is the result of the decision to live in the WUI, but it is not the primary driver of that decision."[3] It is doubtful that insurance rates will rise high enough in the near-term to influence the redesign of a subdivision to direct future homes onto the safest areas, or prohibit home development on the most dangerous lands.

Insurance companies do encourage certain wildfire risk reduction efforts by homeowners already occupying the WUI. Wildfire damage is typically covered by a standard homeowners policy and homeowners may be able to get premium discounts for adopting certain risk management actions. In high-risk areas, insurance companies may even mandate particular investments as a condition of

[3] Carole Walker, personal communication. October 24, 2014. She also said: "A government run high risk insurance fund would ultimately encourage, rather than discourage people to live in the WUI."

coverage. These actions by insurers could be important in increasing mitigation investments, but we do not review them here as we are focused on federal policies.

It is also important to stress that we do not envision a parallel federal wildfire insurance program akin to the National Flood Insurance Program; instead, we focus on other lessons from the NFIP and not the design of a federal disaster insurance program. While there is some concern about increasing rates for homeowners' policies in wildfire-prone areas, the costs of wildfires are still largely manageable for the insurance industry. The Insurance Information Institute estimates that over the last two decades, wildfires were less than two percent of insured catastrophe losses and, for comparison, hurricanes, and tropical storms were more than 40 percent, followed by tornadoes at 36 percent.[4] As such, there is no discussion at this time of the federal government intervening in the fire insurance market and we believe any such program to be politically untenable. Some fire-prone states have, however, adopted regulations aimed at improving the affordability of fire coverage or to offer coverage to high-risk residents (e.g., the California FAIR plan).

A Different Set of Incentives Are Required for Wildfire

Several flood risk management programs use reductions in insurance premiums as an incentive for hazard mitigation or other activities. To encourage risk reduction in wildfire, we envision a different set of incentives that are tied to a community's performance in reducing wildfire risk. These incentives could include:

- Increased timber management priority. While the Forest Service and Bureau of Land Management do not have the resources to conduct fuel reduction on all lands that are in need of treatment, communities that act to reduce wildfire risk could receive more emphasis on fuel reduction by federal land managers (using either prescribed burns or mechanical treatment);
- Grants and technical assistance for land use planning (e.g., for detailed risk mapping, zoning ordinances, transferable development rights programs, open space protection, and other tools for directing or limiting future development on fire-prone lands); and
- Funds for purchase of at-risk lands (or development rights).[5]

Organization of This Report

This report evaluates federal flood risk management programs against several questions. Have the federal flood programs met their objectives? What approaches have found success and which have not? What have been the challenges? What does this tell us about federal wildfire risk management policies?

The next section provides the necessary background on the federal flood risk management programs. The report then turns to a discussion of these programs with the aim of identifying lessons for wildfire. This discussion and the resulting lessons learned are grouped into four topics:

1. Federal influence over local planning;
2. Mapping of risk;
3. Federal hazard mitigation assistance; and
4. The importance of aligning costs and benefits.

Lessons and relevance for wildfire risk management are presented at the end of each section.

[4] See: http://www.iii.org/issue-update/catastrophes-insurance-issues.
[5] Potential incentive-based programs are discussed in more detail in: Reducing Wildfire Risks to Communities: Solutions for Controlling the Pace, Scale, and Pattern of Future Development in the Wildland-Urban Interface: http://headwaterseconomics.org/wildfire/reducing-wildfire-risk.

A word about acronyms: Discussion of flood risk management can involve many acronyms, confusing to those not versed in federal flood policy. We have made every effort to reduce the use of acronyms, with two exceptions: the National Flood Insurance Program will be referred to as the NFIP and the Federal Emergency Management Agency will be FEMA. For all others, we will refer to the acronym when first mentioned, but thereafter will attempt to use descriptive words. For example, although Flood Insurance Rate Maps are often referred to as FIRMs, we refer to them here as "flood maps."

FEDERAL FLOOD RISK MANAGEMENT: Background

This section reviews the three primary programs evaluated in this report: the National Flood Insurance Program, post-disaster aid to flood damaged communities, and hazard mitigation grant programs administered by FEMA.[6]

The National Flood Insurance Program

> *The initial goal of NFIP was for flood insurance to at least partially replace post-disaster federal aid.*

The idea for a federal flood insurance program dates back to the 1950s when it was first proposed by President Truman. He conceived of a flood insurance program as being "based upon private insurance with reinsurance by the Government" and if such insurance were available, "there should be no need in the future for a program of partial indemnities" (Truman 1951). That is, he presumed that flood insurance could replace post-disaster federal aid. Following a damaging hurricane season in 1955, Congress responded to Truman's suggestion and passed the Federal Flood Insurance Act of 1956. The Act authorized a flood insurance program, a reinsurance program, and a loan program; specific design proposals were put before Congress in 1957. However, Congress did not think any of them satisfactory and chose not to appropriate funding. Movement on flood insurance then stalled until 1965.

In 1965, Hurricane Betsy caused extensive damage, primarily in Florida and Louisiana. At the time, it was the most costly disaster to date, the first to cause more than $1 billion in damages. Almost no victim had flood insurance to help cover losses. Flood insurance was largely unavailable on the private market. In response, Congress directed the Secretary of Housing and Urban Development to study programs to provide financial assistance to victims of flood damages and other natural disasters, including insurance. The study, published in 1966, concluded that flood insurance was "feasible" and could "promote the public interest" and could be used to both help victims bear the risk of floods and to discourage "unwise occupancy of flood-prone areas" (U.S. Dept. of Housing and Urban Development 1966). At roughly the same time, the Johnson administration requested that a special task force examine flood risk in the U.S., which also released a report in 1966. The report too recommended a flood insurance program, although cautioned that rates should be risk-based; if they were subsidized it could undermine the goal of reducing flood risk (Task Force of Federal Flood Control Policy 1966).

These reports led to the passage in 1968 of the National Flood Insurance Act. Three other factors contributed to passage of the Act: subsidence of Cold War preoccupations; a focus on Johnson's Great Society initiatives, including disaster protection; and a growth in hazards research and expertise on flood

[6] There are many other minor programs that are, in some way, related to flood risk management that are not covered in this report. For example, the National Oceanic and Atmospheric Administration maps sea-level rise, the Environmental Protection Agency and the Corps of Engineers enforce section 404 of the Clean Water Act, and there are a couple relevant executive orders (e.g., EO 11988).

hazards (Knowles and Kunreuther 2014). Modifications to the program were made over time in response to other flooding events which highlighted weaknesses in the program (we note some of these below). The NFIP is currently housed in the Federal Emergency Management Agency (FEMA) and was ultimately designed as a partnership between the federal government and communities. Communities can voluntarily join the program. In so doing, they must adopt minimum floodplain management regulations and in return, their residents become eligible to purchase a flood insurance policy from the NFIP.

FEMA partners with private insurance companies to administer the program. Private companies write NFIP policies and process claims in exchange for a fee, but they bear none of the risk, which is held by the NFIP. Residents can insure their home up to $250,000 and their contents up to $100,000. Commercial properties can insure both their building and contents up to $500,000 each. Minimum deductibles were recently increased; they are generally $1,000.

> *FEMA maps flood risk in participating communities. The purchase of insurance is mandatory for certain homeowners in high-risk areas. Some classes of policyholders receive lower rates to encourage program participation. Pricing is not designed to cover losses from catastrophic disaster years.*

Under this program, FEMA maps flood risk in communities around the country. This is shown on Flood Insurance Rate Maps (referred to as FIRMs, but for simplicity we refer to them throughout as flood maps). Flood maps indicate different flood zones of varying levels of risk. Special Flood Hazard Areas (SFHAs, but we will refer to them as high flood hazard areas) are 100-year floodplains, or those areas where there is at least a one percent annual chance of a flood.[7] This translates to a roughly 26 percent chance of at least one flood over a 30-year mortgage. In high flood hazard areas, certain regulatory requirements apply, discussed later in this report. NFIP premiums vary by flood zone and by certain characteristics of the property.

Early in the program, few people chose to purchase flood insurance. To encourage greater purchase of policies, Congress offered discounted rates to certain policyholders. The largest group receiving discounted rates included properties built before the flood maps for that community were developed (so-called pre-FIRM properties). These properties were given discounted rates to not penalize those who built before risk information was available, to encourage communities to join the program, to have homeowners cover at least some of the costs of flood losses (it was felt that if they were charged full rates, individuals would not insure and thus require more disaster aid), and to not force the abandonment of otherwise economically viable structures through high premiums (Hayes and Neal 2011).[8] Existing construction is thus treated differently than new construction.

After continued low voluntary take-up of flood insurance, in 1973 Congress established the mandatory purchase requirement. This required homeowners in a high flood hazard area in NFIP participating communities with a loan from a federally backed or regulated lender to purchase flood insurance. Further, to be eligible for disaster assistance post-flood, the new law required communities to participate in the program. These provisions worked as intended to increase participation.

Like wildfire, flood risk is constantly evolving, from changes in pervious surface area in a watershed, to construction of flood control structures, erosion, and climate change. To address changing risks, FEMA

[7] Within these zones, FEMA differentiates inland high flood areas from those on the coast subject to storm surge, which can be more damaging, and different rates and building requirements apply across these two groups.

[8] Subsidized properties are required to pay non-discounted rates when they are damaged at half the property value or when improvements increase their value by 50 percent or more (CBO 2007). It was, therefore, thought the subsidy would phase out quickly as structures were damaged or improved, but modern construction techniques have extended the life of buildings (Pasterick 1998; CBO 2007).

periodically remaps communities. Remapping is also essential for incorporating improved modeling methods and better data. New maps, however, often change the boundaries of high flood hazard areas. This has led to the creation of another group of policies that receive reduced premiums: those that are grandfathered. If an updated flood map changes the boundaries of the high flood hazard area, such that insured property that was previously outside this zone is now inside it, they can be grandfathered. This means they can maintain the premium associated with the previous lower risk zone, as long the structure was built in compliance with the old map and is not altered to violate floodplain building regulations.

In 1981 it was decided that the combined revenue from the actuarial and the discounted policies should be enough to cover losses from the "average historical loss year." Because the pricing only covered average years (and based on a short historical record), it was ill-prepared to handle a catastrophic loss year, such as the 2005 hurricane season which sent the NFIP deeply into debt to the U.S. Treasury. The losses of Hurricane Ike in 2008 and Hurricane Sandy in 2012 only deepened this debt. As of December 31, 2013, the debt stood at roughly $24 billion. FEMA estimates it will not be able to repay this debt during the next decade (Garcia-Diaz 2014).

> *Participation in the NFIP is widespread. The program must balance competing objectives, and reform discussions are ongoing.*

Today, roughly 22,000 communities participate in the NFIP nationwide covering more than 98 percent of the U.S. population. As of April 2014, there were more than 5.4 million policies-in-force nationwide representing a little less than $1.28 trillion in coverage. Florida has close to 40 percent of policies-in-force and dollars-in-force and only five states (Florida, Texas, Louisiana, California, and New Jersey) account for around 70 percent of all policies nationwide (Michel-Kerjan and Kousky 2010).

The NFIP has played a large role in shaping federal management of flood risk over the last four and a half decades. As we will discuss in this report, it has been an important tool in helping the federal government incentivize how land in the floodplain is used, and improve building construction, both of which have reduced flood losses. It has provided insurance protection to millions of individuals.

The NFIP has also struggled to balance competing objectives, such as encouraging flood insurance purchases and maintaining fiscal soundness. It has been accused of encouraging excessive development in risky areas, failing to accurately capture risk, and mandating insurance purchase for homeowners who do not need or want coverage.

Here, we will try to pull out lessons for federal wildfire management on what is worth emulating from the NFIP and what approaches should be avoided. Meanwhile, debate about the merits and drawbacks of the NFIP continue, particularly in light of its massive debt. In July 2012, Congress passed the Biggert-Waters Flood Insurance Reform Act, which reformed many aspects of the program. The most controversial was the phase-out or elimination of discounted insurance premiums. As newer higher rates began to be phased in for some of these policyholders, outcry over the costs ensued. In response, Congress reversed course in March 2014, passing the Homeowner Flood Insurance Affordability Act, which, among other things, reinstated grandfathering and preserved discounted rates for primary residences.

Post-Flood Recovery Programs

Following a major disaster that overwhelms state capacity—this applies to both floods and wildfire, as well as other disaster events—governors can request federal aid through a process outlined in the Stafford Act. Governors first submit a request for a presidential disaster declaration through FEMA to the President. FEMA does a rapid assessment of the damage and makes a recommendation to the President.

If the President issues a declaration, he can authorize one or both of two types of assistance: Individual Assistance grants are given to qualifying households to repair damaged property and Public Assistance is aid to local governments. Once issued, FEMA can disburse funds to the affected states from the Disaster Relief Fund. This fund receives annual appropriations at a level to cover disasters requiring expenditures of less than $500 million; larger events or multiple events in one year require emergency supplemental appropriations from Congress. Stafford Act disaster assistance for floods is tied to certain flood insurance purchase requirements (Liu 2008).[9] If authorized, individuals can receive grants to help repair and replace damaged properties, and communities can receive assistance to repair damage to buildings and infrastructure and cover the cost of other repair activities, such as clearing debris.

The first line of assistance for disaster victims, including households, however, is a subsidized loan from the Small Business Association. Victims may receive assistance from other federal sources as well, such as being able to deduct losses from their income taxes. In severe disaster events, Congress has also recently funneled large sums to the Community Development Block Grant program in the Department of Housing and Urban Development. This offers an easy way to send money to state and local governments over which they have broad discretion (Kousky and Shabman 2013).

For presidentially declared disasters, if aid is given to a community, funds can be made available at a state's request through a grant program to cover the costs of hazard mitigation; this is discussed in the next section. Note, however, that of counties that have been presidentially declared disaster areas, between the 1960s and 2013, only three percent were declared due to wildfire; most were due to severe storms, hurricanes, or floods.[10] This means post-disaster aid, and the post-disaster Hazard Mitigation Grant Program discussed next, are only rarely available due to wildfire disasters. The last wildfire-related declarations were two in 2012, one for Montana wildfires and one for the Colorado High Park and Waldo Canyon fires. In 2011, Texas received a declaration for fire and prior to that Oklahoma received on in 2009.[11]

Flood Mitigation Planning and Grant Programs

FEMA currently has three hazard mitigation grant programs for flood related projects: Flood Mitigation Assistance, Pre-Disaster Mitigation, and the Hazard Mitigation Grant Program. All three programs fund hazard mitigation projects and allow limited amounts of funds for mitigation planning and management costs. To be funded, projects must be shown to be cost-effective (usually through calculation of a benefit to cost ratio greater than one)[12] or, for Flood Mitigation Assistance, projects must be shown to be in the financial interest of the NFIP (FEMA 2013). They must also be shown to be feasible (from an engineering study) and provide a long-term solution (e.g., elevating a property above floodwaters but not sandbagging when a flood is imminent). Background on each program is briefly given in this section.

The Flood Mitigation Assistance program was established in 1994 with the intention of reducing or eliminating claims to the NFIP. It has been used to help mitigate so-called Repetitive Loss Properties, or those which have sustained numerous flood claims under the NFIP (usually defined as two or more losses

[9] A victim of a flood in a Special Flood Hazard Areas (SFHA) is only eligible for Stafford Act disaster assistance if their community participates in the NFIP. Further, the Stafford Act requires that if local governments or non-profits receive FEMA disaster aid to repair or rebuild flood-damaged property, they must maintain flood insurance on the building to be eligible for future disaster aid (from any hazard). Homes that are repaired or replaced with Stafford Act assistance must maintain flood insurance as a condition of the aid and in order to receive assistance from future flood damage.

[10] Here, we are considering major disaster declarations by the President, not a fire management assistance declaration or fire suppression authorization.

[11] Declaration data available on FEMA's website: https://www.fema.gov/disasters.

[12] Under the 5 Percent Initiative, up to 5% of Hazard Mitigation Grant Program (HMGP) dollars can be used for projects difficult to evaluate or justify on cost-effectiveness criteria. Further, if a property is in an SFHA and is declared substantially damaged, no benefit-cost test is required for buyouts.

of at least $1,000 over a 10-year period).[13] Some of the funds for Flood Mitigation Assistance come from NFIP revenue. Grants are given to states (local governments are subapplicants); in FY2014 $89 million was available.

The Pre-Disaster Mitigation program was authorized in 2000 with an amendment to the Stafford Act, although it originally began as a pilot program ("Project Impact") in 1997. The Pre-Disaster Mitigation program was created to reduce risks from future hazards and reduce reliance on federal funding in future disasters. There is a 25 percent state and local cost share. In FY2014, $23 million was allocated, with each state (and Washington, D.C. and the islands) each getting one percent or $250,000. Another $5 million was set aside for tribal governments. FEMA used carryover funds to increase the amount of FY2014 spending on the program. Grants can be used for mitigation projects (capped at $3 million), such as retrofitting buildings against hazards, buying out flood-prone properties, building "safe rooms," and wildfire vegetation management. They can also be used for the creation of hazard mitigation plans. These plans, discussed more below, are a requirement for receiving Pre-Disaster Mitigation project grants or Hazard Mitigation Grant Program funds. Funding for new mitigation plans is capped at $800,000 and funding for plan updates is capped at $300,000. For the last several years, the administration has not recommended funding the program, although Congress continued to do so. Its authorization expired at the end of FY2013 and new legislation has been introduced. Its ultimate fate remains uncertain as of this writing.

The Hazard Mitigation Grant program[14] is a post-disaster program that provides grants to states and local governments to invest in hazard mitigation during rebuilding after they have received a presidential disaster declaration. It is authorized under the Stafford Act. Examples of eligible projects include property acquisition and conversion to open space ("buyouts"), building retrofits, elevating flood-prone properties, minor or localized flood control projects, and activities supporting building codes. There is a 25 percent state cost share.[15] Funding amounts are tied to total FEMA disaster aid awarded and the type of mitigation plan a state has in place.

Some Programs Can Also be Used for Wildfire

The Pre-Disaster Mitigation and Hazard Mitigation Grant programs can also be used for wildfire. They cannot be used for suppression-related expenditures or prescribed burning, but mitigation measures, such as creating defensible space, hazardous fuels reduction within 2 miles of structures, and retrofitting buildings are allowable. To date, however, they have only very occasionally been used for wildfire. For the decade ending in 2012, FEMA estimated that roughly 0.5 percent of all mitigation grant projects, and associated dollars, were for wildfire, with half of the projects in California and Colorado (McCarthy 2014).

FEMA also offers the Fire Management Assistance Grant Program to aid states with firefighting and other measures when the threat of a major disaster exists. The Department of the Interior offers the Wildland Urban Interface Community Fire Assistance program that can fund mitigation activities on or adjacent to federal land.[16]

[13] Note that previously there had been separate grant programs focused on Repetitive Loss and Severe Repetitive Loss properties but the Biggert-Waters Flood Insurance Reform Act of 2012 essentially consolidated these programs into the FMA program.
[14] More information available on FEMA's website: http://www.fema.gov/hazard-mitigation-grant-program.
[15] Community Development Block Grant dollars can be used for the match, as can in-kind donations or services.
[16] https://www.cfda.gov/index?s=program&mode=form&tab=core&id=702d1ff743fd0d5f7b3860cbf07ddeec.

FEDERAL INFLUENCE OVER LOCAL PLANNING

Tying hazard mitigation plans to aid has created widespread adoption of such plans, but they may not be integrated into other community decision-making. Requiring minimum standards for participation in the insurance program has led to avoided flood damages, but some argue these regulations are very minimal.

Incentives for further flood risk reduction are obtained through a reward program, the Community Rating System.

Encouraging land use change and other costly measures have proven difficult.

This section discusses how the federal government has influenced local decision-making to mitigate flood risk. After a description of the programs, lessons learned are presented at the end of the section.

In the U.S., land use regulation, building codes, and many other facets of risk management are largely the purview of local governments, yet with flood risk management the federal government has found ways to influence these local decisions. The federal government has three primary mechanisms for doing this:

1. Tying disaster aid to hazard planning;
2. Baseline NFIP regulations; and
3. An incentive program in the NFIP called the Community Rating System.

Hazard Mitigation Plans are Tied to Disaster Aid

First, the federal government influences local planning by linking disaster aid with hazard mitigation plans. While state plans have been required under the Stafford Act, this requirement became more substantive with passage of the Disaster Mitigation Act of 2000. This amended the Stafford Act to require both state and local governments to have a FEMA-approved hazard mitigation plan in order to apply for any mitigation grant program (FEMA 2013).[17] If a state adopts an "Enhanced Plan," more Hazard Mitigation Grant Program funds are available in the event of a disaster.[18] Enhanced plans do more than the standard plans, such as being required to be integrated with other planning activities and FEMA programs, and demonstrating capabilities beyond the standard plan. State and local plans must be reviewed and revised every five years.

Each plan must be approved by FEMA. FEMA reviews plans to ensure they include certain items. For the standard plan, this includes: description of how the state has coordinated local mitigation planning efforts, development of a mitigation strategy based on vulnerability analyses and risk assessments, description of how the state will provide funding or technical assistance to local governments, discussion of how the state will prioritize jurisdictions for assistance, and establishment of an approach for plan maintenance.

There is not much evidence on how influential such plans are in actually altering policy or practices. An analysis of 30 coastal state plans found that overall plans were of moderate to low quality, with

[17] A waiver for subapplicants may be granted in "extraordinary circumstances," but, in this case, a plan must be approved by FEMA within a year of the award. Subapplicants do not need a plan for planning awards.
[18] With just a standard mitigation plan, a state can receive up to 15% of the first $2 billion of disaster assistance given by FEMA, up to 10% of the total between $2 billion and $10 billion, and 7.5% of aid between $10 billion and $35.333 billion. If a state has adopted an Enhanced Mitigation Plan, then they are eligible to receive up to 20% of the total FEMA assistance given.

substantial variation among states, but there has been a slight trend toward improvement over time (Berke et al. 2012). Hazard mitigation policies that receive federal funding or that are fairly low cost and easy to implement, such as promoting higher awareness, were more common in plans than policies that require more resources, such as regulating development or land use. A 2014 analysis of plans in North Carolina and Florida found that preventative land use policies were given less attention in plans than other policy actions (Berke et al. 2014).

Hazard mitigation plans can be more effective when linked with other community and state planning actions, but many are standalone plans (Schwab 2010). Overall, there is not much evidence to suggest the plans play a large role in influencing local governments to adopt policies they were not already inclined to undertake, particularly related to costly actions such as land use and strict building codes, but there are not solid findings to the contrary either.[19] A trend toward greater involvement of community planners in the development of hazard mitigation plans may help make them more influential going forward. As the plans are required in order for communities to receive certain federal assistance funds after a disaster, they have been widely adopted.

Participation in NFIP Requires Adoption of Floodplain Regulations

The NFIP, however, gives the federal government another, uncommon point of entry into actual local land use regulations. Participation in the NFIP is fully voluntary, so the federal government does not directly regulate land use in the floodplain. In order to participate in the NFIP, however, a community must adopt minimum floodplain management regulations established by the program (FEMA 1998). The required regulations vary according to the flood zone, but some common features include:

- The community must require that all new development in high flood hazard areas obtain a permit;
- New development in floodways (the central portion of a floodplain that carries deep flows) must not be permitted if it increases flood heights; and
- All new construction, or substantially improved or damaged properties in high flood hazard areas, must be elevated so the lowest floor is at or above base flood elevation, which is the estimated height of floodwaters in a 100-year flood (nonresidential structures can also be flood proofed).

In coastal high flood hazard areas, where storm surge is possible, there are additional building requirements. All regulations must use the most recent FEMA maps. FEMA regional offices provide model ordinances for adoption.

Compliance overall is fairly high for the requirement that new buildings be elevated above the base flood elevation. A nationwide survey found that between 86 percent and 95 percent of non-discounted properties were in compliance with the elevation requirements of NFIP ordinances, but only 58 percent to 70 percent are fully compliant with all other regulations, such as elevating mechanical and utility equipment and additional coastal zone standards (Mathis and Nicholson 2006). This could potentially be because elevation is easier to monitor and enforce. In addition, homeowners receive substantial premium reductions for elevation, creating a property-level incentive to do so.

The NFIP estimates that the minimum regulations for new construction avoid $1 billion in flood losses each year and that structures built in compliance with NFIP criteria experience 80 percent less flood damage (NFIP 2002). A study commissioned by FEMA using different methods similarly found that the mitigation provisions of the NFIP save roughly $1.1 billion each year (Sarmiento and Miller 2006). Another independent evaluation confirmed that NFIP standards do reduce damage for today's flood

[19] There is good evidence that building codes can reduce damages but that it might take a disaster event to spur interest in strengthening and enforcing codes (Kunreuther and Michel-Kerjan 2009).

events, but since the flood maps do not currently include future conditions, and the building codes are tied to the current maps, their effectiveness will decrease over time (Jones et al. 2006). The influence on existing construction is also likely much less than new construction. FEMA notes that communities have found it difficult to enforce the requirement that once a home is substantially damaged or improved, it must come into compliance with building regulations if homeowners do not have the funds for mitigation (NFIP 2002). It has also been argued that the building standards may not go far enough. For example, instead of requiring the first floor of a building to be at the base flood elevation, some authors argue the NFIP should require additional height (Jones et al. 2006).

There is little in NFIP regulations to encourage communities or individuals to move out of the floodplain, as opposed to elevating structures higher within it. It has been observed that the NFIP has pushed development up (that is, elevated it), but has not pushed development back from coastal or riverine flood hazards (Platt et al. 2002). Since the NFIP does not have strong provisions that would reduce development in floodplains, most high flood hazard areas are still prone to more development (Wetmore et al. 2006). The only incentive from the NFIP to slow growth in these areas comes from the Community Rating System (CRS).

The Community Rating System Links Hazard Mitigation to a Reward: Premium Reductions

In 1990, the NFIP adopted the Community Rating System program to encourage communities to engage in more extensive flood risk management. Communities that participate can undertake various flood-risk reduction measures and receive points for doing so. As the community accumulates points, they move up through the levels of the program. With each new level, residents of the community receive an additional 5 percent discount on premiums, up to 45 percent. Participation in the CRS does require the community to dedicate a local official to be the point-of-contact and coordinator for the program. There is also paperwork associated with the application process.

There are four groups of activities communities can engage in to receive points:

1. Public information;
2. Mapping and regulations;
3. Flood damage reduction; and
4. Flood preparedness.

Each activity has a different amount of points assigned to it, with, generally speaking, activities that are better at reducing damages receiving more points. All participating communities must maintain elevation certificates for properties in the floodplain; other activities are voluntary. In 2013, after a comprehensive review process, some changes were made to the program, including some updating of the points that different activities received. As of spring of 2014, 1,296 communities participated in the Community Rating System. While these are only 5 percent of communities in the NFIP, they cover over 67 percent of all policies-in-force. Only one community has made it to the highest level of the CRS (Roseville, CA) and only three have made it to the second highest level (Tulsa, OK; King County, WA; and Pierce County, WA) (FEMA 2014).

King County, Washington was the first community in the country to reach the second highest rating in the Community Rating System program.[20] To reach this standard, they have undertaken a wide range of activities. This includes providing information on flood hazards and insurance, developing a flood

[20] http://www.kingcounty.gov/environment/waterandland/flooding/community-rating-system.aspx.

warning brochure as part of a public outreach strategy, disclosing flood hazard through notices in real estate transactions, conducting detailed flood hazard mapping, preserving over 100,000 acres of open space in flood-prone lands, adopting higher elevation requirements than the minimum for most structures, restricting development in the riskiest areas, and elevating structures, among many other activities.

Multiple studies have found that participation in the Community Rating System reduces flood claims and property damage, although some find that significant reductions only come to communities higher up in the program or only for certain actions (such as open space protection, higher elevation requirements, and small flood control projects) (Brody et al. 2007; Michel-Kerjan and Kousky 2010; Highfield and Brody 2013). That said, research on Florida communities suggests that most communities earn very few of the total possible points and that communities focus much more on public information and mapping activities and score low on damage reduction and flood preparedness activities (Brody et al. 2009). This makes sense as the latter activities are generally costlier and potentially restrict development, although they may substantially reduce flood damages.

Achieving a higher level in the Community Rating System program does not appear to be enough incentive to undertake these more difficult activities, although there is some indication that as communities accumulate more points, the take-up for flood insurance in the jurisdiction increases (Zahran et al. 2009). The Florida study also finds that increases in population density, income, percent of the population with university or advanced degrees, number of NFIP policyholders, the value of property, and previous experience with flooding all increase participation in the Community Rating System—but having more land area in the high flood hazard area actually decreases participation (Brody et al. 2009).

Lessons Learned for Wildfire Risk

- **Community ratings tied to financial benefits can incentivize more risk reduction**.

A program similar to the Community Rating System could be created for wildfire, but tied to different incentives, since lower insurance premiums would not be the reward. In order to imagine how this could be applied to wildfire management, it is necessary to think in terms of incentives. What would motivate a landowner or community to reduce its risk from wildfire? We envision a reward system, aimed at communities who reduce risk by altering the pace, scale, and pattern of future home development. Similar to flood management, there could be proportionately higher rewards going to the highest-rated communities. In such a wildfire program, communities could similarly choose to join the program and be awarded points for adoption of different wildfire risk reduction measures, with more points awarded to those policies that have a greater impact. As communities gain more points, they could be rewarded with greater levels of support. Rewards would need to be substantial to encourage the largest and costliest changes to local policy.

The rewards could include:

- *Management priority*: the Forest Service and Bureau of Land Management do not have the resources for active management to thin forests and reduce fuel loads everywhere.[21] They could direct their

[21] According to agency estimates, about 230 million acres of Forest Service and Department of Interior lands are in need of treatment (mechanically or through prescribed burning) because they are at risk from ecological damage from wildfire due to excessive fuel loads (75 million acres are at "high" risk, plus 156 million are at "moderate" risk). Yet, on average less than three million acres are treated per year. See http://headwaterseconomics.org/wphw/wp-content/uploads/fire-costs-background-report.pdf. More can be found in the 2011 CRS Report RL33990: http://www.fas.org/sgp/crs/misc/RL33990.pdf (pages 17-18).

efforts to the highest-rated communities. Management actions, in the form of prescribed burning, mechanical treatment, and forest restoration, could be given to communities that rank high in terms of on-the-ground actions to reduce wildfire risk (clearing flammable materials near homes; creating fire breaks; clustering future homes away from fire-prone lands; detailed fire-risk mapping; zoning ordinances, etc.).[22]

- *Land use planning assistance*: we envision the creation of a new program within the Forest Service, called the Community Planning Assistance Program that would offer small grants and technical assistance for communities who want to improve land use planning to reduce wildfire risk. This could include assistance with tools such as zoning, landscape and subdivision regulations, and growth management policies. Starting modestly, using one percent of the agency's $2.2 billion wildfire management budget, could fund this program at $22 million per year.

- *Land purchase*: programs such as the Land and Water Conservation Fund (LWCF), the Forest Legacy Program, the Community Forest and Open Space Conservation Program, and others, could be used to buy land or development rights. The criteria for the use of these funds could be expanded to include reduction of wildfire risk, and communities who rank high in terms of actions taken to reduce fire risk get priority access to these funds.

The similarity of these rewards to flood management is expressed in terms of giving priority assistance to those who take action to reduce risk. For a detailed description of nine ideas for how to incentivize risk reduction in wildfires, see: http://headwaterseconomics.org/wildfire/reducing-wildfire-risk.

- **Plans can force consideration of hazards but are not guaranteed to translate into action.**

FEMA has effectively encouraged local jurisdictions to adopt multi-hazard mitigation plans by requiring them for certain forms of assistance. However, there is little evidence that plans alone lead to meaningful changes in policy on the ground, although some influence is no doubt likely. These plans are multi-hazard and so include wildfire in fire-prone areas.

The Healthy Forest Restoration Act created an incentive for communities to develop a Community Wildfire Protection Plan (CWPP) in order to receive priority for funding and fuel reduction projects. Following the mitigation plans, these could be encouraged to be more detailed and broader, including community level mitigation priorities, in exchange for greater mitigation or aid funding. CWPPs often focus on prioritization of fuel reduction projects, education, increased access, improved signage, and new equipment. Attempts could be made at greater emphasis on land use planning, in particular, efforts to alter where homes are built in the undeveloped portion of the Wildland Urban Interface.

Across both hazard mitigation plans and CWPP plans, more could be done to link them with other community planning documents and development decisions. For example, one of the challenges for county governments is to have coordination and consistency in language and policy between the county comprehensive plan, the hazard mitigation plan, and the wildfire protection plan. This could make all the documents stronger and more influential.

[22] An example of preferential treatment as a reward for local action exists in the Community Wildfire Protection Plans. CWPPs are authorized and defined in the Healthy Forest Restoration Act (HFRA). HFRA directs that half of federal fuel reduction funds need to be used in the WUI, that the boundaries of the WUI can be defined locally, and that priority consideration must be given to fuel reduction efforts identified in a CWPP: http://www.stateforesters.org/files/cwpphandbook.pdf (page 4).

- **Proper incentives can lead to minimum standards being adopted at a local level, which do reduce damages. Altering the existing building stock is more difficult than increasing standards for new construction.**

As stated earlier, almost all the population in flood-prone areas participate in the NFIP. This is due to both the lack of availability of flood insurance on the private market and restrictions on disaster assistance if a community does not participate. Since participation is voluntary, FEMA has been able to tie participation to adoption of minimum floodplain management regulations. These ordinances have been shown in several studies to have substantially reduced flood damages, largely through elevation requirements on new construction. They do not appear to have slowed development in high flood risk areas and some observers argue they are not as stringent as they should be. It has also proven more difficult to obtain substantial modifications to existing construction.

For communities that adopt some minimum wildfire risk reduction ordinances, and therefore receive a high rank in a fire community rating system, aid could be made available larger amounts. A similar challenge will likely emerge of how to encourage risk reduction on existing homes, as opposed to just new construction.

- **It is difficult to achieve substantial land use changes and other costly mitigation actions.**

The federal government has no direct authority over local land use, and incentivizing substantial changes in floodplain development has proven challenging. Only a few communities have engaged in substantial restrictions on development in floodplains; the Community Rating System points do not appear incentive enough to encourage widespread adoption of the most costly hazard mitigation policies. A stronger incentive program presumably would be needed in wildfire-prone areas, since, like many floodplains (particularly coastal ones), the amenity values of these areas are quite high, such as the proximity to natural areas, the views, and the privacy. The reward for developing away from wildfire danger would have to be significant to dissuade people from living in forested areas.

MAPPING RISK

Flood risk maps are produced by the federal government and used to set insurance rates and to inform landowners. This could similarly be done for wildfire, but requires continued funding. Good maps are a necessary first step for informing households and communities about risk, but more measures may be needed to ensure hazards are completely understood by all relevant stakeholders.

As noted above, FEMA produces flood hazard maps. According to the Association of State Floodplain Managers, flood mapping has guided development in a way that has saved more than $1 billion per year in flood damages. As of 2013, the U.S. has spent $4.3 billion in flood mapping (ASFPM 2013). Their data, made available to the authors, indicates that between 1969 and 2012, an average of $140.7 million a year (in 2012 dollars) was spent on mapping, from a low of $57 million in 1992 to a high of $348 million in 2008. Map production has been funded both by general tax revenues, and by NFIP revenue.

The maps serve three official purposes;

1. Setting premiums in the NFIP;
2. Delineating flood zones, which are used for the baseline floodplain regulations communities must adopt if they choose to participate in the NFIP; and
3. Delineating high flood hazard areas, which are used for determining where the mandatory insurance purchase requirement applies.

Maps are also used for many unofficial purposes, such as providing input to communities in development planning or providing information to homeowners.

Hazard Mapping Can be Costly and Contentious, but Has Produced Benefits

Producing flood maps is a fairly expensive and in-depth undertaking (National Research Council 2009). Elevation data is used in hydrologic and hydraulic modeling to produce estimates of the extent of the floodplain and the depth of flooding. Some states, communities, or regional entities have entered into an agreement with FEMA to be a partner in preparing the maps. FEMA may vary the level of detail in maps, depending on the costs and level of development in an area. A National Research Council study found that the more detailed maps, which show base flood elevations, produce net benefits, in that they can help guide building elevation requirements, but maps without this information produce net costs (National Research Council 2009). Before final maps are issued, FEMA releases preliminary versions for community review, public comment, and a 90-day appeal period. If homeowners or communities disagree with a designation, or want to register a change after a map is adopted, FEMA has processes for appealing those classifications—at a property or community level.[23] When new maps are finalized, communities must update their floodplain regulations to conform to the new maps.

The success of the mapping program is that the vast majority of the country now has maps delineating flood risk. That said, the hazard mapping process has been criticized on a number of grounds related to map quality and FEMA has undertaken many modifications in response. FEMA has now adopted a prioritization process for when communities receive new maps, set new standards and guidance for map quality, implemented standards for elevation data used in map production, provided funding for acquisition of high quality elevation data, and developed quality control measures—although the

[23] For more detail on these processes, see: FEMA (2012).

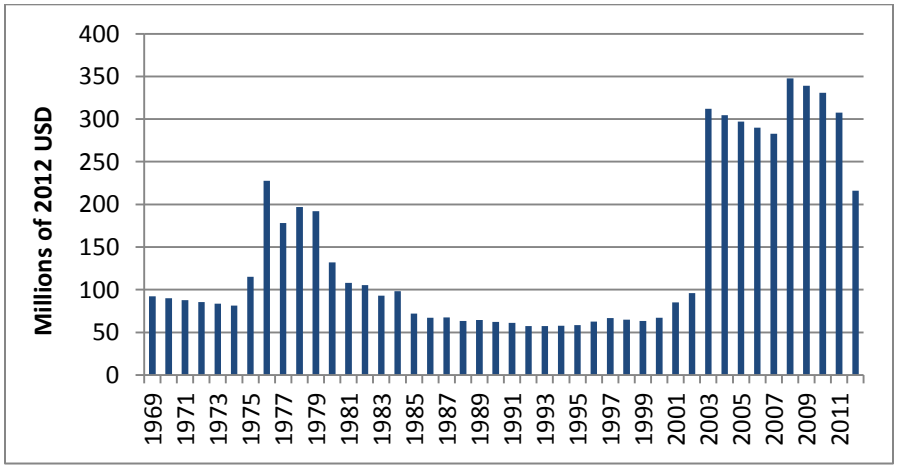
Government Accountability Office recently noted there is still room for further improvement (GAO 2010).

As the quality of topographic data is critical in determining the quality of the Flood Insurance Rate Maps (FIRMs), FEMA has been urged to partner with other institutions and acquire high-accuracy, high-resolution topographic data (National Research Council 2009). Between 2003 and 2008, FEMA undertook a Map Modernization process to update and digitize flood hazard maps around the country; the cost was $1.2 billion, funded through general appropriations (Garcia-Diaz 2014). In 2009, FEMA launched Risk MAP, which further updated maps and began reviewing 20 percent of all flood maps annually for any updating needs. The new maps under this initiative are also providing more detailed risk information. Through this program, FEMA is providing updated flood hazard data for populated coastal areas, building on work that was begun under Map Modernization (Westcott 2011). Risk MAP involved $300 million of funding from the NFIP itself, as well as congressional appropriations. Coastal studies are using state-of-the art models and methods and FEMA is exploring additional tools and products to provide to communities to help them understand their risk (Westcott 2011).

The Biggert Waters reform legislation in 2012 instituted some further changes to maps to ensure map accuracy. The Association of State Floodplain Managers estimated that producing adequate maps for the country under the 2012 guidelines would cost $4.5 – $7.5 billion, with annual maintenance costs of $116 – $275 million; while expensive, they argue the benefits exceed these amounts, with two studies finding benefits twice or more than costs (ASFPM 2013).

Funding for mapping overall has fluctuated over the years, as shown in the figure below. There was a peak in the 1970s as maps were being produced for communities for the first time. Funding then dropped until the new mapping efforts just described began in 2003. As it has become clear how important up-to-date maps can be, and the importance of new data and methods demonstrated, some observers have been concerned about drops in mapping funding in last couple years. In a recent hearing, Senator Landrieu (D-LA) voiced her support for increasing the resources given to FEMA for mapping, and more funding has been proposed for FY2015.[24]

Annual Funding for Flood Insurance Rate Maps



Source: Data provided to authors by the Association of State Floodplain Managers

[24] Senate Appropriations Homeland Security Subcommittee hearing (July 23, 2014) entitled "Insuring our Future: Building a Flood Insurance Program we can Live With, Grow With, and Prosper With." Online at: http://www.appropriations.senate.gov/hearings-and-testimony/dhs-insuring-our-future-building-flood-insurance-program-we-can-live-grow-and.

Flood hazard maps have also been criticized for what they do not show. Of concern for coastal areas, NFIP maps do not show erosion risk. This issue was studied for FEMA by the Heinz Center more than a decade ago, which found that roughly 1,500 homes will be lost to erosion each year and that (assuming no change in enrollment) the NFIP would pay roughly $80 million a year for erosion-related damage (The Heinz Center 2000). Perhaps unsurprisingly, the report recommended that erosion be shown on maps and included in pricing. They estimated the costs of mapping erosion at $5 million per year. To date, this has not been done. The NFIP did, however, begin increasing rates on V zone policies (along coasts) in 2001 to at least partially account for erosion.

Maps are snapshots in time of flood risk, but flood risk is dynamic, changing over time, and this is also not indicated on maps. Two particular concerns have emerged: development-induced changes and climate-induced changes, particularly sea-level rise. Both have parallels in wildfire risk. On the former, under FEMA's Map Modernization effort, the agency evaluated mapping "future-conditions hydrology"—essentially the flood risk projected under assumptions about expanded development in the watershed. Currently, FEMA does not show future conditions on maps, but communities can request it. If they ask for it, FEMA will delineate "future base flood" areas (that is, estimates of the 100-year flood under the build-out scenario) and communities can choose whether or not to regulate to this higher standard.[25] A study of this issue found that the differences in flood losses under a situation of full build-out of the floodplain compared to current conditions can vary dramatically by community (Blais et al. 2006). FEMA does not currently map or price for sea-level rise, either. The 2012 legislation, however, established a group to provide recommendations on how sea-level rise could be incorporated into flood hazard maps (among other things).

Risk delineation can also change due to improved methods and improved data, necessitating continual revision of flood maps. FEMA is required to revise and update flood maps every five years; it thus reviews 20 percent of maps annually (GAO 2010). Yet communities charge that often these revisions use outdated data, generating map errors (Meyer 2013b). While aiming for continual revision of maps is important to ensure they continue to provide an accurate depiction of risk, such revisions can also be quite contentious, since they have regulatory implications. If the boundaries of the high flood hazard area change, so will the households subject to the mandatory purchase requirement. And if base flood elevations change, this has implications for premiums. When there is a long period between map revisions, the change can be quite dramatic, as seen recently in New York and New Jersey coastal areas. FEMA had been in the processes of updating maps for this area before Hurricane Sandy, since the current maps were in some places based on data that was close to three decades old. The number of structures in high flood hazard areas doubled in New York's preliminary revised maps, and base flood elevations increased as well (Buckley 2013).

Many homeowners and communities have been upset when new maps were issued (e.g., Murray 2008; Bartlett 2014). Mapping is highly technical, however, and it is difficult to disentangle when there may be a true problem in FEMA's mapping methods and when residents are simply angered at the mandatory purchase requirement or higher rates. While FEMA does have an appeal process, it has been noted that this can be quite costly as it involves the need to hire firms that specialize in mapping to analyze FEMA's studies and determine what—if any—changes are needed (Meyer 2013b; Leitsinger 2014). At least one news article has charged that this favors the wealthy, even in risky areas, because they can afford to navigate the process (Dedman 2014). One way that the NFIP had lessened opposition to new mapping, without unfairly penalizing homeowners who built in compliance with previous maps, was through the

[25] More on this can be found on FEMA's website: http://www.fema.gov/national-flood-insurance-program-0/final-guidelines-using-future-conditions-hydrology.

process of grandfathering mentioned earlier. Properties built according to old maps can keep the rate of the old map, even if new maps show their risk has increased.

Maps Can Inform Landowners of Risk

> *Maps provide hazard information to homeowners, as demonstrated by the capitalization of flood risk into housing prices. Full information provision is most likely to be accomplished when strong disclosure laws are adopted. Notification about the risk must occur early in the sale process, be clearly communicated, involve education of real estate professionals, and be strongly enforced.*

While maps are used for pricing and community regulations, they should also inform households about flood risk. One mechanism for this is through the mandatory purchase requirement—part of this requirement is that borrowers be notified that property is in a high hazard area before signing the mortgage. There is some evidence, however, this may not be sufficient for informing homebuyers about the risk. In 1998, California enacted a law requiring disclosure of natural hazard risks prior to closing. An analysis of home sale prices right before and after this law found no difference in selling prices for floodplain homes before the law, but a slightly more than four percent drop afterwards, suggesting that it improved provision of flood risk information over existing NFIP policies—an effect, though, stemming largely from Hispanic neighborhoods (Troy and Romm 2004).

A survey of homebuyers in Boulder, Colorado in 2002 found that 60 percent learned about the flood risk of their property at closing and 70 percent learned the amount of the flood insurance premium at closing (Chivers and Flores 2002). As the authors note, closing is very late to learn about flood risk since at that point backing out of the sale is difficult and costly, and it is too late for it to impact offer prices. Perhaps it is also worth noting that 82 percent of those surveyed by Chivers and Flores said that the cost of flood insurance given to them at closing was higher than they thought it would be and that earlier knowledge of this would have impacted either their choice to make an offer or the amount of the offer. It is difficult to know if these findings in Boulder would apply more broadly across the U.S., and also whether they have changed significantly in the last 12 years. Research on disclosure requirements across multiple areas suggests that to be effective, notification about the risk must occur early in the sale process, be clearly communicated, involve education of real estate professionals, and be strongly enforced (Godschalk *et al.* 2000).

Nonetheless, there is evidence that the housing market has incorporated—to some extent—information about flood risk. Many studies have estimated the extent to which flood risk is capitalized in property values. The vast majority of these compare properties that are in a high flood hazard area to those outside, as this is the primary information disclosed to home buyers. Unsurprisingly, the studies consistently find a reduction in the price of homes in high flood hazard areas, often (although not always) in the range of 3 percent to 10 percent (e.g., Harrison *et al.* 2001; Bin and Polasky 2004; Bin and Kruse 2006; Bin *et al.* 2008; Daniel *et al.* 2009; Kousky 2010; Bin and Landry 2013). This likely reflects a combination of the risk and insurance requirements.

This is not true for coastal properties, however, where the amenities of being located on the beach appear to outweigh any effect of higher risks (Bin and Kruse 2006). One study attempted to control for such amenities, despite the high correlation with risk, and then found a discount for properties at high flood risk (Bin *et al.* 2008). Work has also examined the impact of being in a 500-year floodplain and results vary, with some finding a price discount and some not (Bin and Kruse 2006; Bin *et al.* 2008; Kousky 2010). Finally, a few recent papers have tracked this discount over time following flood events. These papers have found that the discount for floodplain or flood-impacted properties spikes immediately after a

disaster event and then recedes (Bin and Polasky 2004; Kousky 2010; Atreya *et al.* 2013; Bin and Landry 2013).

While the market thus does seem to capitalize some amount of flood risk, it is still widely asserted that residents often have an inaccurate perception of risk, deterring them from purchasing insurance or investing in risk reduction measures (e.g., Garcia-Diaz 2014). Simply having the maps available and alerting those subject to the mandatory purchase requirement may not be sufficient risk education.[26] The two recent NFIP reform bills have taken steps to increase outreach and communication about flood risk. The 2012 law requires homebuyers be given a disclosure of the availability of flood insurance by their lender, even if they are not in a high hazard area. The 2014 Act requires disclosure of the full flood risk, even to properties that are receiving discounts on their premium.

These recent legislative changes are attempting to help overcome what some see as an artificial line created by the high flood hazard area boundary. The boundary may suggest that flood risk changes abruptly from within the zone to outside it. In reality, of course, risk changes continuously across the landscape, but some boundary is needed for regulatory purposes, such as defining who falls under the mandatory purchase requirement and to what homes land use regulations should apply. The line may, however, create the impression that actions to reduce flood risk are not needed outside the high flood hazard zone. There is still risk outside, however: average claims outside high flood hazard zones are only slightly less those within it (Kousky and Michel-Kerjan 2014) and a substantial share of claims can come from outside the high hazard areas (Highfield *et al.* 2013). There will be places where mitigation is cost-effective for floods greater than the one percent annual chance event (Jones *et al.* 2006). FEMA has been working to inform those outside high flood hazard areas that there is still a risk of flooding and that insurance and mitigation actions could be prudent. They have been doing this through a website, floodsmart.gov, as well as TV and print commercials.

Many observers have questioned over the years whether the one percent chance flood is the appropriate threshold, from a 1979 report that stated that the 100-year flood standard "should be evaluated" (GAO 1979), to a 2006 analysis, which determined it was a political compromise and may not be optimal (Galloway *et al.* 2006). A 1983 review of the standard found that it was "reasonable and consistent with national objectives in reducing flood losses" (for a discussion, see: FEMA 1983). The committee writing the report surveyed many stakeholders and found that a majority found the standard was working, was not overly restrictive, that there were no better alternatives, and that changing the standard now would be disruptive (FEMA 1983). In contrast, a 2014 report by the National Research Council argued that there is no evidence that it is the best standard—in some places it will be excessive and in some not stringent enough (National Research Council 2014). It may be more appropriate to follow a Dutch approach and set variable risk standards around the country based on costs and benefits (Kind 2014).

[26] There is a voluminous literature on risk perception and risk communication that is not reviewed here. This includes behavioral studies of mental shortcuts used by individuals in evaluating risks (e.g., Kahneman et al. 1982) and studies of optimal risk communication strategies (e.g., Mileti and Kuligowski 2006).

Lessons Learned for Wildfire Risk

- **Fire-risk mapping could be undertaken at coarse scale by the federal government and modified locally**.

FEMA's flood mapping program has demonstrated how the federal government can systemically provide hazard maps for the country. Such a program would need sufficient funding to produce accurate maps for all fire-prone areas, but could have multiple benefits. This work could be done by the federal government and/or in partnership with local governments and private businesses.[27] The federal government could provide coarse or baseline wildfire-risk mapping and communities could improve upon this at a finer scale, with appropriate incentives to do so.

There are already a number of mapping efforts underway, such as the National Association of State Foresters' Communities at Risk Program and at the state level, Colorado's Wildfire Risk Portal, and many others. Fire-risk maps are also part of Community Wildfire Protection Plans. As with flood maps, the challenge exists to produce fire-risk maps at a fine scale that are accurate and up-to-date. Ideally, the more input communities have into the production of the maps, the higher the level of receptivity.

Fine scale mapping at the community and neighborhood level could be used as one of the criteria in a ranking for communities to receive federal assistance of some sort (e.g., technical and financial assistance in land use planning or funds for purchasing land or development rights). While maps in Community Wildfire Protection Plans can be used to leverage community-suggested management actions, a community ranking system could place higher rewards for Community Wildfire Protection Plans that contain fine scale delineation of the as-yet undeveloped portion of the Wildland Urban Interface.

- **Maps need to be continually updated.**

Flood risk is not stationary but changing over time, particularly in coastal areas subject to erosion and sea level rise. Coupling this with changes in development in a watershed and improvements in data and modeling, maps can become out of date in a matter of years. If risk is changing and maps do not account for or show this change, users of the maps may think they are making decisions in accordance with a risk that in reality is quite different. Routine updates are time-consuming and costly, however, and, as discussed above, can be contentious when they subject people to new regulations. Mechanisms to allow for more continuous incorporation of new information are needed. This will also be true for wildfire, as the risk changes due to changes in vegetation, soil erosion, climatic conditions, and home development. Wildfire maps, similar to the suggestions for flood maps, could also include projections of wildfire risk under future residential build-out and climate change scenarios.

Updating fire-risk maps may receive more political support if the maps are used to drive incentives to assist communities (e.g., a higher probability of active management for those with detailed maps), and not as a punitive tool.

- **Accurate maps are needed for regulating land use, but when maps are tied to regulations, it can make mapping contentious.**

The flood maps have become a critical input into local level regulation of high flood risk areas. Accurate and up-to-date maps are needed to ensure that communities regulate and manage to current risks. That

[27] Examples of private companies include CoreLogic: http://www.corelogic.com/products/wildfire-risk.aspx; and Anchor Point: http://www.redzonesoftware.com/products/rzrisk.

said, since designations on the map are tied to requirements to purchase insurance, and mapped base flood elevations greatly influence the price of insurance, criticisms are often directed at new maps. FEMA has limited this problem to some extent by allowing grandfathering. Thus, while mapping of wildfire risk is essential to help communities plan, if those maps become tied to regulatory requirements, the experience with the NFIP suggests this could make mapping contentious. Instead, with wildfire, maps could be seen as a benefit, with higher levels of financial, technical, and management assistance going to communities that produce detailed fire-risk maps (in addition to other actions).

Several states, such as California, already provide wildfire maps and may even link them to disclosure requirements for property sales. Even at the state level, however, politicization of maps remains a concern. In California, very high fire-hazard severity zones are determined by the California Department of Forestry and Fire Protection (known as CAL FIRE) in collaboration with local authorities. Local authorities are able to change the zone's suggested boundaries and as a result, there is a discrepancy between state and local zoning maps. In areas where local governments have rejected the designations, the risk is not disclosed to homebuyers (Troy and Romm 2006).

- **The housing market will often incorporate available risk information. The housing market also reacts to disaster events but any risk discount declines as time from the event increases.**

Multiple studies have confirmed that properties in areas designated on FEMA maps as being at higher risk of flooding sell at a discount relative to those outside the high risk area. This is confirming evidence that the market does incorporate flood risk (or insurance costs) to some extent. Prices also appear to drop after flood events. Studies also show, however, that this discount declines as the time since a flood event increases, suggesting there may be some "forgetting" of the risk over time. This has also been found for wildfires. Examination of housing prices around Los Angeles, California, for example, has found that prices drop after wildfire events, but slowly increase as the time since the last fire increases (Mueller and Loomis 2008). In high amenity flood areas, little or no decrease in selling prices is observed, which may also apply to high wildfire-risk, areas. The value of the amenities of living in a forest may outweigh the risk for many homeowners.

- **Simply having maps available may not be enough to fully inform individuals of their risk.**

There is evidence that some households may not be notified that they live in a high flood hazard area, particularly if not subject to the mandatory purchase requirement. It is also the case that homeowners may be informed they are in a risky location, but the risk in those areas can vary substantially, and they may not have any knowledge of this variation. In addition, there is still flood risk outside of high-risk areas and homeowners will not be informed of this and may even falsely think that because they are outside the high-risk zone they are completely safe. For wildfire, this means that mapping efforts need to be accompanied by other outreach activities.

A lesson for wildfire is that notification about the risk must occur early in the sale process and be clearly communicated. This can be done with strong disclosure laws. Another way for this to happen is to make public participation in county land use planning, as it relates to fire risk, part of federal land manager job responsibilities. For example, Forest Service District Rangers could be required, as part of their job responsibilities, to attend county commission meetings where proposals for new residential subdivisions are being proposed and where it would be beneficial to alert local government of potential wildfire danger. Their job would not be to tell county commissions to not approve subdivisions. Rather, they would provide fire risk information to the commission and county planning departments for them to incorporate into their decision-making.

MITIGATION ASSISTANCE

There is usually more demand for mitigation funding than has been made available by the federal government. The majority of federal mitigation spending occurs after a disaster event and there has been almost no effort in prioritizing risk reduction at a regional or national scale for large-scale investment before a disaster occurs.

This section focuses on lessons learned for wildfire related to encouraging mitigation of risky properties. As discussed previously, FEMA administers several mitigation grant programs, some targeted specifically at reducing flood damages. In many areas, floodplains are developed and, particularly after a large flood event, interest emerges in reducing the risk to these properties. This could involve elevation, flood-proofing activities, or buyouts of floodplain properties and conversion of the land to open space. Mitigation grants will often fund small protective investments in communities, as well, such as improving drainage. Demand for mitigation grants exceeds the available funds. For example, in 2013, FEMA received applications for more than twice the appropriations received for the Flood Mitigation Assistance Program (Garcia-Diaz 2014). In 2006 and 2007, FEMA received funding requests for the Pre-Disaster Mitigation program three times greater than what was available (McCarthy and Keegan 2009).

Mitigation grants can help cover the costs of actions that have high upfront costs.[28] Between 2001 and 2005, for example, the Hazard Mitigation Grant Program funded the acquisition of 22,564 properties, the relocation of 733 properties, and the elevation of 2,504 properties at a total cost of $826.9 million (NFIP 2002). Many homeowners may not have the upfront costs for these types of measures without federal support. Some evidence of this comes from a survey in multiple communities receiving mitigation funds. The authors found that if a state or local government (instead of the individual) paid the 25 percent match, households were 6.5 times more likely to engage in mitigation; similarly, when low and middle income property owners were given matching funds, their participation increased dramatically (Fraser et al. 2006).

Buyouts have been undertaken in many communities over the years and raise unique policy concerns. FEMA data indicates that the Hazard Mitigation Grant Program was used to acquire over 13,000 properties nationwide between 2001 and July of 2014. These lands are set aside as permanent open space. (Note: purchasing unimproved land is not an eligible activity under these grants.) All sales are strictly voluntary and homeowners are offered the pre-flood value of their property. Missouri has perhaps made the most extensive use of buyouts. Following the devastating 1993 flood, they spent $100 million to acquire thousands of properties and turn them into open space; subsequent floods have demonstrated the benefits as there was substantially less damage (FEMA 2002). Neighborhood attachment, however, can prevent many residents from wanting to relocate and the buyout process can take a long time and be challenging (Fraser et al. 2003). In addition, since they are voluntary, removals can be ad hoc and leave a reduced tax base and yet the need exists to provide services to remaining residents. Post-Sandy, New York City is giving bonuses to those who relocate within the same county, to preserve taxes, and also bonuses if adjoining properties also agree to relocate.

Grants are often tied to requirements that the benefits of the activity exceed the costs. A study of 5,500 FEMA mitigation grants between 1993 and 2003 for multiple hazards found that on average, they had a benefit to cost ratio of 4.1, with the highest scores for flood mitigation and the lowest for earthquake mitigation (wildfire was not examined) (Rose et al. 2007). This study compared the cost of groups of mitigation measures to the benefit of the expected avoided future damages over the life of the investment

[28] Post-disaster, the Small Business Administration can give subsidized loans; these can be increased to include hazard mitigation measures.

using a base discount rate of two percent. This included an estimate of both direct and indirect losses, including nonmarket damages. It should be kept in mind that benefits and costs vary greatly across hazards and projects, and estimates of each are subject to multiple assumptions; while these results are encouraging, they should not be taken to mean every mitigation project would pass a benefit-cost test.

The NFIP has also used mitigation grants to target specific problem properties. FEMA indicates that claims payments are concentrated on a few policies: around 30 percent of claims payments are made to only about 1 percent of policyholders—these are the so-called repetitive loss properties. In 2004, special mitigation grant programs were created to target these properties. The 2012 reform legislation, however, merged these grant programs into the Flood Mitigation Assistance program. Now, under this program, FEMA offers special incentives for mitigating these structures. For example, FEMA may contribute up to 100 percent of the funds (that is, completely waive the cost share) for mitigating severe repetitive loss properties and 90 percent for repetitive loss properties (FEMA 2013).

In addition to the FEMA programs, another source of post-disaster mitigation spending that has received increasing funding is the post-disaster Community Development Block Grant program of the Department of Housing and Urban Development. After recent large disasters, such as Hurricanes Katrina and Sandy, Congress chose to allocate large sums of money to this program.[29] These grants give states and local governments enormous flexibility in how they use the funds. Each recipient must prepare an Action Plan, which is submitted to HUD for approval. Eligible activities can include repairing and replacing damaged structures and infrastructure, as well as investments in hazard mitigation. Some proportion, determined by the administrator, must benefit low and moderate income households. After Sandy, HUD adopted higher mitigation standards for use of its funds, guided by the Hurricane Sandy Rebuilding Task Force, established by executive order. These included requirements that rebuilding must incorporate green building principles, that grantee plans include sustainable rebuilding scenarios, and that new and substantially improved structures be elevated one foot above FEMA base flood elevations.[30]

Much federal mitigation spending occurs after a disaster event, often through supplemental appropriations, which fund the Community Development Block Grant disaster program and the Hazard Mitigation Grant Program. Spending before a disaster on mitigation is more limited and there has been almost no effort in prioritizing risk reduction at a regional or national scale (e.g., National Research Council 2014). The source for pre-disaster mitigation grants is the Pre-Disaster Mitigation program discussed previously. Funding amounts have fluctuated but have never been very large. Beginning in FY2008, Congress earmarked some of these funds for the first time—44 percent of total funds. When this is combined with the state minimums, only a third of the funds were available for competitive grants (McCarthy and Keegan 2009). For comparison, in FY2013, FEMA obligated roughly $31 million in the Pre-Disaster Mitigation program, but over $700 million in the Hazard Mitigation Grant Program (Miller 2014). While the post-disaster grants have much more funding, they are available only to those areas that have been struck by a disaster event. It is important to address mitigation in the rebuilding process, but this distribution of funds prevents a nationwide examination of the risks different communities face and an allocation to mitigation based on those risks. It also does little to reward communities that invest heavily in risk reduction, thus preventing hazards from being disaster declarations.

[29] After Sandy, HUD received the largest share of the supplemental funds—$16 billion. For more on the Sandy supplemental, see: Kousky and Shabman (2013).
[30] These guidelines are in the Federal Register notices (78 Fed. Reg. 14333, 2013; 78 Fed. Reg. 23579, 2013).

Lessons Learned for Wildfire Risk

- **There is more demand for mitigation funding than is available.**

As demonstrated by excess demand, more local governments and households would adopt mitigation measures paid for by the federal government if Congress appropriated more funds to this purpose. A couple studies, discussed in the above section, indicate many of these investments may be cost effective. That said, communities and individuals are not necessarily choosing to invest their own dollars.

In the wildfire context, an important first step debated by Congress currently is whether wildfire suppression costs should be treated like other natural disasters and funded through FEMA. This would eliminate some of the "fire borrowing" challenge that currently exists (where wildfire preparedness funds are instead used for suppression). If fire preparedness funds could be used as they are intended to be (for fire risk reduction), then a portion of the Forest Service's $1 billion Preparedness Program could fund a new Community Planning Assistance Program (for example, 1% of the $2.2 billion wildfire management program would create $22 million per year to fund the new program). This program could be used to augment some of the mitigation efforts currently used, such as Firewise education, but focus assistance in a way that encourages future home building away from the most fire-prone lands.

How much mitigation funding should be the responsibility of the federal government, over local and private sources of funds, is debatable. It is true, however, that many—but not all—flood mitigation measures have high upfront costs that may be prohibitive for some homeowners. This may be equally true of wildfire. Some authors have suggested access to low interest loans as another strategy for encouraging more mitigation. It is plausible that wildfire risk reduction measures, if fully or partially funded through federal grants, would prove equally popular. This funding, however, should be its own program that cannot be raided to cover wildfire suppression costs.

- **There is not enough spending and prioritization on mitigation before a disaster event.**

The majority of federal mitigation spending is given after a disaster occurs and is directed at the impacted area. While this can help ensure that rebuilding is done with future hazards in mind, there is much less funding for areas before they are hit by a disaster. No systematic evaluation of where mitigation would be most cost-effective, where it could benefit the greatest number of people, or where it would reduce federal costs the most, or its evaluation based on any other public policy criteria to guide deployment of federal dollars, has occurred. If a new wildfire mitigation program is established, there is the possibility of undertaking such prioritization initially and not tying funding to severe fire seasons.

- **Federal post-disaster spending can be tied to mitigation requirements.**

Federal spending creates a unique lever to encourage certain activities. Tying aid dollars to certain standards may encourage more risk reduction. The Hurricane Sandy Rebuilding Task Force, for example, had rebuilding projects funded by the Sandy supplemental meet a slightly higher elevation standard.[31] This strategy could presumably be used for even stricter requirements if deemed beneficial to do so. Provision of aid following major wildfires could similarly be tied to mitigation requirements.

[31] See the press release on this standard: http://portal.hud.gov/hudportal/HUD?src=/sandyrebuilding/FRRS.

- **Mitigation grants help lower losses to development that is already in a hazardous area (or remove development); they do not target preventing development initially.**

Most mitigation spending is directed at improving existing properties, or, in the case of buyouts, removing structures. These programs do not provide funds for land acquisition that prevents development initially and, apart from the requirement to have a hazard mitigation plan, are not tied to stringent land use regulations or building codes. Preventing development through acquisition raises thorny issues, such as: are the dollars being used to protect land that otherwise would have been developed, or are they protecting land that never would have been developed or that would have simply displaced the development elsewhere? A similar challenge would likewise present itself with any federal attempts to prevent development initially in wildfire-prone areas.

ALIGNING COSTS AND BENEFITS

Communities gain from allowing risky development but federal taxpayers cover much of the costs when a disaster occurs. Also, when communities invest heavily in reducing risk, they ironically qualify for less federal assistance that is tied to disaster declarations.

Discussions of the federal role in flood risk management have long involved consideration of moral hazard. A term borrowed from insurance economics, used in this context, it refers to the possibility that if an entity does not bear all the costs of flood risk, they will underinvest in hazard mitigation and excess development in high risk areas will occur. While the economic theory behind moral hazard arguments is clear and has a long history (e.g., Buchanan 1975; Coate 1995), there is actually little empirical evidence on this point in the context of flood programs. Does underpriced insurance lead to excess development? Does federal disaster aid encourage local governments to not regulate flood risks and lead households to fail to adopt risk reduction measures? Very similar questions could be asked of federal aid provided for rebuilding after fires or to cover the costs of wildfire suppression.

At the individual level, one study found that household-level federal disaster aid grants from FEMA have a small crowding-out effect on the amount of insurance purchased (Kousky et al. 2014). That work found no substantial impact on the uptake of insurance, likely due to federal requirements that recipients of federal aid after a flood event purchase and maintain flood insurance. Failure to do so exempts them from future disaster aid.

Another study found that the premium discounts in the NFIP artificially inflate the value of those homes, potentially discouraging mitigation of these properties (Sarmiento and Miller 2006). The discount is indeed a benefit to those properties as it reduces the cost of insurance. The argument is made that if those properties were charged risk-based rates, it would encourage more investments in hazard mitigation to lower rates. Risk-based rates would be higher, however, and concerns about affordability and economic hardship emerged in response to the 2012 law. There is an ongoing debate about how much of the costs of living in a hazardous area should be borne by those households.

An investigation of what households can expect to receive after a disaster event found that traditional aid programs can actually be quite limiting in terms of funds for households to repair or rebuild (Kousky and Shabman 2012). A Small Business Administration loan is often the first place disaster victims are sent, but these, while at a lower rate, must be repaid. FEMA Individual Assistance grants are capped at $31,900 (in 2012; number indexed to inflation) but the average grant to repair a damaged home is much

lower at around $4,000 (McCarthy 2010). In part this is because these grants are only to make homes safe and inhabitable, not bring them back to pre-disaster conditions. Homeowners may receive greater funds through the Community Development Block Grant program, but given the enormous flexibility local governments have in choosing programs, it is difficult to predict such amounts *ex ante*. Still, what matters for incentives to under-invest in risk mitigation is not what homeowners actually receive, but what they expect to receive.

Concerns are also raised about moral hazard at the level of local governments. For example, it has been observed that the costs and benefits of development in coastal areas are misaligned in that local governments and developers benefit from being allowed to develop in hazardous areas but the costs are borne by others, often the federal government (National Research Council 2014). After presidentially declared disaster events, local governments can get substantial amounts of federal funds for rebuilding and repair work. Indeed, local governments are much more likely to get disaster aid than households. The GAO has found that for declarations between 2004 and 2011, only 45 percent authorized assistance to households, but 94 percent authorized assistance to local governments (39% authorized both) (GAO 2012). For disaster declarations between 2004 and 2011, the 25 percent cost share for local government assistance was waived or reduced roughly 20 percent of the time (GAO 2012).

As noted in a public presentation by a representative from Charlotte-Mecklenburg, North Carolina,[32] a community that has been a leader in investing in flood mitigation measures, local governments have very little financial risk for flood events—the communities gain from allowing risky development and federal taxpayers cover the costs. Creating an even greater disincentive to invest in hazard mitigation, the official noted that when communities invest heavily in reducing risk, such as has been done in Charlotte-Mecklenburg, they qualify for less federal assistance if a disaster occurs (or are less likely to receive a declaration in the first place). With Hazard Mitigation Grant Program and Community Development Block Grant dollars tied to those designations, the communities taking responsibility for lower risks are given much less support than those that do nothing.

The number of disaster declarations has been increasing over time. While this is not the place to rehash the history of federal disaster aid, suffice it to say that this is a more modern dilemma. At the time of the great 1927 flood on the Mississippi, most financial disaster aid fell to the Red Cross, funded by donations, not by the federal government, and compared to today's standards, the amounts spent on reimbursing victims were extremely small (Moss 1999).

Lessons Learned for Wildfire Risk

- **Not bearing costs of disaster events could lead to under-investment in hazard mitigation.**

The theory that when households or local governments do not bear the full costs of disaster events they may under-invest in risk mitigation is intuitive. There is only a little empirical evidence, however, on the extent of such effects when it comes to U.S. disaster policy. A review of the amounts of aid given suggests that households may be receiving less than is often presumed, but it is their expectations that will drive their pre-disaster decisions. Local governments, on

[32] Presentation given to the National Research Council Committee on the Analysis of Costs and Benefits of Reforms to the National Flood Insurance Program on March 27, 2014 by Tim Trautman titled "Local Initiatives in Flood Risk Management and Affordability."

the other hand, are often given substantial funds to cover disaster damages. As many have speculated,[33] this may discourage local governments from enacting stricter building codes or land use regulations or discourage investments in insurance. Applying this logic to wildfires, it is possible that if local governments had to pay more of the cost of fighting fires they would invest more in preventing them in the first place.

CONCLUSIONS

This report reviews the federal experience in managing flood risk during the last several decades, a period that has seen a switch from a focus on structural flood protection to one that encourages reduced exposure and promotes financial protection for victims of flood events. Similarly, greater federal emphasis on mitigating wildfire risk before it occurs, through improved building and land use decisions could help stem the trend of ever-increasing wildfire losses.

The analysis above teased out three lessons from federal flood risk management policies for wildfire. First, mapping of the hazard is a necessary first step for managing risk. The federal government and certain states are already well underway in producing and sharing fire-risk maps, although a nationally consistent standard would be beneficial. Flood maps are often perceived as punitive because they are used to set insurance rates. With wildfires, improved risk-maps could instead be rewarded. This is already an element of the Community Wildfire Protection Plans.

Second, there is much room for the federal government to incentivize adoptions of risk reduction measures. This can be done by tying suppression dollars and disaster aid to minimum mitigation requirements. To encourage even greater investments, a community rating program could be developed, which would reward those communities that go above and beyond in reducing wildfire risk. We envision a bundle of rewards—higher management priority and levels of financial and technical planning assistance, and, where appropriate, funds for land purchases—that would be given preferentially to the higher ranking communities. A separate grant program where the dollars are not allowed to be transferred to suppression efforts could also be established to help fund community wildfire mitigation, as has been the case for floods. While wildfire-prone communities can apply for Pre-Disaster Mitigation dollars and—if in an area of a declared disaster—Hazard Mitigation Grant Program Dollars, a fire-specific mitigation program could be useful, akin to the Flood Mitigation Assistance Grant program.

Finally, the federal flood programs reviewed here demonstrate that the federal government has limited ability to reduce building in high-risk areas or to encourage the adoption of cost-effective measures if the upfront costs are large. That said, federal dollars for reconstruction post-disaster and for combatting disasters as they unfold could be creating a moral hazard problem in that local governments receive all the benefits of allowing development in high-risk areas and being lax on building requirements, but pay none of the costs of those actions. Forcing local governments to pay more disaster costs may induce them to invest more heavily in risk reduction.

[33] For example, see the blog post by UCLA economist Matthew Kahn: http://greeneconomics.blogspot.com/2012/10/rebuilding-new-jersey-and-coastal-moral.html.

REFERENCES

ASFPM (2013). Flood Mapping for the Nation: A Cost Analysis for the Nation's Flood Map Inventory, Association of State Floodplain Managers.

Atreya, A., S. Ferreira, and W. Kriesel (2013). "Forgetting the Flood? An Analysis of the Flood Risk Discount over Time." Land Economics 89(4): 577-596.

Bartlett, J. (2014). "Quincy officials likely to appeal new FEMA flood maps." Boston.com, Boston, MA, February 4.

Berke, P., W. Lyles, and G. Smith (2014). "Impacts of Federal and State Hazard Mitigation Policies on Local Land Use Policy." Journal of Planning Education and Research 34(1): 60-76.

Berke, P., G. Smith, and W. Lyles (2012). "Planning for Resiliency: Evaluation of State Hazard Mitigation Plans under the Disaster Mitgation Act." Natural Hazards Review May: 139-149.

Bin, O. and J. B. Kruse (2006). "Real estate market response to coastal flood hazards." Natural Hazards Review 7(4): 137-144.

Bin, O., J. B. Kruse, and C. E. Landry (2008). "Flood Hazards, Insurance Rates, and Amenities: Evidence From the Coastal Housing Market." The Journal of Risk and Insurance 75(1): 63-82.

Bin, O. and C. E. Landry (2013). "Changes in implicit flood risk premiums: Empirical evidence from the housing market." Journal of Environmental Economics and Management 65(3): 361-376.

Bin, O. and S. Polasky (2004). "Effects of Flood Hazards on Property Values: Evidence before and after Hurricane Floyd." Land Economics 80(4): 490-500.

Blais, N. C., Y.-C. Nguyen, E. Tate, F. Dogan, L. Samant, E. Mifflin, and C. Jones (2006). Managing Future Development Conditions in the National Flood Insurance Program. Irvine, California, ABSG Consulting Inc. and American Institutes for Research.

Brody, S. D., S. Zahran, W. E. Highfield, S. P. Bernhardt and A. Vedlitz (2009). "Policy Learning for Flood Mitigation: A Longitudinal Assessment of the Community Rating System in Florida." Risk Analysis 29(6): 912-929.

Brody, S. D., S. Zahran, P. Maghelal, H. Grover, and W. E. Highfield (2007). "The Rising Costs of Floods: Examing the Impact of Planning and Development Decisions on Property Damage in Florida." Journal of the American Planning Association 73(3): 330-345.

Buchanan, J. (1975). The Samaritan's Dilemma. Altruism, Morality, and Economic Theory. E. Phelps, Russell Sage Foundation: 71-85.

Buckley, C. (2013). "Twice as many structures in FEMA's redrawn flood zone." The New York Times, New York, January 28.

Chivers, J. and N. E. Flores (2002). "Market Failure in Information: The National Flood Insurance Program." Land Economics 78(4): 515-521.

Coate, S. (1995). “Altruism, the Samaritan's Dilemma, and Government Transfer Policy.” The American Economic Review 85(1): 46-57.

Daniel, V. E., R. J. G. M. Florax, and P. Rietveld (2009). “Flooding risk and housing values: An economic assessment of environmental hazard.” Ecological Economics 69(2): 355-365.

Dedman, B. (2014). “Why taxpayers will bail out the rich when the next storm hits.” NBC News, February 18.

Donovan, G. and T. C. Brown (2007). “Be careful what you wish for: the legacy of Smokey Bear.” Frontiers in Ecology and the Environment 5(2): 73-79.

FEMA (1983). The 100-Year Base Flood Standard and the Floodplain Management Executive Order: A Review Prepared for the Office of Management and Budget by the Federal Emergency Management Agency. Washington, DC, Office of Management and Budget.

FEMA (1998). Managing Floodplain Development Through The National Flood Insurance Program. Home Study Course. Washington, DC, Federal Emergency Management Agency.

FEMA (2002). Success Stories from the Missouri Buyout Program. Washington, DC, Federal Emergency Management Agency.

FEMA (2012). Adoption of Flood Insurance Rate Maps by Participating Communities. Washington, DC, Federal Emergency Management Agency.

FEMA (2013). Hazard Mitigation Assistance Unifed Guidance. Washington, DC, Federal Emergency Management Agency, Department of Homeland Security.

FEMA (2014). Community Rating System Fact Sheet. Washington, DC, Federal Insurance and Mitigation Administration, Federal Emergency Management Agency.

Fraser, J., R. Elmore, D. Godschalk, and W. Rohe (2003). Implementing Floodplain Land Acquisition Programs in Urban Localities. Chapel Hill, North Carolina, The Center for Urban & Regional Studies, University of North Carolina at Chapel Hill.

Fraser, J. C., M. W. Doyle and H. Young (2006). "Creating effective flood mtigation policies " Eos 87(27): 265-267.

Galloway, G. E., G. B. Baecher, D. Plasencia, K. G. Coulton, J. Louthain, M. Bagha, and A. R. Levy (2006). Assessing the Adequacy of the National Flood Insurance Program’s 1 Percent Flood Standard. College Park, Maryland, Water Policy Collaborative, University of Maryland.

GAO (1979). Report to HUD Secretary: Efforts to Reduce Flood Losses: FIA's Flood Insurance Program; CED 79-58. Washington, D.C., U.S. General Accounting Office.

GAO (2010). Some Standards and Processes in Place to Promote Map Accuracy and Outreach, but Opportunities Exist to Address Implementation Challenges. Washington, DC, United States Government Accountability Office.

GAO (2012). Improved Criteria Needed to Assess a Jurisdiction's Capability to Respond and Recover on Its Own. Washington, DC, US Government Accountability Office.

Garcia-Diaz, D. (2014). Testimony to the Subcommittee on Housing and Insurance, Committee on Financial Services, House of Representatives. U.s. Government Accountability Office. Washington, DC. April 9.

Godschalk, D. R., R. Norton, C. Richardson, and D. Salvesen (2000). "Avoiding Coastal Hazard Areas: Best State Mitigation Practices." Environmental Geosciences 7(1): 13-22.

Gorte, R. (2013). The Rising Cost of Wildfire Protection. Bozeman, MT, Headwaters Economics.

Harrison, D. M., G. T. Smersh and A. L. Schwartz (2001). "Environmental determinants of housing prices: the impact of flood zone status." Journal of Real Estate Research 21(1): 3-20.

Hayes, T. L. and D. A. Neal (2011). Actuarial Rate Review: In Support of the Recommended October 1, 2011, Rate and Rule Changes. Washington, D.C.DC, Federal Emergency Management Agency.

Headwaters Economics (2013). As Wildland Urban Interface (WUI) Develops, Firefighting Costs Will Soar: http://headwaterseconomics.org/interactive/wui-development-and-wildfire-costs.

Headwaters Economics. Rasker R. (2014). Reducing Wildfire Risks to Communities: Solutions for Controlling the Pace, Scale, and Pattern of Future Development in the Wildland-Urban Interface. Bozeman, MT.

Highfield, W. E. and S. D. Brody (2013). "Evaluating the effectiveness of local mitigation activities in reducing flood losses." Natural Hazards Review 14(4): 229-236.

Highfield, W. E., S. A. Norman and S. D. Brody (2013). "Examining the 100-year floodplain as a metric of risk, loss, and household adjustment." Risk Analysis 33(2): 186-191.

Jones, C. P., W. L. Coulbourne, J. Marshall, and S. M. Rogers, Jr. (2006). Evaluation of the National Flood Insurance Program's Building Standards. Durham, North Carolina, Christopher Jones and Associates and American Institutes of Research.

Kahneman, D., P. Slovic and A. Tversky, Eds. (1982). Judgment under Uncertainty: Heuristics and Biases. Cambridge, UK, Cambridge University Press.

Kind, J. M. (2014). "Economically efficient flood protection standards for the Netherlands." Journal of Flood Risk Management 7(2): 103-117.

Knowles, S. G. and H. C. Kunreuther (2014). "Troubled Waters: The National Flood Insurance Program in Historical Perspective," The Journal of Policy History 26(3): 327-353.

Kousky, C. (2010). "Learning from Extreme Events: Risk Perceptions After the Flood." Land Economics 86(3): 395-422.

Kousky, C. and E. Michel-Kerjan (2014). Not As Much as You Thought (Most of the Time): Examining the Size and Distribution of 30 Years of U.S. Flood Insurance Claims. Discussion Paper.

Kousky, C., E. Michel-Kerjan and P. Raschky (2014). Does Federal Disaster Assistance Crowd Out Private Demand for Insurance? W. P. #2014-04. Philadelphia, PA, Risk Management and Decision Processes Center The Wharton School, University of Pennsylvania.

Kousky, C. and L. Shabman (2012). The Realities of Federal Disaster Aid: The Case of Floods. RFF Issue Brief. Washington, DC, Resources for the Future.

Kousky, C. and L. Shabman (2013). A New Era of Disaster Aid? Reflections on the Sandy Supplemental. RFF Issue Brief. Washington, DC, Resources for the Future.

Kunreuther, H. and E. O. Michel-Kerjan (2009). At War With the Weather: Managing Large-Scale Risks in a New Era of Catastrophes. Cambridge, MA: MIT Press.

Leitsinger, M. (2014). "For Average Joes, Fighting FEMA Flood Maps Isn't Easy or Cheap." NBC News, July 24.

Liu, E. C. (2008). Flood Insurance Requirements for Stafford Act Assistance. CRS Report for Congress. Washington, DC, Congressional Research Service, The Library of Congress.

Mathis, M. L. and S. Nicholson (2006). An Evaluation of Compliance with the National Flood Insurance Program Part B: Are Minimum Building Requirements Being Met? Fairfax, Virginia, Dewberry and American Institutes for Research.

McCarthy, F. X. (2010). FEMA Disaster Housing: From Sheltering to Permanent Housing. Washington, DC, Congressional Research Service.

McCarthy, F. X. and N. Keegan (2009). FEMA's Pre-Disaster Mitigation Program: Overview and Issues. Washington, DC, Congressional Research Service.

McCarthy, F. X. (2014).). FEMA's Pre-Disaster Mitigation Program: Overview and Issues. Washington, DC, Congressional Research Service.

Meyer, T. (2013a). "As need for new flood maps rises, Congress and Obama cut funding." ProPublica, May 24.

Meyer, T. (2013b). "Using outdated data, FEMA is wrongly placing homeowners in flood zones." ProPublica, July 18.

Michel-Kerjan, E. and C. Kousky (2010). "Come Rain or Shine: Evidence on Flood Insurance Purchases in Florida." Journal of Risk and Insurance 77(2): 369-397.

Mileti, D. and E. Kuligowski (2006). "Evidence-Based Guidance for Public Risk Communication and Education." www.start.umd.edu/start/publications/research_briefs/20060926_mileti.pdf

Miller, D. (2014). Statement of David Miller, Associate Administrator, Federal Insurance and Mitigation Administration, Federal Emergency Management Agency, U.S. Department of Homeland Security before the Committee on Homeland Security and Governmental Affairs, Subcommittee on Emergency Management, Intergovernmental Relations, and the District of Columbia. Washington, DC, U.S. Senate.

Moss, D. (1999). Courting Disaster? The Transformation of Federal Disaster Policy since 1803. The Financing of Catastrophe Risk. K.A Froot. (Ed.) Chicago, IL, University of Chicago Press: 307-362.

Mueller, J. M. and J. B. Loomis (2008). "Spatial dependence in hedonic property models: do different corrections for spatial dependence result in economically significant differences in estimated implicit prices?" Journal of Agricultural and Resource Economics 33(2): 212-231.

Murray, C. (2008). “Insurance: New Flood Maps Could Prove Costly for Hundreds of Homeowners in Wheatfield and Lewiston.” Tonawanda News, North Tonawanda, New York, October 27.

National Research Council (2009). Mapping the Zone: Improving Flood Map Accuracy. Washington, DC, The National Academies Press.

National Research Council (2014). Reducing Coastal Risks on the East and Gulf Coasts. Washington, DC, The National Academies Press.

NFIP (2002). National Flood Insurance Program: Program Description. Washington, DC, Federal Emergency Management Agency, Federal Insurance and Mitigation Administration.

Platt, R. H., D. Salvesen and G. H. I. Baldwin (2002). “Rebuilding the North Carolina Coast after Hurricane Fran: Did Public Regulations Matter?” Coastal Management 30: 249-269.

Rose, A., K. Porter, N. Dash, J. Bouabid, C. Huyck, J. Whitehead, D. Shaw, R. Eguch, C. Taylor, T. McLane, L. T. Tobin, P. T. Ganderton, D. Godschalk, A. S. Kiremidjian, K. Tierney, and C. T. West (2007). “Benefit-Cost Analysis of FEMA Hazard Mitigation Grants.” Natural Hazards Review 8(4): 97-111.

Sarmiento, C. and T. R. Miller (2006). Costs and Consequences of Flooding and the Impact of the National Flood Insurance Program. Calverton, MD, Pacific Institute for Research and Evaluation.

Schwab, J. C. (2010). Hazard Mitigation: Integrating Best Practices into Planning. Chicago, IL, American Planning Association.

Task Force of Federal Flood Control Policy (1966). A Unified National Program for Managing Flood Losses. Washington, DC, U.S. Goverment Printing Office.

The Heinz Center (2000). Evaluation of erosion hazards. Washington, DC, The H. John Heinz III Center for Science, Economics and the Environment.

Troy, A. and J. Romm (2004). “Assessing the Price Effects of Flood Hazard Disclosure under the California Natural Hazard Disclosure Law (AB 1195).” Journal of Environmental Planning and Management 47(1): 137-162.

Troy, A. and J. Romm (2006). An Assessment of the 1998 California Natural Hazard Disclosure Law (AB 1195). Detailed Research Findings. Berkeley, California, California Policy Research Center, University of California.

Truman, H. S. (1951). Special Message to the Congress Requesting Additional Funds for the Rehabilitation of the Flood Stricken Areas of the Midwest. The American Presidency Project. J. Woolley and G. Peters. Santa Barbara, University of California, Santa Barbara.

U.S. Department of Agriculture. Office of Inspector General. (November 2006). Audit Report: Forest Service Large Fire Suppression Costs. Report No. 08601-44-SF.

U.S. Department of Housing and Urban Development (1966). Insurance and Other Programs for Financial Assistance to Flood Victims. Washington, DC, Committee on Banking and Currency, United States Senate, 89th Congress, 2nd Session.

Westcott, J. E. (2011). "New Tools from FEMA to Help Communities Understand their Coastal Flood Risk." Solutions to Coastal Disasters: 558-568.

Wetmore, F., G. Bernstein, D. Conrad, L. Larson, D. Plasencia, R. Riggs, J. Monday, M. F. Robinson, and M. Shapiro (2006). An Evaluation of the National Flood Insurance Program: Final Report. Washington, D.C.DC, American Institutes for Research.

Zahran, S., S. Weiler, S. D. Brody, M. K. Lindell, and W. E. Highfield (2009). "Modeling National Flood Insurance Policy Holding at the County Scale in Florida, 1999-2005." Ecological Economics 68: 2627-2636.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