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The Developmental and Environmental Impacts of the National Flood Insurance Program: A Review of Literature

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Evaluation of the National Flood Insurance Program

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Prepared as part of the Evaluation of
the National Flood Insurance Program

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EVALUATION OF THE NATIONAL FLOOD INSURANCE PROGRAM

This Evaluation is comprised of a series of reports prepared by the American Institutes for Research (AIR) and selected subcontractors under a contract managed by AIR. These reports assess questions identified and prioritized by a steering committee about the National Flood Insurance Program. Individual reports will be posted on the FEMA website as they are finalized. The website URL is http://www.fema.gov/nfip/nfipeval.shtm. The reports in the Evaluation are:

The Evaluation of the National Flood Insurance Program – Final Report
American Institutes for Research and Evaluation Advisory Committee

Assessing the Adequacy of the National Flood Insurance Program's 1 Percent Flood Standard. Galloway, Baecher, Plasencia, Coulton, Louthain, and Bagha, Water Policy Collaborative, University of Maryland.

Assessing the National Flood Insurance Program's Actuarial Soundness. Bingham, Charron, Messick and Kirschner, Deloitte Consulting.

Costs and Consequences of Flooding and the Impact of the National Flood Insurance Program. Sarmiento and Miller, Pacific Institute of Research and Evaluation.

Developmental and Environmental Impacts of the National Flood Insurance Program: A Review of Literature. Rosenbaum, University of Florida.

The Developmental and Environmental Impact of the National Flood Insurance Program: A Summary Research Report. Rosenbaum, University of Florida.

An Evaluation of Compliance with the National Flood Insurance Program Part A: Achieving Community Compliance. Monday, Grill, Esformes, Eng, and Kinney, American Institutes for Research.

An Evaluation of Compliance with the National Flood Insurance Program Part B: Are Minimum Building Requirements Being Met? Mathis and Nicholson, Dewberry.

Evaluation of the National Flood Insurance Program's Building Standards. Jones, Coulbourne, Marshall, and Rogers, Christopher Jones and Associates.

Managing Future Development Conditions in the National Flood Insurance Program. Blais, Nguyen, Tate, Dogan, ABSG Consulting; and Mifflin and Jones.

The National Flood Insurance Program's Environmental Reviews: An Assessment of FEMA's Implementation of NEPA and Executive Order 11988. Rosenbaum, University of Florida.

The National Flood Insurance Program's Mandatory Purchase Requirement: Policies, Processes and Stakeholders. Tobin and Calfee, American Institutes for Research.

The National Flood Insurance Program's Market Penetration Rate: Estimates and Policy Implications. Dixon, Clancy, Seabury, and Overton, RAND Corporation.

Performance Assessment and Evaluation Measures for Periodic Use by the National Flood Insurance Program. Miller, Langston, and Nelkin, Pacific Institute of Research and Evaluation.

State Roles and Responsibilities in the National Flood Insurance Program. Mittler, Morgan, Shapiro, and Grill, American Institutes for Research.

Dr. Walter Rosenbaum completed this study for the American Institutes for Research (AIR). Established in 1946, with headquarters in Washington, D.C., the American Institutes for Research (AIR) is an independent, nonpartisan not-for-profit organization that conducts behavioral and social science research on important social issues and delivers technical assistance both domestically and internationally in the areas of health, education, and workforce productivity.

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Substantial growth in many Americans' personal wealth, combined with cheap flood insurance and a period of relatively few hurricanes, have contributed to billions of dollars worth of real estate development in high-risk and environmentally fragile coastal areas. Low-cost federal flood insurance has substantially reduced the financial risk of this development, and government-financed flood control, beach restoration, and shoreline hardening projects have created a false sense of security for residents in these low-lying areas…The National Flood Insurance Program should be reformed.

Pew Oceans Commission (2003)

It is difficult to sort out the variety of co-existing influences on floodplain development to draw clear cause and effect relationships between the NFIP and observed encroachment into flood hazard areas.

Evatt (2000)

These observations reflect a dissonance that permeates the literature on the environmental and developmental impacts of the National Flood Insurance Program (NFIP). Created in 1968, and now administered by the Federal Emergency Management Agency (FEMA), the program has been controversial from its inception. Research about these impacts began with the creation of the so-called Emergency Program (1969), which permits property owners in participating communities to purchase limited amounts of flood insurance at estimated rates until completion of a Flood Insurance Rate Map (FIRM).[1] This research expanded enormously in volume and diversity with the passage of the Flood Disaster Protection Act in 1973, which mandated the purchase of flood insurance as a condition for mortgage loans guaranteed by federal agencies or issued by federally regulated lending institutions for properties in Special Flood Hazard Areas in communities that participate in the NFIP.[2]

Concern about the NFIP's possible environmental impacts was also evident in 1994 when the flood legislation was amended to recognize the Community Rating System (CRS). The CRS encourages communities to exceed the NFIP's minimum standards for floodplain management, provides incentives for communities to reduce flood losses, to create accurate insurance rating, and to promote awareness of flood insurance. Communities that exceed the program's minimum standards can apply for a rating from Class 1 to Class 10, based on the number of points they accumulate for various activities. The more points they receive, the lower are policyholders' premiums in those communities. Communities can receive CRS credit for a variety of environmentally protective activities such as preserving open space, creating higher regulatory standards for storm water management, and preserving the natural and beneficial functions of floodplains. Environmental protection and management have been issues inherent in the NFIP throughout its history, and the NFIP's environmental history is thus a matter of ongoing research and interest.

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[1] FIRMs identify areas designated as Special Flood Hazard Areas (SFHAs), which defines the area in which there is a 1 percent chance of being flooded in any given year (i.e., the 100-year floodplain). Over a 30-year period, there is at least a 26 percent chance that a SFHA will be flooded to the elevation of the 100-year flood.

[2] A useful history of the NFIP can be found in Pasterick (1998). See also FEMA (1991, 2002a) and the American Institutes for Research (2004). The Flood Disaster Protection Act prohibited federally regulated lenders from providing mortgages in communities that did not participate in the NFIP, but this prohibition was removed in 1977.

Overview

The literature related to the NFIP's developmental and environmental impacts can be usefully separated in terms of source, methodology, substantive content, and significant conclusions or hypotheses relating to the NFIP.

Information sources

The literature varies enormously in the quality and range of information it provides. From the viewpoint of utility in guiding further inquiry about the NFIP's impacts, these materials assume a rough order:

Conceptually and empirically rigorous studies: a relatively small proportion of the available literature, less than 50 articles (excluding theses and dissertations), attempts to test various propositions about NFIP's impact through case studies, econometric modeling, survey research, conservation biology, or through the use of geographic information systems (GIS). Most of these materials are found in professional and academic journals.

Descriptive and anecdotal studies: a much larger body of literature, exceeding 100 studies, asserts various impacts on the basis of impressionistic, descriptive, or derivative information whose empirical basis is often unclear or absent. This literature is found in virtually all varieties of publications, including newspapers, congressional testimony, and journals of think tanks and advocacy groups.

Legal briefs and related documents: materials associated with litigation completed or active, involving claims of the NFIP's impact on habitat of endangered species or other issues related to the Endangered Species Act.

Theses and dissertations: primary empirical studies available through academic libraries and reference services.

Substantive focus

A relatively small proportion of the reviewed literature focuses primarily on the environmental impact(s) of the NFIP with considerable empirical detail. A much larger group of studies imply various environmental consequences in discussions of "development" (Evatt 1999; Salvesen and Godschalk 1998) and some generalize broadly about environmental impacts (Pew Oceans Commission 2003; Task Force on the Natural and Beneficial Functions of the Floodplain 2002). Most of this literature is concerned with various developmental implications of the NFIP, including such matters as rate of growth in housing units, density and quality of development on floodplains, zoning and land-use changes associated with federal flood insurance, and developmental pressures that the NFIP allegedly creates or exacerbates. Environmental impacts, with a few exceptions to be noted, are discussed more generally in terms of lost or degraded wetlands, accelerated coastal erosion, disturbed plant and animal habitat, and transformed ecosystems. Much of the discussion on environmental impacts, with the exception of some

studies associated with litigation involving the Endangered Species Act, lacks a well-grounded analytic or empirical basis.

Methodology

To the extent that studies are at least partially empirical, they are grounded in one or more of five methodologies: survey research; intensive case studies of one or several communities or geographic locations; economic or statistical data modeling; sampling of aggregate data from geographically distributed communities; and quasi-experimental comparisons of developmental patterns in NFIP communities with those of units in the Coastal Barrier Resources System (CBRS). The Coastal Barrier Resources Act of 1982 and related legislation created a system of protected coastal areas. The legislation is intended to preserve coastal barriers by prohibiting federal loans, grants, guarantees, insurance payments, rebates and subsidies including, in particular, federal flood insurance for new construction or substantial improvement of structures existing on or after an area's inclusion in the CBRS. Thus, developmental patterns on CBRS lands where federal flood insurance should be unavailable is sometimes compared with development on adjacent, or similar, non-CBRS lands to simulate a "controlled" experiment measuring the NFIP's impact on coastal development.

While the literature on developmental impacts draws widely from these methodologies, the environmental impact studies depend much more on impressionistic observations, data derived from conservation biology (as in the case of endangered species), or inferences drawn from well-documented transformations in floodplains associated with community development. Especially notable is the absence among environmental studies of research associated with remote sensing, GIS databases, the national biological data banks increasingly available, and other recent innovations in environmental monitoring. Consequently, the empirical basis for generalizations about developmental impacts is far more substantial than that concerning environmental impacts.

Findings

Assertions about the developmental and ecological impact of the NFIP need to be carefully nuanced (see later discussion of "Research Conclusions") in light of the many different methodologies, geographic and temporal settings, and research objectives associated with the relevant literature. At least two broad conclusions are evident.

First, most of the literature related to the NFIP's environmental and developmental impacts suggests that the program encourages, in some manner, the development and environmental transformation of wetlands and coastal areas, or that it does little to impede these impacts. For example, 52 of the 97 research documents included in this report's bibliography assert, with varying degrees of qualification, that the NFIP creates incentives for the development of wetlands and coastal areas.[3]

[3] This list of 97 excludes other materials such as edited collections, congressional hearings and technical documents related to the NFIP. Many of these edited collections contain additional articles suggesting that the NFIP is associated with the development of floodplains and coastal areas.

Not all these documents present an informed understanding of the NFIP or its components, and many are impressionistic. Environmental or advocacy groups (e.g., Richman 2001; Friends of the Earth 1998; DiSilvestro 1997) produce about a third of the commentaries, most of which depend on a few case studies, or largely anecdotal or impressionistic evidence, for their conclusions. Indeed, these studies typically do not provide any empirical evidence to support their claims that the NFIP promotes unwise development (e.g., Pew Oceans Commission 2003).

At the same time, however, other well-designed, empirical studies do suggest the NFIP encourages, to some extent, floodplain development, or may have done so in the past (Bollens 1990; Burby et al. 1988). In contrast, six of the analyses conclude that the NFIP is significantly protective of wetlands and coastal areas, or that it impedes development on these areas (e.g., Bollens, Kaiser, and Burby 1988; Baumann and Emmer 1976). An additional 17 documents assert that the NFIP had no significant developmental impacts, or that the impacts are ambiguous.

Second, most research does not identify which aspects of the NFIP are most strongly related to accelerated floodplain development or specify the relative importance of the NFIP among many other related factors associated with these developmental and environmental impacts. As an illustration, some studies assess the public's perceptions about low frequency/high damage events, such as flooding, and conclude that many people are unaware of or discount these risks when they make decisions about where to build or locate (e.g., Hallstrom and Smith 2004; Ryland 2000; KRC Research & Consulting 1995c). Other research (e.g., KRC Research & Consulting 1995c; Bozell, KRC Research & Consulting, and Westhill Marketing Sciences n.d.) has found that most people believe their homes will never be flooded, so they see no reason to purchase flood insurance.

Many other people are unaware that federal flood insurance is available to nearly everyone who might want to purchase it (KRC Research & Consulting 1996). Turner, Nigg, and Paz (1986) found that even high levels of awareness of high-risk natural disasters, such as earthquakes in California, do not prompt people to be better informed, to take preventive actions, or to purchase insurance. In short, the literature consistently suggests that many people put their lives and homes in jeopardy because they underestimate the risks to which they are exposed. When they are informed of the risks to which they are exposed, many do little with that information. In such circumstances, the availability or absence of flood insurance is unlikely to influence decisions about whether development in floodplains is desirable or prudent.

These perceptions about risk and insurance raise at least one further issue. If the availability of flood insurance promotes development that would not otherwise occur, then one would reasonably presume that most people who build in floodplains would purchase *and* retain flood insurance. When the National Flood Insurance Act was approved in 1968, the widespread assumption was that many communities would join the program, thus making their residents eligible for federal flood insurance. This was a flawed assumption. Four years after the program began, less than 100,000 policies were in force. Most of these policies were subsidized and most were for homes built prior to 1968. In 1973, the Congress imposed a mandatory purchase requirement on many property owners in SFHAs, and then strengthened that requirement in

1994. Despite these efforts, most people who purchase flood insurance in SFHAs do so because they must (Kriesel and Landry 2000). Although the total number of policies in force has increased considerably since the program began, eight states, Puerto Rico, and the Virgin Islands had fewer policies in force in mid 2004 than they did in 1980. During that period, Oregon's population increased by almost 20 percent, but the number of policies in force decreased by almost one-third. Arizona's population increased by nearly 90 percent, but the number of policies in force in the state increased by 9 percent over the same period. There were nearly 50 percent more policyholders in Texas in January 2005 than there were in January 1999, *but more than 80 percent of that growth was due to the purchase of policies by property owners outside of SFHAs*.

Furthermore, as many as a half million policies are cancelled or not renewed each year (Thomas 2004). FEMA recognizes that the slow growth in policies is due to a large number of policies that lapse or are not renewed (Hayes and Sabade 2004). In the two years between September 30, 2002 and September 30, 2004, as an illustration, the total number of policies in force increased by about 2.5 percent -- to 4,498,324 from 4,390,083. To achieve this gain, however, FEMA had to enroll almost 1.26 million new policyholders. This means that approximately 1.15 million policies lapsed or were not renewed during this period. Some portion of these policies were cancelled because the property owner moved or because the property was no longer in a SFHA. In contrast, however, some portion of these policies probably should have been retained or renewed because the coverage was mandatory. In either case, such data suggest that flood insurance is not a primary cause of development in floodplains.

Scope and Frequency of Research

Much of the empirical and descriptive research, particularly during the 1970s and 1980s, was conducted within communities during the NFIP's emergency phase, before FIRMs were widely available (Evatt 2000, 1999; Shilling, Sirmans, and Benjamin 1989; Bollens, Kaiser, and Burby 1988; Burby 1986; Burby and French 1981). With some exceptions (e.g., Sheaffer, Mullan, and Hinch 2002), these studies suggest that the NFIP influences floodplain development in the communities studied and was sometimes an important influence.

At the same time, however, several researchers have suggested that studies focusing on development during the Emergency Program may not be accurate indicators of the longer-term impact of the NFIP on community development once communities adopt their FIRMs. On the one hand, when the Emergency Program started in 1969, federal flood insurance was offered at highly subsidized rates (about $.25 per $100 of coverage) to attract communities into the program. This incentive is no longer required or necessary, and premiums for coverage in the Emergency Program have been raised substantially since 1969 while the total amount of insurance that can be purchased is limited to $35,000.

On the other hand, as Burby (2002) and Kusler (1982) have suggested, requirements for post-FIRM construction have been a much greater inhibitor of floodplain development than had existed before and during the emergency period of the same communities. Once a community enters the NFIP, all new residential construction within SFHAs must be at or above the base flood elevation and meet other flood-related building standards. These standards are more costly

in coastal areas than in areas adjacent to rivers. In addition, as noted above, buyers of properties in SFHAs in communities that participate in the NFIP who obtains mortgages from federally regulated lending institutions are required to purchase and retain flood insurance for the life of their loan. In either case, the cost of complying with flood-related requirements increases the cost of living in flood-prone areas, thus providing some deterrent to development in SFHAs.

Coastal communities and units in the CBRS have been the more common research settings (U.S. Commission on Oceans Policy 2004; Dunn, Friedman, and Baish 2000; Leatherman 1997; Whiteman 1997; Abernathy and Weiner 1995; U.S. Department of the Interior 1994; Miller 1990; Jones and Stolzenburg 1988; U.S. General Accounting Office 1982; Lowry 1980). In contrast, riverine and lake communities, while they have received attention (Burby and Holway 1990), have not generally been studied as consistently, or in as much detail, as the coastal locations (Carey 2003; Shipley 2003a, 2003b). That the coastal areas should receive more sustained attention is understandable. Such areas are vulnerable to hurricanes and coastal storm surges that can cause far more damage than gradually rising flood waters from rivers. In other words, the availability of flood insurance presumably promotes development in highly vulnerable coastal areas.[4]

Several studies have suggested that the NFIP's impact on floodplain development can vary significantly between riverine and coastal communities as a result of differences in real estate markets, regional political cultures, and developmental pressures (Burby 1994; Interagency Floodplain Management Review Committee 1994a; U.S. General Accounting Office 1982). Perhaps for similar reasons, studies tend to cluster primarily in high-growth southeastern and southwestern states.

Several studies focus on developmental patterns in areas constituting part of the CBRS, particularly in the Southeast (H. John Heinz III Center 2000b; Allen 1999; Platt et al. 1992). The Coastal Barrier Resources Act prohibits federal flood insurance for most properties in the CBRS. These studies are often considered to provide a control for purposes of comparing developmental patterns on floodplains or coastal areas where NFIP insurance is, and is not, available (Salvesen 2002; Daniel 2000; Salvesen and Godschalk 1998; U.S. General Accounting Office 1992; Bollens, Kaiser, and Burby 1988; Platt 1985; Miller 1977/1981). These studies generally suggest that developmental pressures on the CBRS are sufficiently intense that the absence of NFIP insurance does not inhibit development in some units of the CBRS.

Methodologies

The literature concerned with the developmental and environmental impacts of the NFIP is predominantly descriptive and anecdotal, despite the presence of many conceptually and methodologically sophisticated studies. Among the studies grounded in some empirical, or

[4] In fact, however, less than 2 percent of all federal flood insurance policies are sold in coastal V zones, which are subject to high velocity waters from wave action. Moreover, if the availability of flood insurance in these areas promotes development, then the number of policies in these areas should increase over time. Between January 31, 1999 and January 31, 2005 the number of federal flood insurance policies in V zones increased by 0.3 percent, from 83,970 to 84,223 policies. Over the same period, the number of policies in all other zones increased by 11.3 percent. Florida, South Carolina, and Texas have the largest number of policies in V zones.

quasi-empirical method, the majority depends on econometric or statistical modeling, community comparisons using aggregate socioeconomic data, survey research, and case studies.

The most conceptually well-developed theory applicable to the impact of the NFIP is derived from conservation economics. Krutilla (1966), for example, suggested that compulsory flood insurance could improve the economic efficiency in the use of community flood-prone areas for several reasons: (1) "[p]remiums proportional to risk and equal to both the private and social cost of flood plain occupancy will serve as a rationing device, eliminating economically unwarranted uses of flood plain lands on one hand, while not prohibiting uses for which a flood plain location has merit on the other hand"; (2) "reduction of flood loss insurance premiums can serve as a standard to measure the economic justification of alternative flood control measures and/or discrete increments in scale of protective works or other nonstructural flood control measures"; and (3) "[a] final advantage of flood loss insurance, which no alternative in flood management possesses, is indemnification for the residual damage potential against which it is not economic to seek protection" (Krutilla 1966, cited in Chivers and Flores 2002). Tobin and Montz (1986) suggest that many more opportunities exist to evaluate empirically the utility of theories from conservation economics as a strategy for evaluating the NFIP's potential impacts.

To a lesser extent, decision theory also creates opportunities to test the NFIP's impact through analyses of perceptions of risk and the program's influence on the purchase of floodplain properties, both insured and uninsured (Camerer and Kunreuther 1989). For the most part, however, the literature attributing an especially strong influence to the NFIP in promoting floodplain and coastal development is predominantly descriptive and impressionistic, including much of the literature asserting that the NFIP has been the primary, or major contributing factor, to the degradation of habitat protected by the Endangered Species Act (U.S. Commission on Ocean Policy 2004; *Forest Guardians and Sierra Club* v. *Federal Emergency Management Agency* 2001; DiSilvestro 1997; *Florida Key Deer* v. *Stickney* 1994; Glick 1994). Much of the literature associated with organizations engaged in ecological, conservation, and endangered species issues appears to be impressionistic (e.g., Pew Oceans Commission 2003; Warrick 1999; Friends of the Earth 1998).

In addition, many analyses and commentaries depend on case studies or anecdotal materials (Hartill 2000; Ullmann 2000a, 2000b; Ullman, Overberg, and Hampson 2000; Quinn 1996; Philippi 1995; Daly 1993; Dean 1992). Case studies, or impressionistic and anecdotal materials, do not necessarily invalidate conclusions but demonstrate the continuing utility of more empirical studies to establish some basis for assigning credibility to such claims.

Among approaches with claim to some empirical foundation, the most common procedures for studying the NFIP's developmental and environmental impacts involve survey research, comparison of aggregate economic data among NFIP and non-NFIP communities, econometric modeling, and case studies. Several studies since 1970 have involved survey research. Among these, six used surveys of NFIP policyholders, property owners on community floodplains, or consumers (Institute for Business and Home Safety 1999; Burby et al. 1991; Bollens, Kaiser, and Burby 1988; Kaiser et al. 1987; KRC Research & Consulting 1995a; Miller 1977/1981). Several of these studies appear to be variations on essentially the same database. These six studies appear to be the only ones in the survey literature derived directly from

interviews with various segments of the public that relate motivations for the purchase, or non-purchase, of flood insurance to developmental impacts on floodplains. The remaining studies are derived from interviews with local officials, realtors, insurance agents and insurers (Leatherman 1997; KRC Research & Consulting 1995b; Insurance Research Council 1990; Cross 1989, 1985; Montz 1983).

Case studies typically involve one or several different communities, less often a larger number, most of which are coastal or CBRS communities (Montz and Tobin 1999; Leatherman 1997; Mittler 1997; Interagency Floodplain Management Committee 1994a; Montz and Gruntfest 1986; Burby et al. 1985; U.S. General Accounting Office 1982; Carlozzi, Sinton, and Vilkitis, Inc. 1978; Scheaffer and Roland 1976; Miller 1975). These case studies typically involve a comparison of aggregate data among communities and more detailed analysis of communities individually. Research based on aggregate community data from a large number of sites (n>20) is less common (Kriesel and Landry 2000; Burby et al. 1988; Burby and French 1981; Sheaffer and Roland, Inc. 1981a; U.S. Department of Housing and Urban Development and FEMA 1981; Kriesel, Landry, and Keeler 1999). Econometric modeling is least common (Cordes and Yezer 1998; Shilling, Sirmans, and Benjamin 1989).

More frequently, evaluation methodologies are focused on indicators of community impact defined variously. These indicators include density or rate of floodplain occupancy, infrastructure development, community adoption of floodplain zoning and other ordinances, changes in property value, and other land-use indicators. Some studies, most previously noted, have attempted to create a quasi-experimental setting where controlled variables can be introduced. These studies have compared various indicators of floodplain or coastal development in lands where federal law prohibits property insurance through the NFIP – areas designated as constituents of the CBRS – with nondesignated but generally comparable lands where NFIP insurance is available (Daniel 2000; Leatherman 1997; U.S. General Accounting Office 1992; Platt 1985; Godschalk 1984).

While survey research methods are sometimes utilized in studies of the NFIP's community impact, most of these studies are focused on insurers, developers, financial lenders, or other individuals assumed to be knowledgeable about factors encouraging or inhibiting community floodplain development (KRC Research & Consulting, 1998; Bollens, Kaiser, and Burby 1988; Cross 1989, 1985). Survey studies of property owners, consumers, residents in high flood risk areas, or other publics relevant to the NFIP's activities are relatively infrequent (Institute for Business and Home Safety 1999). Moreover, most existing survey research is based on interviews with policyholders conducted years ago, and the findings may no longer hold.

Several potentially valuable research methodologies are seldom utilized, creating important constraints on the conclusions that can be reached with existing research about the NFIP's possible developmental and environmental impacts. The most conspicuous example is the infrequent use of clearly specified, differentiated indicators to evaluate the *ecological* impact of floodplain development that might be associated with the NFIP, or its absence, in specific communities. Exceptions include studies by the H. John Heinz III Center (2000a, 2000b) and Fridgen and Schultz (1999). Several studies suggest the transformations that might be expected

from floodplain development (Task Force on the Natural and Beneficial Functions of the Floodplain 2002; H. John Heinz III Center 2000a, 2000b; Haeuber and Michener 1998; Kusler 1994; Kusler and Larson 1993; Office of Technology Assessment 1984). Specific environmental indicators can be identified from many sources (Task Force on the Natural and Beneficial Functions of the Floodplain 2002; U.S. Department of the Interior 1994; Weber and Sutton 1965). One useful indirect indicator of environmental impact would be the number of permits issued under Section 404 of the Clean Water Act. This section regulates the discharge of dredged and filled materials into the navigable waters of the United States.

Several other studies provide an inventory of specific biological indicators – especially those associated with the natural and beneficial uses of floodplains – that might be used to characterize these possible transformations (U.S. Environmental Protection Agency 2002; Morris 1997; Federal Interagency Floodplain Management Task Force 1996). Closely related to the spare use of environmental indicators is the absence of methodologies for environmental characterization using GIS and closely related remote-sensing technologies. A variety of potentially useful databases exist for the utilization of these methodologies in many NFIP communities, and the relevant database is continually expanding (U.S. Environmental Protection Agency 2004; U.S. Geological Survey 2004a, 2004b; U.S. Department of the Interior 1994).

The absence of carefully delineated environmentally related evaluations (as distinguished from indicators of developmental impact that may sometimes imply environmental aspects) exemplifies the extent to which the evaluative literature on community impacts of the NFIP, with the exception of materials related to the Endangered Species Act, largely ignore environmental consequences. Not coincidentally, a keyword search of the hearing to review and reauthorize the NFIP conducted by a U.S. House of Representatives' Subcommittee on Housing and Community Opportunity (2003) revealed only three occurrences of the term "environmental" with no substantive discussion in any instance.

The history of the NFIP is now sufficiently long that time-series methodologies could also be productively exploited to characterize environmental and developmental change in participating communities. For example, natural resource economists, including Krutilla (1966, but see also Holway and Burby 1990; Muckleston 1983) have suggested that the NFIP requirement for community FIRMs might act like a rationing device for floodplain occupancy so that undeveloped land subject to flood risk would sell at a discount while developed property subject to the same degree of risk would not have a flood risk discount.

This hypothesis has been tested in Colorado and California where the investigators (e.g., Troy and Romm 2004; Chivers and Flores 2002) concluded that market failure, largely resulting from the a lack of information available to property buyers concerning flood risk, prevented the anticipated discounting. With this exception, developmental hypotheses concerning NFIP's long-term impact that could be derived from resource economics have not been tested by longitudinal studies in participating communities. These potential hypotheses are the more attractive since they could provide an empirical means of characterizing the NFIP's developmental impacts that do not depend on the availability of non-NFIP communities for purposes of comparative analysis. Another time-based approach to analysis of the NFIP's potential impacts might assess

patterns of floodplain development within the same community before and after a community adopts its FIRM.

Other Factors Associated with Floodplain Development

The literature points to factors other than flood insurance that may be responsible for development of floodplains in areas where such insurance is available. Researchers vary greatly in the extent to which they believe these factors are correlated with flood insurance and the comparative influence that they attribute to various factors individually and collectively. It is possible, however, to create a brief inventory of those factors most commonly mentioned in association with the NFIP as possible explanations for floodplain development in communities that participate in the program.

Adverse selection: Communities likely to join the NFIP, particularly during the emergency phase, have pre-existing developmental pressures whose impact on floodplain and coastal areas may be intensified by local political cultures (Burby et al. 1991; Burby 1986; Burby and French 1981; Sheaffer and Roland 1981b).

Subsidized insurance premiums: When communities are in the NFIP's Emergency Program, insurance rates are not based on appropriate actuarial data, thereby allowing some property owners to pay premiums that do not fully reflect their exposure to risk (Richman 2001; Shope 2000; Bovard 1999; U.S. House of Representatives 1999; Shilling, Sirmans, and Benjamin 1989).[5]

Increased prosperity: Developmental pressures are strongly associated with increased disposable family income and other economic consequences of national economic growth since 1970 (Ullmann, Overberg, and Hampson 2000; Leatherman 1997).

Development of infrastructure: Federal, state, and local governments' development of infrastructure, such as flood control, highways, schools and other public facilities, has increased the market appeal of floodplains and public perceptions of diminished flood risk from development (Cordes and Yezer 1998; Interagency Floodplain Management Review Committee 1994a; Miller 1990; Scheaffer and Roland 1976).

Other federal and state programs: In addition to infrastructure development, governments can also encourage development in floodplains by providing other kinds of incentives, such as windstorm and hail insurance, or subsidies for coastal armoring (Shipley 2003a, 2003b; Faber 1996a, 1996b; Godschalk, Brower, and Beatley 1989).

[5] Subsidized insurance available through the Emergency Program may have been an important factor in the NFIP's first years but is clearly less important today. In early 2005, there were 665 communities, with fewer than 1,700 policyholders, in the Emergency Program. Texas, Illinois, Indiana, and Tennessee accounted for more than half of all policies in the Emergency Program in early 2005. Texas (122 communities), Michigan (90), and Georgia (59) had the largest number of communities in the program. Most of these communities are recent entrants into the program and will enter the Regular Program once they adopt their FIRMs.

Riverine versus coastal location: Developmental pressures may be less intense in noncoastal areas where alternatives to floodplains may be more, or equally attractive, to consumers and/or the costs associated with replacing flood-damaged property may be a major deterrent to floodplain development (Interagency Floodplain Management Review Committee 1994a, 1994b; Sheaffer and Roland, Inc. 1981).

Amenities: Coastal lands and many other water-related locations provide amenities for which consumers perceive no satisfactory alternative (including proximity to metropolitan areas) and, consequently, are willing to accept the associated risk exposures even in the absence of NFIP or other flood insurance (Bollens 1990; Miller 1990).

Local political cultures: Local governments may provide many inducements for floodplain development through, for example, failure to enact or to enforce ordinances affecting development or other constraints on floodplain transformation (Sierra Club 2000; Burby, May, and Paterson 1997; Robinson 1989).

What Is Suggested, What Is Needed

The literature offers a number of significant claims about the NFIP's environmental and developmental impacts – some more robustly supported than others, some inconsistent or contradictory – that should serve as a strategic framework for continued research.[6]

Research claims

The NFIP is only one of several influences driving the development of floodplains. Seventeen research articles cited in the accompanying bibliography, including several reports produced by the FEMA (1997) or its program staff (Robinson 1989) identify many influences promoting development of floodplains and coastal areas, among which the specific influence of the NFIP is difficult to characterize (see especially U.S. Commission on Ocean Policy 2004).

Several developmental drivers closely associated with rapid development of SFHAs can be identified (Evatt 1999). Many studies characterizing these drivers are based on surveys of informed community respondents, such as mortgage lenders, floodplain managers, and local public officials and appear to be empirically sound (Miller 1990; Montz and Gruntfest 1986; Montz 1983). Nonetheless, it is difficult to determine the relative influence of these various developmental drivers on the basis of available research (National Research Council 1990; Robinson 1989).

The communities where the NFIP may significantly inhibit floodplain development have several identifiable characteristics found in various combinations. First, they tend to be riverine and Midwestern rather than coastal (Montz and Tobin 1999; Interagency Floodplain Management Review Committee 1994a; Bollens, Kaiser and Burby 1988). Second, they have local political cultures congenial to aggressive conservation and regulation of floodplains (Platt

[6] Unless noted otherwise, citations in this section represent studies based on empirical research or that summarize a significant body of empirical research. These citations, in many instances, represent only a portion of related studies included in the references at the end of this report.

et al. 1992; Blocker, Rochford, and Sherkat 1991; Sheaffer and Roland, Inc. 1981). Third, such communities typically adopt ordinances that require more than the NFIP mandates. Finally, few such communities are in the NFIP's Emergency Program.

In contrast, communities where the NFIP may be associated with rapid development of local floodplains typically have several characteristics. First, the most rapid surge of development in SFHAs is associated with the Emergency Program (Kusler 1982). Second, many are coastal communities (H. John Heinz III Center 2000a; Cordes and Yezer 1998). Third, such communities tend to have significant governmental infrastructure associated with their floodplains, although this is often implied (Carey 2003; Shipley, 2003a, 2003b; Marlowe 2000; Friends of the Earth 1998).

Fourth, there is a widely shared perception among policyholders and prospective policyholders that the federal government will dependably and generously compensate property owners for repeated flood loss (Philippi 1996; Godschalk, Brower, and Beatley 1989).

The impact of the CRS on the character of development in floodplains is unclear although some evidence suggests that the impact of the CRS may be confined largely to minimizing flood damage, reducing repetitive claims, and increasing awareness of flood risk and strategies for structural mitigation (FEMA 2002b, 2000, 1998a, 1998b). The availability of flood insurance may have a negligible effect on the rate of floodplain development because the availability of NFIP insurance is seldom a major consideration in decisions by developers and property owners to purchase property in SFHAs (Chivers and Flores 2001; National Research Council 1990; U.S. General Accounting Office 1982; Kriesel, Landry, and Keller 1999). As noted earlier, studies in Colorado and California suggest that the NFIP has limited impact on property values because of the late stage in the purchasing process at which buyers typically learn about flood risk and the costs of flood insurance (Troy and Romm 2004; Chivers and Flores 2002).[7]

Comparison of developmental patterns between NFIP communities and CBRA areas suggests that land development is not significantly inhibited by the unavailability of NFIP insurance (Salvesen 2002; Daniel 2000; U.S. General Accounting Office 1992; Godschalk 1984). Most of the NFIP's environmental impacts have been inferred from other developmental patterns of land use in participating communities and not from empirical measures of environmental indicators themselves. Among the environmental impacts attributed to the NFIP, coastal beach erosion and surface and groundwater degradation appear to receive the greatest attention (Pew Oceans Commission 2003; H. John Heinz III Center 2000a, 2000b; National Research Council 1995, 1990). Similarly, it is unclear what environmental impacts of floodplain development in NFIP communities can be attributed directly to property development rather than to governmental infrastructures.

[7] In contrast to these findings, developers and realtors around the Puget Sound in Washington State claim that the inability to obtain federal flood insurance "would effectively shut down new housing in affected areas." The Home Builders Association of Kitsap County noted that all of its members rely on the NFIP to obtain financing for their projects. See U.S. District Court, Western District of Washington (2004).

The NFIP's alleged contribution to the degradation of habitat for species protected by the Endangered Species Act is unclear, for many of the same reasons often cited in discussion of the NFIP's developmental impacts on SFHAs.

Future research

The research claims previously discussed provide richly varied opportunities to characterize the NFIP's developmental and environmental impacts more convincingly and precisely, and this suggests a productive strategy for continuing research.

First, with the exception of litigation and related materials concerning the NFIP's alleged impact on the habitat of endangered species, the most consistent deficiency in the research appears to be carefully conceptualized and empirically robust studies documenting the program's environmental impacts. Most environmental claims relating the NFIP closely to specific environmental impacts (for example, to accelerated beach erosion) are inferential and often vague.

Second, the NFIP has been in existence sufficiently long to support analysis of developmental and environmental change over time in participating communities. These analyses could be associated with important prior research claims in a variety of ways. For example, the use of time-series studies would be particularly useful in clarifying (1) the extent to which the NFIP's Emergency Program accelerated floodplain development within specific communities; (2) the extent to which significant environmental indicators have changed over time; and (3) the relationship of other community variables, such as participation in the CRS or geographic location, to the rate of development in floodplains.

Third, surprisingly little information about the program's impact on developmental patterns is based on recent survey research focused on attitudes and perceptions of policyholders. This is especially relevant to issues involving the extent to which the availability of flood insurance, and the cost of that insurance, is related to people's propensity to develop SFHAs and the extent of information about the NFIP.

Finally, it would be useful to have more comparisons between communities differentiated by geographic location and a wider regional variation in geographic location than most current research provides.

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Note: In addition to works cited in the previous literature review, this bibliography also contains documents not cited to conserve manuscript space and improve readability. These additional items include articles important to interpreting the intent and scope of the NFIP's environmental impact (such as congressional hearings and related materials), documents largely duplicating or repeating earlier cited studies, and article collections (such as conference proceedings) that appear to contain potentially relevant additional information but could not be reviewed.

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