

FLOODPLAIN PLANNING AND MANAGEMENT: RESEARCH NEEDED FOR THE 21ST CENTURY

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Sharing the Challenge highlights the important role state and local planning and floodplain management can play in reducing the nation's vulnerability to floods. The report devotes a full chapter to "Avoiding Vulnerability Through Planning," noting:

- o With planning and education as the cornerstones of floodplain management, the nation can further reduce risks.... (pg. 93)
- o The development and implementation of state and community floodplain management and hazard mitigation plans can reduce significantly federal expenditures for future disasters. (pg. 99)

To realize that potential, the Interagency Floodplain Management Review Committee calls for Congress to adopt a National Floodplain Management Act (modeled after the Coastal Zone Management Act). The new act would fund and set standards for floodplain management plans and programs in order to increase state and local governments' accountability for past and future vulnerability to flood losses.

While moving planning and floodplain management to center stage in national flood-loss reduction efforts, the committee generally ignored the need for continued investment in research to make the called-for floodplain planning and management effective. In this article, I show that progress has been made in floodplain management research, but that gaps remain in what we need to know to manage floodplains effectively. In particular, state and local floodplain managers will have to develop much more sophisticated tools for building the private sector's commitment to and capacity for accomplishing flood-loss reduction.

What Is Already Known

Floodplain planning and management (as distinct from flood control and loss sharing through insurance and relief) reduce vulnerability by affecting the type, amount, location, and character of private and public development in floodplains. They are best understood as a system that includes a set of actors, actions, and effects, as illustrated in Figure 1. This figure also provides a useful means of reviewing the current state of knowledge. Most research to date has focused on the three boxes to the left of the figure, which comprise the governmental components of the system; relatively little work has been devoted to understanding the three boxes to the right of the figure, which comprise the private sector components and outcomes in terms of changes in the built environment and the

impacts of those changes.

The first order of business in managing floodplains was development of what might be termed the technology of planning and floodplain management--the set of techniques for delineating flood-hazard areas, establishing standards for development in those areas, and formulating strategies (information, regulations, incentives, capital improvements) for affecting development decisions. A fairly complete enumeration of measures governments can employ in development management is provided in Table 1. While refinements to improve the efficiency and effectiveness of those measures are always needed, for the most part the technology of planning needs little additional work.

The basic elements of floodplain management technology were in place by the early 1950s, but few governments employed any of the measures that were available. The second order of business, which has occupied researchers to this day, was to understand in what circumstances governments will adopt various floodplain management techniques. Propositions emerging from this research are summarized in Table 2.

In a nutshell, researchers have found that local governments are most likely to adopt floodplain management measures when (1) federal or state mandates require local plans (comprehensive or floodplain management) that address the hazard; (2) citizens and interest groups recognize hazards as a problem and want something done to reduce risks; (3) the problem has been catalyzed, sometimes by the occurrence of a flood disaster, but also by rapid development of hazardous areas; (4) the problem is tractable through building and land use adjustments (tractability depends, in particular, on the absence of previous extensive/intensive development of the floodplain and availability of hazard-free sites for future development); (5) comprehensive or floodplain management plans recommend the adoption of such measures; (6) the planning leadership and staff are committed to doing something; (7) the leadership and staff have the capacity to address the flood problem; and (8) the community has the resources to support floodplain management.

In general, communities are more likely to adopt floodplain management measures that address future development (where costs can be anticipated and incorporated in development decisions) than they are to adopt measures that require retrofit of existing development (where costs were not anticipated by property owners). In fact, substantial measures to reduce the exposure of existing development usually are adopted only when large federal or state subsidies can be obtained, such as for the construction of public works to control the severity of floods or

the relocation of structures at risk. *Sharing the Challenge* recognizes this and calls for enlarged federal support of relocation and retrofitting (through the National Flood Insurance Program).

Also, communities are most likely to adopt measures that affect the character of development (e.g., requirements for elevation of structures or floodproofing of new construction in the floodplain) than measures that affect the location of new development. In part, that is due to federal policy. Congress has been reluctant to require local planning for flood-hazard areas and, instead, has tried to foster safe development practices through regulatory standards for community participation in the National Flood Insurance Program. As a result, it could be said that most floodplain management is devoted to teaching people how to build safely in floodplains, rather than how to avoid building at all in such areas. The consequence has been increased potential for catastrophic losses from floods, such as the 1993 event on the upper Mississippi and Missouri rivers, that exceed commonly accepted design standards. *Sharing the Challenge* recognizes the misplaced emphasis on safe building rather than hazard avoidance, stating bluntly, "The nation should discourage new development in floodplains" (pg. 113). How that change is to be effectuated is unstated, but presumably the National Floodplain Management Act, if adopted, and the already-in-place NFIP Community Rating System could be used to foster a "floodplain avoidance" or "environmental protection" ethos in place of the "safe development" ethos the federal government currently endorses.

What Needs to Be Known

Difficulties in reducing the vulnerability of existing development at risk and limiting new development in floodplains signal the need for research on ways to accomplish those policy goals espoused in *Sharing the Challenge*. That research should be linked to efforts to better understand decision making in the private sector, since private decisions will be the primary target of public policy.

In contrast with the wealth of research on the public side of floodplain management systems, however, relatively little research has been devoted to the effects of floodplain management on development decision making in the private sector and on the ultimate impacts of public policy on economic, social, and environmental well-being. Evidence is mounting, however, that private compliance with regulatory mandates is problematic, that there is some interest but strong barriers to investment in retrofitting and relocation, and that while economic and social impacts may be positive, environmental impacts of present policies may in many cases be negative.

The lack of information on development decision making hinders the effective application of incentives and sanctions to secure compliance with regulations and other policy objectives. The design of enforcement systems and development of techniques for working with the private sector, such as cooperative enforcement strategies that emphasize flexible

application of rules and building capacity to comply, are likely to take center stage over the next decade. Research to support those efforts should receive high priority.

With tight federal budgets, subsidies to reduce risks to existing development are likely to be difficult to secure, except in the aftermath of a disaster. That will increase the importance of finding means to foster self-protective behavior among individuals and firms so that a higher proportion become willing to invest enough of their own funds in structural retrofit to reduce significantly susceptibility to loss. Research is needed to document cost-effective programs, where they have been developed, and to better understand factors that affect individuals' and firms' decisions about retrofitting and relocation.

Structural flood control measures and the availability of flood insurance through the National Flood Insurance Program have the potential to stimulate development in floodplains and increase the potential for catastrophic losses when flooding exceeds design standards. In addition, increased development in floodplains could result in environmental damage, but little research has examined the impacts (either intended or unintended) of nonstructural flood-hazard mitigation programs on various accounts (environmental, economic, social). Also, local governments do not have adequate capacity for conducting benefit-cost analyses of floodplain management policy alternatives, and, as a result, local policy often is adopted in response to state or federal mandates (such as the National Flood Insurance Program), rather than in response to a clear understanding of local policy options and impacts. Research is needed to better identify the effects of existing floodplain management programs on communities' economic, social and environmental well-being and to develop usable policy analysis tools for local decision makers.

Use of Existing Knowledge

Local governments for the most part have used available technology effectively to reduce potential losses to new development taking place in floodplains. As suggested above, they have not used that technology effectively to restrict new development in floodplains or to reduce potential losses to existing development at risk. Yet *Sharing the Challenge* argues that both are essential steps if flood losses are to be reduced in the 21st century.

Federal agencies, and some states, have kept abreast of research findings related to planning and floodplain management and have attempted to incorporate many of those findings in their hazard mitigation programs. The Federal Insurance Administration, for example, has developed the Community Rating System to increase local governments' willingness to prepare floodplain management plans and commitment to reduce the vulnerability of existing structures located in flood-hazard areas. *Sharing the Challenge* recognizes the Community Rating System as an important tool and looks to it as the primary means of promoting floodplain

planning (if Congress fails to enact its proposal for a National Floodplain Management Act). Federal agencies, however, have been slow to deal with local governments' revealed reluctance to limit development in hazardous areas. *Sharing the Challenge* reiterates the need to halt further development in floodplains, but it provides no advice about how to attain that end.

Federal agencies have not effectively used existing knowledge on private-sector decisions related to hazard mitigation and, except for the National Science Foundation, have not done enough to invest in building knowledge about floodplain management that would enable them to deliver programs more effectively. As a result, some federal programs have not penetrated private markets adequately (flood insurance, for example, had been purchased by only about twenty to thirty percent of the property owners who experienced losses in the 1993 flood), and many opportunities to foster private retrofitting, such as after disasters, are lost due to the absence of information about how to act effectively. *Sharing the Challenge* notes one of those problems, calling for research to increase the market penetration of flood insurance, but it has little new to say about how to foster retrofitting and relocation before disasters occur (beyond calling for more federal funding of such efforts).

Conclusion

Sharing the Challenge rightly argues that state and local governments and the private sector must assume more responsibility for reducing vulnerability to flood losses. For that to occur, new institutional arrangements are needed. A National Floodplain Management Act would go far toward putting in place the cooperative federal-state-local planning and floodplain management needed. Also essential, however, is better use of existing knowledge to foster attention to planning and floodplain management in the public sector and increased support of research to develop the tools state and local governments need to work cooperatively with the private sector to limit further encroachment on floodplains and reduce existing developments' susceptibility to flood damage.

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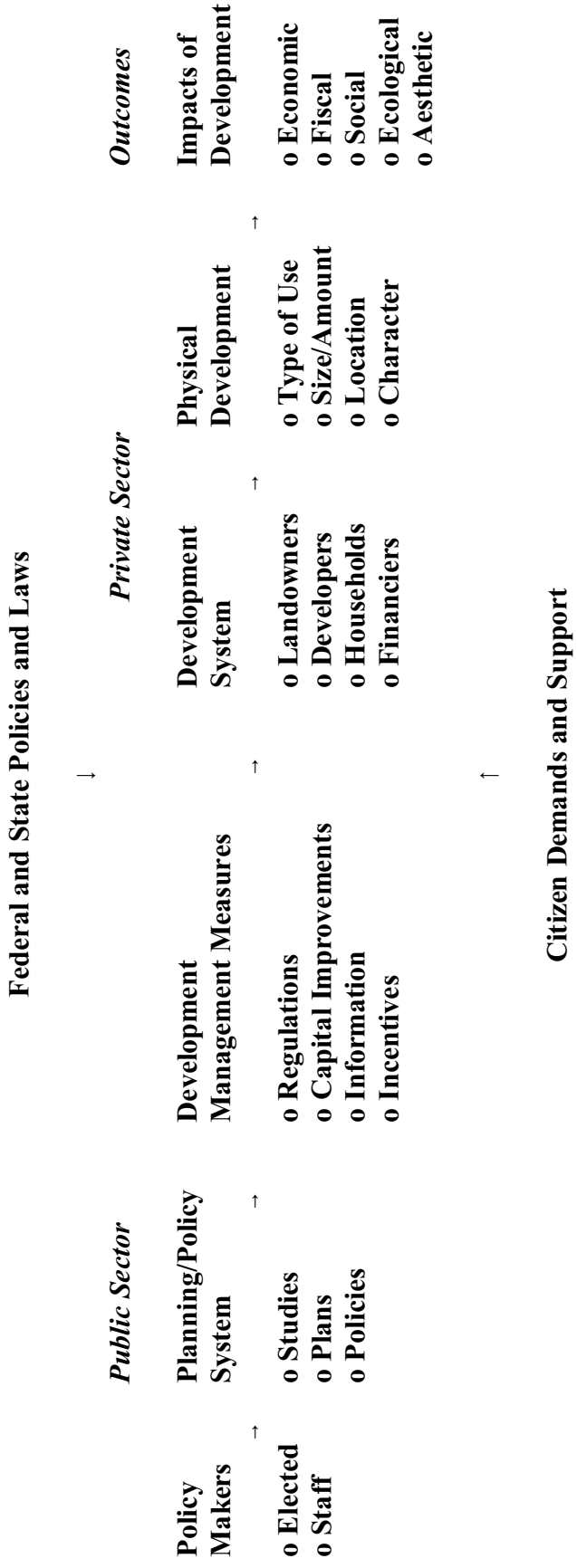


Figure 1. Local Planning and Development Management System

Table 1. Compendium of Development Management Techniques

Plans/Policy Documents: Measures to Guide Public and Private Decision Making

- o Safety/natural hazards element of comprehensive plan
- o Floodplain management plan
- o Post-disaster hazard mitigation study/plan
- o Special studies of hazardous areas
- o Vulnerability assessment of public infrastructure

Information: Measures to Increase Awareness of Hazards

- o Maps of areas subject to flood hazards published in plans, brochures, etc.
- o Signs posting boundaries of flood-hazard areas
- o Warning systems that alert occupants to impending severe flood
- o Campaign to educate public about flood hazards
- o Program to encourage purchase of flood insurance
- o Regulation requiring disclosure of flood hazards risks in real estate transaction, on deeds, on plats

Regulations: Measures to Limit Development of Hazardous Areas

- o Low density/intensity conservation or other floodplain zone in zoning regulations
- o Overlay zone with reduced density provisions
- o Downzoning of existing zoning density specifications
- o Cluster development (density transferred to hazard-free portion of same site)
- o Transfer of development rights (downzoning with provision for transfer of density to hazard-free site)
- o Mandatory dedication of open space with preference given to land exposed to flooding

Regulations: Measures to Reduce Developments' Susceptibility to Loss from Natural Hazards

- o Special studies/impact assessment required for development in identified flood-hazard areas
- o Site plan review to determine conditions needed to reduce potential damages from flood hazards
- o Site development standards
- o Setbacks (floodway buffers)
- o Compensatory flood storage
- o Peak discharge limits
- o Infrastructure placement to discourage floodplain development
- o Safe building standards related to flood hazards
- o Retrofitting requirements to minimize unsafe conditions in existing structures

Incentives and Sanctions: Measures to Increase Voluntary Compliance

- o Incentives
 - o Tax benefits
 - o Density bonuses
 - o Subsidized loans
 - o Insurance availability
 - o Technical assistance
 - o Provision of infrastructure in hazard-free areas
- o Sanctions
 - o Fines
 - o Criminal penalties
 - o Stop work orders
 - o Injunctions
 - o Financial performance guarantees

Capital Improvements: Measures to Control Severity of Hazards

- o Channel improvements and maintenance
- o Diversions
- o Dams and reservoirs
- o Levees
- o Watershed treatment

Table 2. Factors Reported to Be Associated with Adoption of Floodplain and Other Hazard Management Measures*

1. Recognition of Natural Hazards as a Community Problem

The more people recognize that hazards exist and that the probabilities of loss are not trivial, the more likely communities are to adopt hazard mitigation measures (Alesch and Petak, 1986; Burby and French et al., 1985; Drabek, Mushkatel and Kilijanek, 1983; French and Harmon, 1982; Godschalk, Brower, and Beatley, 1989; Mushkatel and Weschler, 1985). The more hazards are viewed as controllable by individuals, the less likely communities will adopt hazard mitigation measures (Graham, 1982).

Absence of a political constituency for hazard mitigation and presence of active opposition by economic development and real estate interests diminishes the adoption of such measures (Burby and May et al., 1994; Drabek, 1986; Godschalk, Brower and Beatley, 1989; Rubin, 1981; Wyner, 1984). Varying values and perceptions among stakeholders makes it difficult, if not impossible, to reach consensus about appropriate mitigation policy (Alesch and Petak, 1986; Petak, 1984). Hazards, such as floods, which allow victims or potential victims to be easily recognized are more amenable to land use adjustments than hazards, such as earthquakes, where victims are more spatially diffuse (Graham, 1982).

2. Policy Catalysts

Recent losses due to natural hazards are associated with the adoption of hazard mitigation measures (Alesch and Petak, 1986; Godschalk, Brower and Beatley, 1989; Luloff and Wilkinson, 1979; May and Williams, 1985; Wyner, 1984; for countervailing evidence, see Burby and May et al., 1994; Rubin, 1981). Objective risk of experiencing a hazardous event, as opposed to actually experiencing such an event, has little effect on community adoption of hazard mitigation measures (Godschalk, Brower and Beatley, 1989) or on local elites' support or opposition to such measures (Mitler, 1989). One study indicates that uncertain risks are associated with policy adoption (Graham, 1982), while another suggests that uncertainty leads to fatalism and failure to adopt adjustments (Wyner, 1984).

Faster growing communities are more likely to adopt hazard mitigation measures than slower growing communities (Burby and French et al., 1985).

The more intensively hazardous areas are developed, the more likely communities are to adopt hazard mitigation measures (Burby and French, 1981; Burby and French et al., 1985).

3. Tractability of the Problem Vis-a-Vis Nonstructural Adjustments

Characteristics of hazards (technical difficulties identifying hazard areas; large size of population whose behavior needs to be affected; diversity of behaviors to be changed; high costs imposed on a narrow group) reduce the feasibility of nonstructural hazard mitigation measures (Wyner, 1984).

Alesch and Petak (1986) note that the availability of a policy option that is viewed as practical and efficacious is an important factor in the adoption of hazard mitigation measures (also see May and Williams 1986). The more nonhazardous sites available for development, the more likely communities are to adopt land use adjustments to natural hazards (Burby and French, 1981; Burby, French et al., 1985; Godschalk, Brower and Beatley, 1989). Where structural solutions are available (i.e., a distributive or redistributive solution), communities will look toward them before pursuing land use (i.e., regulatory) adjustments to hazards (Burby, et al. 1988; Burby and French et al., 1985). The more visible the costs of the adjustment, the less likely it is to be adopted (Graham, 1982). Governments that depend on property taxes for revenue are less likely to adopt land use adjustments than governments that rely on other revenue sources (Hutton, Mileti et al., 1979).

4. Commitment of Governmental Leaders and Professional Staff

Higher priority of natural hazards problems is associated with more attention to hazard mitigation (Berke and Beatley, 1992; Burby and French, 1981; Burby and French et al., 1985; Burby and Dalton, 1994; Burby and May et al., 1994; Dalton and Burby, 1994; Godschalk, Brower, and Beatley, 1989; May and Birkland, forthcoming; Petak and Atkisson, 1982; Wyner, 1984). Priority of natural hazards relative to other problems, however, is irrelevant to support or opposition of nonstructural hazard mitigation among state and local elites (Mitler, 1989).

The adoption of hazard mitigation measures is associated with the presence of strong advocates who have access to policy makers and a high degree of legitimacy due to technical expertise, political power, or the prospects of longevity in office (Alesch and Petak,

1986; Beatley and Berke, 1989; Berke, Beatley and Wilhite, 1989; Drabek, Mushkatel and Kilijanek, 1983; May and Williams, 1985; Wyner, 1984).

Table 2. continued

5. Capacity of Governmental Leaders and Staff

Lack of trained personnel diminishes local attention to hazard mitigation (Berke and Beatley, 1992; Burby and Dalton, 1994; Godschalk, Brower and Beatley, 1989; French and Harmon, 1982; Mushkatel and Weschler, 1985; Petak, 1984; Wyner 1984); staff professionalism increases such attention (Hutton, Mileti et al., 1979). Larger governments are more likely to adopt hazard mitigation measures (Hutton, Mileti et al., 1979). Larger jurisdictions are more likely to adopt hazard mitigation measures than smaller jurisdictions (Burby and French, 1981; Burby and French et al. 1985; Godschalk, Brower and Beatley, 1989; Hutton, Mileti et al., 1979; for countervailing evidence, see Berke and Hinojosa, 1987; Rubin, 1981).

Local governments with more experience with land use management are more likely to use nonstructural adjustments (Burby and French, 1981; Burby and French et al., 1985). Communities whose personnel participate more frequently in professional meetings (where nonstructural adjustments to hazards are discussed) are more likely to adopt such measures than communities where such participation is low (Alesch and Petak, 1986).

6. Capacity of Community to Support Land Use Adjustments

Higher median home values/community wealth are associated with local attention to hazard mitigation (Burby and Dalton, 1994; Burby and French, 1981; Burby and French et al., 1985; Godschalk, Brower and Beatley, 1989; Hutton and Mileti et al., 1979; Nilson and Olsen, 1981; Wyner, 1984).

7. Inclusion of Natural Hazards in Local Comprehensive Plans

When local governments prepare comprehensive plans that include (more) attention to natural hazards through provision of facts about hazards, goals for hazard reduction, and policy proposals, local governments are more likely to adopt measures to limit the development of hazardous areas (Burby and Dalton, 1994; Burby and May et al., 1994).

8. Intergovernmental Mandates

State and federal planning and development management mandates increase local governments' adoption of nonstructural hazard mitigation measures (Berke and French, 1994; Burby and French et al., 1985; Burby and Dalton, 1994; Burby and May et al., 1994).