

*Towards a Systems Approach: The Localized Incentives of Federal  
Flood Control Policy*

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**Abstract.** Flooding along major rivers causes significant property damage and often leads to loss of life. In the mid-1800s, federal policy towards river systems focused on building navigation structures for transport. Since then policy mandates have grown to include the desire for clean water, farm irrigation, and flood control. Because of its historic reliance on engineering, the Army Corps of Engineers has relied on the construction of physical barriers to keep flood waters at bay. However, this system has encouraged development in floodplains, thereby increasing the monetary and physical loss following a major flood. In addition, current federal policy views flood control policy as a localized phenomenon and encourages a patchwork of federal and nonfederal levees that work in isolation from one another. This paper examines the incentive structure present in current federal flood control policy and argues that a more systems-wide or holistic approach to policymaking would benefit local communities and lessen monetary bailouts.

## **Introduction**

The current state of federal flood control policy creates perverse incentives for development and coordination. Not only does the construction of physical barriers like levees create incentives to develop floodplains, but federal bailouts and insurance programs foot the bill for unwise development decisions. However, these decisions are made within the context of federal policy programs and one can easily see why development in floodplains is rational giving the institutional context.

The average American, and to some degree the Congress, rarely considers the cost of massive flooding, except when it is so grievous that it makes national headlines. When this occurs, such as the Midwestern floods of 1993 or the Red River flood of 1997, billions of dollars in property damage occur and human lives are sometimes lost. Though flood works protect property development, it will be argued that the property saved from flooding wouldn't need saving if the flood works weren't constructed in the first place. Furthermore, it will be argued that the piecemeal approach to current flood control policy could better be supplanted by a holistic, systems approach to river system management that acknowledges natural inflows, outflows, and floodplains.

Section I briefly outlines a holistic systems approach to river systems. Section II then examines the nature of the good desired and the disparate stakeholders involved in the policy debate. Section III highlights how the nature of flood control engineering provides incentives to develop in risky floodplains. Section IV then looks at current federal policies and how these influence individual decision-making on a local level. Section V attempts to bring the previous sections together and addresses the difficulty in changing the status quo.

## **Section I. A Systems Approach to Flood Control Management**

Rivers are complex systems. Not only does an individual river generally cross several political and ecological boundaries, but they are the product of much larger river basins that include tributaries and estuaries (GAO 1995). The Mississippi River Basin alone includes the Missouri, Ohio, Tennessee, Illinois, Iowa, and Minnesota rivers, just to name a few. But in addition to inflows of water, river systems have over centuries cut paths of least resistance to the sea, culminating in complex wetlands. Official U.S. policy, as stated in the Clean Water Acts, is that wetlands must be protected, not only for their water purification attributes, but also for their natural function as river outlets. Furthermore, because some years see more snow melt and rainfall than others, vast and fertile floodplains often border large rivers. All of these attributes of river systems serve as natural ways to spread out floodwaters, thereby reducing local effects of high water. Despite this, American mentality on flood control has long advocated the construction of artificial barriers like levees that push up water levels and increase the force of water flow.

A coordination problem exists within the modern conception of river system management because each community has only local incentives to protect its own interests. Since the addition of each levee increases the pressure put on all other levees, constructing such works may actually add to the propensity for flood damages (see Section III for more detail). Stakeholders are thus stuck in a social dilemma—everyone would be better off if there were a unified policy on flood control, but it is in each individual's or community's interest to construct flood works independently. Before

turning to a description of current flood control policy, one must understand why collective action is so difficult within a river system.

The study of collective action has produced competing theories about the conditions under which groups of individuals will voluntarily contribute to public goods. Mancur Olson (1965) argued that collective action is most likely to be successful when there are small and homogenous groups of individuals. Olson argues that as group size increases, each individual's share of expected benefits from collective action decreases, as does the ability for group members to detect free riding. Similarly, homogenous groups have common interests, higher levels of trust, and familiarity that increases the probability of successful collective action. On the other hand, some scholars (Esteban and Ray 2001) have posited that larger group size equates with a larger pool of potential resources to be used in organizing collective action and that the cost per-individual to collectively act decreases, thereby making collective action more likely. Group heterogeneity works the same way by allowing a group to draw on diverse skills that may actually decrease the costs to collectively act. Both sets of theories are equally compelling, so the context in which collective action takes place greatly influences the outcome.

In the case of flood control management, it will be argued that the sheer number of disparate interests and population size affected by any given river system makes voluntary contributions to collective action infeasible. Instead, even under the current federal system of limited coordination, most stakeholders have incentives to construct flood works without regard for the up- and down-stream consequences. If one believes that navigable waterways, farmer irrigation, or riverfront development are desirable

within the modern political economy, then one must acknowledge the important role the federal government has in increasing cooperation within complex river systems.

Now that we have established the collective action problem inherent in flood control policy and the complexity of river system management, we can begin to address how and why current federal programs do not operate in such a context. As we shall see in section IV, the current state of federal policy encourages local actors to concentrate solely on their own needs and prevents federal bureaucracies from engaging in a systems coordination role.

## **Section II. The Nature of the Good and Stakeholders**

Perhaps the greatest challenge to effective flood control management is in understanding the nature of the goods provided. If all federal policies related to river management were undertaken with the goal of minimizing flood damage, then the problem would be straightforward. Instead competing bureaucratic interests and rent-seeking behavior by legislators often conflict with statutory obligations and diverse constituent interests. Even within a single bureaucracy, the Army Corps of Engineers, projects are undertaken for, at times, conflicting purposes—the need for effective navigation on rivers necessitates a threshold water level which may conflict with flood prevention goals or agricultural irrigation needs, for example. This section first identifies the salient actors and goals in river management, then outlines the nature of the conflict between the competing interests, and finishes by positing that the characteristics of the good desired by different interests creates a patchwork of incompatible policy goals. The total costs in physical and environmental damage that this patchwork creates is hypothesized to be greater than the sum of its parts because each project not only has

identifiable costs, but also creates perverse incentives that allow for one interests' goal to be achieved at the direct expense of another.

Two federal agencies, the Natural Resources Conservation Service (NRCS)<sup>1</sup> and the Army Corps of Engineers (Corps) share responsibility for the construction and maintenance of levees, though other federal agencies and departments have undertaken construction projects with the cooperation of these two primary agencies. Formed during the New Deal programs of the 1930s, the NRCS was established to coordinate watershed management within the Department of Agriculture. However, in 1954 Congress broadened its mandate to include the construction of flood prevention measures that affect local agricultural watershed districts at the bequest of local governments (P.L. 83-566). Typically these projects are much smaller than the ones undertaken by the Corps and are dominated by the construction of reservoirs and channels, rather than large-scale floodwall construction (GAO 1995: 21-22). Considering its place within the Department of Agriculture, it is no surprise that NRCS works serve a dual purpose of flood prevention and irrigation needs.

One of the earliest federal agencies, the Army Corps of Engineers (Corps) was established in the early 1800s to manage navigable waterways for commerce. By the mid-1800's, however, this mission expanded to include the construction of flood control projects along the Mississippi River Basin (ACE 2005). Thus today its mission statement is to provide "quality, responsive engineering services to the nation" through the management of water resources generally (ACE 2005). At least on its website, the mission statement of Corps makes no specific reference to either navigation or flood control priorities. And though its mission statement would appear to show a holistic

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<sup>1</sup> Formerly the Soil Conservation Service

emphasis on management of water resources generally, we shall see that the current state of policy constrains the Corps from performing such an overarching managerial role. Instead, it responds to individualistic construction demands that at times conflict with its other project objectives.

Throughout its history, one of the primary responsibilities of the Corps has been the creation and maintenance of works to improve inland navigation. Included in this mission is the necessity to maintain a depth of water in rivers and channels that allow for adequate navigation. As of 1997, 60% of all inland waterways had an average depth of nine feet or more (Bronzini 1997: 69). At times the Corps' responsibility in navigation may conflict with its mission to provide adequate flood control. Not only does the depth of water influence the size and strength of flood control measures needed to counteract potential flows, but the dredging of waterways to maintain navigable levels may in turn take out important sediments that would otherwise build fertile delta floodplains further down. This is not to say that navigable waters are any less desirable than flood control projects; only to say that the two are at times incompatible. One could easily argue that the need for harbors, locks, and dams to serve inland shipping requires construction of support facilities near rivers and that this necessitates floodplain development and consequently the construction of floodwalls to prevent local flooding. In addition, the natural geographic location of fertile agricultural lands within river basins (particularly along the Mississippi river) makes river transportation of heavy bulk commodities not only practical, but economically essential. Currently, 60% of all US grain exports flow down the Mississippi alone (MNRRA 2005). Yet many of the facilities for navigation have become obsolete or have outlived design criteria because the Corps directs resources

to a variety of policy and project objectives. For these reasons and others, The Inland Waterway Users Board, created in 1986 to oversee Corps navigation projects, has insisted that the Corps focus its efforts on maintaining current navigation works before considering the construction of new works (Bronzini 1997: 71).

In addition to conflicting goals within the Corps, external interest groups and loose coalitions of property owners exert great political pressure on the agency. These groups include environmentalists, farmers and urban dwellers, each with their own respective objectives in river management projects. To understand how these various interest groups influence the policy debate and how they interact with Congressional lawmakers, we now turn to detailed descriptions of each of these groups, the interest they have in flood control works, and the policy tools they use to influence project selection.

Disparate environmental groups work to achieve different goals within the broad category of environmental stewardship. Since ‘environmental group’ can be applied to numerous interests, I will simplify the analysis by assuming that the goals of such groups are the preservation of wild river system. The Sierra Club, for example, has a mission to keep the Atchafalaya Basin near New Orleans, “wet and wild” (qtd. In Berlau 2005). With this stated goal and definition of a unified policy goal, one can understand why environmental groups work to shut down almost any engineering construction project that influences water flow in a river system. Some groups, like American Rivers and the Mississippi River Basin Alliance, see levees as direct threats to natural flows of freshwater that provide habitat for wildlife and recreation for people. Since these groups take as a given that flood control projects affect the wildlife they seek to preserve, they have utilized several strategies to prevent further construction (Berlau 2005).

Environmental groups often call on one of two pieces of major federal legislation to constrain Corps projects, the National Environmental Policy Act and the Clean Water Act (and subsequent amendments). Passed during the rush towards pro-environmental legislation in the late 1960s, the National Environmental Policy Act requires the use of environmental impact statements (EISs) for all federal programs affecting the quality of “the human environment” (qtd. In Kraft and Vig 2000: 16). Since its passage, detailed requirements for consideration in these reports have been implemented by the Council on Environmental Quality and have found strict enforcements in the courts (ibid). These require public hearings on the environmental impact of most federal projects and can be a useful tool in slowing down a flood control project or in creating a contestable issue that environmentalists can take to court (i.e. disagreement over the procedure of writing an EIS can be used as cause to take a project to court). A 1996 proposal by the Corps to add over 300 miles of levees along the lower Mississippi was blocked in such a way when environmentalists argued that the Corps had neglected the adverse affects of the project on bottomland hardwoods. A compromise was reached in 1997 when the Corps agreed to postpone some construction while another two-year study was conducted on the impact (Berlau 2005).

In addition to the use of environmental impact statements, environmental groups often turn to the provisions of the Clean Water Acts to stop or slow down construction projects. These Acts are complex and have numerous provisions that cannot be adequately addressed here. One relevant aspect of the law, however, is that they explicitly contain provisions to protect wetland forests, which can be at odds with flood control policy (Stavins and Jaffe 1990). Section V deals with this example more in-

depth, but for now it suffices to say that environmental goals can conflict with flood prevention measures.

In rural areas, the demand for high quality agricultural lands often lead to the creation of federal or nonfederal levees aimed at reclamation of prime soil. Since floodplains are the source of high quality nutrient overflows, farmer demands for reclaimed agricultural land sometimes drive rural project selection. This could occur because a floodplain has been planted in the past and then during a flood year massive crop failures led to a federal or insurance bailout that in turn brought the issue of flood control to the forefront of local policy debate. On the other hand, it could simply be that farmers see the potential to develop land that consistently becomes flooded and then pressure engineers into constructing levees. In either case, the economic drive for this prime land influences the policy debate and leads to the construction of rural levees. Moral hazard thus ensues—since the land is protected it is developed—and the cycle of development, flood, bailout continues.

Cities rely on river systems as a source of hydroelectric power, recreation, and for transportation needs. Because of their strategic geographic locations one could not simply argue that cities should move away from rivers, though it has happened before (see for example Napa, California). No matter the size of the city in question, be it a few hundred or a few million people, floods can cause massive capital improvement damage and may threaten lives. Obviously city dwellers have an incentive to protect what has been built through the construction of floodwalls. But that is not the only way that flood control measures are built. Instead, it may also be the case that developers or city leaders want more land for development and taxation, respectively. This leads to development

within pre-existing urban flood plains (where levees were already present) and the call for the construction of new flood works where it may become profitable to develop. Because city governments can be influenced by the lobbying of developers and the lure of a bigger tax base, the city will have little incentive to consider a holistic flood management approach. Instead, it will construct flood works protecting property within its municipal or metropolitan boundary.

In the aftermath of recent flooding in New Orleans, numerous articles have been published on both sides of whether cities should ever be located in risky floodplains. Editorials in major newspapers asked whether it was worth rebuilding the city or whether natural forces would consume it again. Notice first that these arguments assume that the flooding caused in New Orleans were the result of natural causes. As we will argue in the next section, however, flood works increase the propensity of floods to cause damage and as argued, development within floodplains are perfectly rational for developers within the current institutional framework. We cannot say with any certainty what the counterfactual of flood works in the New Orleans area would be; if no levees exist it is possible that development would only occur on higher ground. But this ignores the economic reality of the geopolitical location of New Orleans. As George Friedman (2005) argues, New Orleans is located at a point along the Mississippi River that requires a large port. Not only does the bulk of U.S. agricultural exports flow through the city, but so too do industrial products from upriver cities. If we believe that a port is necessary there, then all of the support industries are necessary as well—restaurants, shopping centers, schools, etc. (*ibid.*). Even if there is enough land within the New Orleans area that naturally avoids flooding, this land may be too expensive for service workers to live.

Instead, it may be necessary to dam some extent of floodplains in order to secure housing for low income families or to simply increase the supply of available real estate to lower the market prices across the board. The point here is that we cannot ignore the tradeoffs between ecological and economic benefits.

This section has identified three interest groups with stakes in federal flood control policy, but there are certainly more. The simple exercise of thinking through the major actors and their motivations in influencing the policymaking process provides valuable insights into how actual policy is made. But before we turn to the current state of federal policy over flood control projects, it is useful to understand some of the perverse incentives that the construction of flood works may induce. In the next section we examine flood works projects more in depth to understand both how their presence influences individual investment decisions and how these works might contribute to increased damage when flooding does occur.

### **Section III. Engineering Floodplains and Incentives to Develop**

At the heart of current federal flood control policy lies the construction of physical works like levees and dams. Since the majority of flood prevention measures are in the construction of levees or coastal seawalls, and since this paper focuses on perverse development incentives, we skip over dams, whose purpose generally lie in hydroelectric uses or in creating irrigation reservoirs. Though important in their own right, they are not addressed here. Instead, we focus on a positive assessment of the development incentives created by the existence of flood works projects and how these projects may add to the destructive force of floods.

In a perfect free market situation, construction would not occur within floodplains unless the benefit outweighed the risk. A rational property owner would make an investment decision based on the perception of flood risk and property value versus the lost value of property in the case of flood damage. A properly working insurance market could take hold and would be willing to insure property that was within reasonable risk parameters. Because an insurance company is just as likely to have information about the location of floodplains near rivers as a property owner is, the effects of asymmetric information is minimized relative to other forms of insurance. Thus, one could argue that in the absence of flood prevention engineering and federal bailouts after the fact, real estate market mechanisms would take hold and prevent risky development. By constructing such works, however, moral hazard ensues and the loss of property following flooding is greater than would otherwise be the case. However, there is more to the story than just the density of development in floodplains.

The construction of a levee itself increases the destructive power of flooding. This occurs for two reasons: Increased flood level and increased water pressure. As the General Accounting Office notes:

“...the construction of a levee in a floodplain forces the water into an artificial floodway, causing the water to back up, just as the loss of a traffic lane on a busy highway causes heavy traffic to become congested. This restriction raises the level of the water both upstream of the levee and at the levee itself. It also forces the water to flow faster than it would if it were permitted to spread out across the whole floodplain,” (GAO 1995: 37).

Natural processes have created fertile floodplains for centuries as outlets for swollen rivers. To put this simply, water needs a place to go and if one cuts off its path of least resistance, one can expect to have serious ramifications up- and down-stream. Not only

does the construction of levees provide incentive to construct in floodplains, but the destructive power of the flooding is greater in a floodplain than would otherwise occur.

None of this should be taken to insinuate that levees alone cause water levels to rise or water pressure to increase. Indeed several natural factors like rain fall, vegetation levels, and water temperature also affect water levels and flow (GAO 1995: 44). Additionally, human induced changes aside from flood work construction can have affects on river flows, especially when those changes include irrigation channels, canals, or development on wetlands. Nonetheless, the following example of the 1993 Midwestern floods provides an excellent example of how levees can increase flood severity.

Before getting into the details of levee construction and the consequences on the 1993 flooding, however, we should note several important points that have so far been overlooked. First, levees are not all constructed by the federal government. Instead, each state has independent regulations on where, how high, and with what local levees can be built. Not only do communities build such ‘nonfederal’ levees, but so too do individual property owners. Though some of these nonfederal levees are regulated by federal statutes in relation to the National Flood Insurance Program, many others are not. One important difference between federal and nonfederal levees is that the former are generally built to withstand up to the level of a 100-year flood whereas the latter are only built for 5-year floods (GAO 1995: 3). Severe flooding that has a 1% chance of occurring in any given year is a 100-year flood and flooding with a 20% chance of occurring in any given year is a 5-year flood. The combination of these different engineering specifications and policies creates a patchwork of unregulated water flow

blocking which further hampers the efforts of a managed approach to river system flood control management.

The Midwestern floods of 1993 provide a good example of what structural problems can occur under the current system. Following unprecedented rainfall throughout the Mississippi River Basin, which includes the Missouri, Ohio, Minnesota, Iowa, and Tennessee rivers, as well as all tributaries flowing into these arteries and the Mississippi itself, Midwestern flood defenses were put to their hardest test to date. Record water flows were reported along 1600 km of the Mississippi and Missouri rivers (Pinter 2005) and total damages were estimated to be around \$12-16 billion (GAO 1995: 19). Though some of these damages were the result of agricultural loss caused by rainfall rather than river flooding, upwards of \$10 billion in damage can be attributed directly to river flooding (ibid.). Despite 63% of the land area inundated by floodwaters occurring in agricultural areas and only 2-3% in urban areas, it is estimated that the bulk of monetary damages occurred in the St. Louis metropolitan area (GAO 1995, Pinter 2005). As a result of this significant damage, the Federal Emergency Management Agency (FEMA) purchased close to 7700 properties valued at over \$56 million from the floodplains surrounding St. Louis in an effort to minimize future monetary loss (Pinter 2005: 207). The general consensus following the flooding was that major steps would need to be taken to prevent future damages on the scale of 1993 (GAO 1995).

Most of the federal levees withstood the flooding, but most of the nonfederal levees failed. The Corps estimates that only a few of its levees failed to meet design specifications, but that upwards of 1100 out of 1358 nonfederal levees affected by the flooding failed (GAO 1995: 25). Regardless of the success of the federal, 100-year

levees over the nonfederal 5-year levees, the backup of water resulting from these flood works greatly increased the flood levels and force. Computer simulations of the flood show that federal levees alone (presumably since most nonfederal levees failed they were not included) added 2.7 feet to the flood crest in downtown St. Louis, and upwards of 7.3 feet in other places along the floodplain (GAO 1995: 37). And while Corps officials acknowledge these data, they are quick to point out that the system of levees prevented \$19 billion in damages along other parts of the river basin, thereby producing a net benefit in flood protection (Pinter 2005: 207). Yet, as Pinter points out, the only reason that \$19 billion in damages were prevented was because the levee system produced incentives to develop real estate within natural floodplains, \$19 billion of which were successfully protected (*ibid.*).

Since 1993, development along the St. Louis floodplains has boomed, despite federal buyouts in some locations. Over 28,000 new homes have been built in floodplains with an accompanying population increase of 23% (Pinter 2005: 207). While this boom has occurred, the Corps has been busy creating new and enhancing existing levee systems to protect an additional 18,000 acres in the St. Louis region (*ibid.*). One may wonder how it would be possible that so much development has occurred in an area that was just 12 years earlier completely inundated by flood waters, especially since it must be recognized that the levees in the inundated area failed. Why should one expect a different result now? The answer is complex and involves the manner in which floods are insured against by the federal government, and the manner in which the Corps chooses its projects.

Levees, dikes, floodwalls, dams, and reservoirs are all legitimate policy tools to prevent flooding. Following the 1993 floods the Corps pointed out that, though flooding was more severe where levees breached than if no levees had been there at all, the net effect of all levees was to reduce total damage (Pinter 2005, GAO 1995). In the next section we turn to examining current federal policy in order to highlight the localized focus that the institutional environment has produced. One of the advantages of a holistic approach to flood control management is its ability to focus not on ‘net’, but rather on marginal damages. The current state of federal policymaking, however, has created a patchwork of individual projects built in isolation from a managed approach. As a result, damages can be quite severe locally even if the net effects are positive. Moving towards a holistic approach to management would, it will be argued, create positive net benefits throughout the system *and* decrease the likelihood of localized disaster.

#### **Section IV. Current Flood Control Policies and Localized Incentives**

As argued in the first section, proper flood control prevention requires a holistic, systems-wide approach. Not only have academics, industry researchers, and government bureaucrats recognized these benefits, but so too have various individuals in the Corps (NRC 2004: 3-4). Nonetheless, the current structure of project selection and financing hinders the development of large scale projects. This structure has evolved over the past several decades to focus Corps projects on local desires in an attempt to make the federal government more responsive to the needs of individual communities. Though this approach has succeeded in reducing Corps expenditures on specific projects and has probably made the Corps more responsive to local needs, it has created a patchwork of localized projects uninhibited by vertical coordination. As well shall see, the rhetoric of

holistic flood management approaches and the reality of specialized projects are the direct consequence of at least two pieces of federal legislation and will require far reaching policy change to overcome.

At least two pieces of federal legislation mandate local and federal cooperation in flood control projects, the Water Resources Development Act (WRDA) and the National Flood Insurance Program (NFIP). Beginning in 1986, the WRDA introduced local cost-sharing arrangements between federal and local agencies in the planning and constructing flood prevention measures (P.L. 104-303). The purpose of this shift in cost arrangements was presumably to make Corps projects more relevant to local needs and by making local governments share in the cost, to make these projects more cost effective. Since a local government's budget can be more easily scrutinized by stakeholders, the idea was that projects would be undertaken with cost-efficiency in mind. As a result, however, local politicians and regional Congressmen became more involved in project planning, coordination, and construction (NRC 2004: 4). This has led to a decrease in vertical project linkages and an increase in site-specific construction.

To guard the federal government against the constant constituent pressures to bailout property owners and farmers in flood prone areas, Congress passed the National Flood Insurance Program (NFIP) in 1968. Administered by the Federal Emergency Management Agency (FEMA), the NFIP guarantees communities federal insurance against flooding, provided that the local community develops flood reduction projects. These projects may include the construction of levees, or at times the clearing of a floodplain to prevent perverse development. The goal of the program is to reduce the need for federal bailouts by insuring communities that properly prepare for floods

(FEMA 2000). Though a community puts together the flood reduction plan, it is individual property owners that are able to be insured. Because a community must be able to demonstrate that it has undertaken its own flood control prevention measures, though these may also be a result of local-federal joint projects, a community's interest lies solely in reducing flood risk within its jurisdiction, without regard for upstream or downstream consequences.

One criticism of the program is that the NFIP constrains development in the so-called floodway, or central portion of a floodplain, but allows for unchecked development on the peripheries, so long as the developed areas are either raised or protected by a 100-year levee (Pinter 2005). As discussed above, the building of a levee itself increases the potential for damage and cost when a flood breaks its barriers. Since a 100-year levee has a 1% chance of failing in any given year, private insurance companies would no doubt calculate the value of property and determine premiums with the failure rate in mind. Because the federal government insures the loss in these areas, however, and because the only stipulations to qualify for NFIP are flood prevention measures like building the 100-year levee, it is reasonable to assume that the federal government undercharges from what a market-induced insurance premium would be. Though I do not go into detail of this premise here, a careful study could be done to ascertain whether this is in fact the case.

According to FEMA, one of the objectives of the NFIP is "to reduce future damage and provide property owners with protection from financial losses through an insurance mechanism that allows a premium to be paid for protection by those most in need of protection" (quoted in Chivers and Flores: 2002, p 515). Anecdotal evidence,

however, would suggest that those most likely affected by levee breach flooding are those most unable to pay such a premium. Though large-scale capital investments are made in former floodplains at the risk of billions of dollars, many urban dwellings built on reclaimed or flood prone areas have low property values, suggesting that market forces already lower the values of such areas contingent on the probability of flood damage. If one accepts that adverse selection drives flood control project construction or that moral hazard leads to inefficient property construction once a project has been completed, then one can easily see a major (and potentially expensive) flaw in FEMA's logic. Since property values along reclaimed land are lower than they would be in identical circumstances not on reclaimed land, urban dwellers will be less likely to afford the premium in the first place. As a result, the federal government will be put in a position following a disaster to bailout property owners based on political incentives of the constituents that lacked market insurance before the disaster.

The result of federal legislation mandating local cost sharing and planning has been to usurp Corps oversight and coordination of multi-level flood projects. In order to finance a project or to initiate a project, the 1986 and all subsequent WRDAs require the Corps to first find a local sponsor. Furthermore, the NFIP requires communities seeking federal flood insurance to devise local flood control projects. The intersection of these two pieces of legislation clearly lies in narrowly conceived projects aimed to protect one town or watershed district without regard for upstream or downstream consequences. This situation is only further hampered by the existence of numerous nonfederal flood projects mentioned in the previous section.

Besides providing direct incentives to develop in risky floodplains, federal policies have also influenced the depletion of vital outlets for water overflow. It has been argued that wetlands serve as a natural flood outlet and that federal policy already explicitly protects these areas. Yet the loss of wetlands continues to be an externality of current federal flood policy. Stavins and Jaffe (1990) found that upwards of 30% of forested wetland depletion in the Mississippi Valley since 1934 can be attributed to private investment decisions encouraged by federal flood control policy despite other federal policies aimed to protect wetlands. Wetlands have little real estate potential without major reclamation projects that dry the fertile land for agricultural and urban development. In the Mississippi Valley, the authors theorized that the existence of federal programs for drainage and flood-control increases the value of wetlands as agricultural fields and would lead to more conversion than if no federal flood policies existed. They then constructed a dynamic optimization model of individual landowner decisions and assembled data on county-level property use records over a fifty-five year period. Their findings suggest that in a 36-county area studied, 1.15 million acres fewer would have been deforested without federal drainage and flood control projects (Stavins and Jaffe 1990: 349).

The example of wetland loss emphasizes a much larger point about inconsistent federal policies—not only does it cause a loss in wetland, but it forces wetland protection policies to spend marginally more to save diminishing acreage. Though for most of the paper I have referred to the need for a holistic approach to flood control management, to do so requires an understanding of the complexity of river-drainage systems and an understanding of the disparate policies that affect it. One clearly must weigh the

economic, transportation, security, ecological, and political ramifications of a river system in order to appropriately plan for such a system.

The next section offers initial suggestions on how a transition from patchwork to holistic management may take place by first briefly gauging Congress's ability to reform in the face of numerous stakeholders.

### **Section V. Towards a Holistic Systems Approach**

A holistic approach to river system management would seem an attractive alternative to current policy, but understanding the complexity of an entire system is both costly and imprecise. For an individual policymaker or bureaucracy to collect the scientific knowledge of the economic, social, political, biological and ecological consequences of each policy on a higher-level system would face diminishing marginal returns and would be inefficient. As scholars have shown, localized knowledge of a natural resource system can often trump a government's 'scientific' knowledge in terms of sustainable resource use (Ostrom 1990). The problem with a large and multi-use river system like the Mississippi, however, is that competing interests will put competing demands on the resource and each interest will provide knowledge specific to its perception of the resource system. Farmers will provide input aimed at increasing irrigation and arable land, barge companies will demand wider and deeper rivers, and environmentalists will provide information on biodiversity loss. An argument certainly could be made for external policy enforcement over complex resource systems.

The Army Corps of Engineers seems a logical choice to become a proactive manager of river systems. Not only does it have the expertise in construction projects, but it has specialized knowledge about river system complexity. The National Resource

Council (2004), after consultation with the Corps has argued that “Watershed planning requires cooperation with multiple agencies at federal, state, and local levels of government, as well as organized groups of stakeholders” (p. 9). Throughout its report, the National Resource Council indicates that most employees of the Corps see the benefits of a systems approach with multi-layered policy coordination, but that the agency cannot change because Congress will not allow it to. This indicates that constituent pressure on members of Congress can have the effect to sway policy towards individualistic and localized goals aside from the institutional mechanisms that require flood control policies to be local. Despite the calls for change by many academics, bureaucrats, and scientists, changing the status quo will not be easy.

Congress faces at least two forces preventing a holistic approach to flood control policy. First there is the simple draw of pork barrel politics. Second, the nature of Congressional oversight of bureaucratic agencies prevents the issue from becoming important until after a disaster has already hit. Even after a disaster strikes there are simply no guarantees that Congress would like to abandon the status quo. To understand how Congress operates in regards to flood control policy, we turn to an analysis of Congressional oversight. Once one understands the incentives facing members of Congress in regards to flood control policy, one can better understand the potential need for radical reform.

Questioning the widely held belief that Congress generally neglects oversight of executive agencies, Mathew McCubbins and Thomas Schwartz (1984) posited that there are actually two forms of oversight between which Congress may choose—police patrol and fire alarm. As the phrases depict, police patrol oversight consists of centralized

examinations of agency activity with the goal of catching problems before or while they occur. Contrariwise, fire alarm oversight consists more of an informal structuring of oversight that allows relevant interests groups or stakeholders to bring a problem to the attention of Congressional overseers after the problem has occurred (McCubbins and Schwartz 1984: 166). Each of these forms of oversight has positive and negative characteristics. For example, though police patrol oversight allows problems to be rectified before they cause significant damage (which often implies large costs), there are large transactions and monitoring costs in overseeing the day-to-day operations of a large federal bureaucracy. If monitoring an agency has a 1-in-100 chance of detecting a problem that will cost, say, \$1000, then it is irrational for an oversight committee to engage in monitoring if the costs to do so will exceed \$10 ( $\$1000 * .01$ ). This problem is further compounded by the fact that a member of Congress wants discernable results to bring to constituents. If monitoring an agency takes up vast amounts of time, but no problems are discovered, it may appear that an individual member of Congress accomplished nothing during his term in office. By engaging in fire alarm oversight, however, a rational member of Congress does not expend time or effort in monitoring an agency, but rather waits until a problem has occurred. Since these problems, like massive flooding, are often publicly acknowledged a member of Congress can *ex post* engage in criticism and oversight of the agency in question at much lower cost than *ex ante* oversight. In addition, the member of Congress will be seen by his constituents as engaged in a positive oversight role, which may not have occurred using police patrols (McCubbins and Schwartz 1984).

For the most part, Congressional oversight on flood control measures has been of the fire-alarm variety. There is little to be gained by an individual member of Congress in proposing far sweeping changes to flood control management until after a flood has brought the issue to the attention of the public. Furthermore, any individual member of Congress has little incentive, outside of potential logrolls, to champion a systems approach to river management because flood control projects outside of her jurisdiction brings little tangible benefit. Thus, one should not expect major changes to the Army Corps of Engineer's procedures unless a major disaster has already occurred.

One example of a modest systems approach to water management can be found in the National Estuary Program (NEP) created by the 1987 amendments to the Clean Water Act. The goal of NEP was to supplement local and federal control over water quality in coastal estuaries through vertical and horizontal linkages amongst various stakeholders (Schneider et al. 2003, see also Estuary and Clean Waters Act of 2000). Because estuaries often cross existing geopolitical boundaries, it was difficult to reduce pollutant discharges into these water systems without some external coordination. Rather than a simple top-down managerial approach, however, Congress authorized the Environmental Protection Agency (EPA) to create policy boards that oversee the entirety of an estuary. Schneider et. al (2003) argue that the strength of the program lies in its ability to give different stakeholders a policy instrument to voice opinions, while also giving legitimacy to the policy decisions because all of the stakeholders are given consultation rights. The authors find that this has created a network of property owners, business owners, local governments, politicians, scientific experts, and bureaucrats that coordinates information

sharing. This has reduced the costs of collective action and helped to improve water quality where the program has been implemented (Schneider et al. 2003).

The NEP shows that federal-state-local coordination can be possible across geopolitical boundaries. However, the example does not completely extend to flood control policy because the NEP has one stated goal—water quality improvement for drinking and recreation (EPA 2005). The coordination, then, is in the discharge of pollutants and in the regulation of water use generally to conform to this goal. As we've seen, flood control policy must be balanced against the goals of navigation and irrigation amongst others. Nonetheless, the EPA (2005) reports that numerous forms of governance have emerged through the program, with each estuary board determining its own course of action. This provides at least a glimpse at one prospective way for flood control policy to be strengthened, namely through a policy of bringing the diverse interests together in one governing structure.

The need for diverse interests to compromise on a unified policy may best be achieved through the bureaucratic oversight of a single coordinating agency. As the NEP example demonstrates, diverse interests can be coerced into a working relationship that effectively governs large scale ecosystems. In the case of large river systems, the heterogeneity of interest groups and the large numbers of people affected by policy choices could lead to a failure in self-organized governance.

A holistic approach to modern flood control policy would require great sacrifice by several conflicting interest groups. In theory, such a policy should not emerge until the costs to clean up after flooding exceeds the costs to subsidize agricultural, residential, and commercial developments in floodplains. This would only occur, however, in a

frictionless political system devoid of interest group pressures. As experience has shown, the American Congress does not necessarily respond to economic incentives. Instead, constituent pressures and the short time horizon of legislators often lead to inefficient and costly policy. Furthermore, the status quo of flood control policy cannot be so easily changed without some form of logroll or external influence. Congress has, however, achieved difficult policy change before. For example, military base closures once seemed impossible given the personal stake most elected representatives had in maintaining the economic benefit within their districts. After lengthy debate and compromise, a deal was finally struck to create the Commission on Base Closures, which has several checks against individual members of Congress attempting to save specific bases (Mayer 1995). Whether Congress has the willpower to create such a system with flood control policy remains to be seen.

A coordinated American flood control policy can be viewed as a solution to a collective action problem. As was argued in earlier sections, the construction of flood control projects in one location has negative externalities for other places. Each floodwall or levee built increases water height and pressure, which means that while the effect of each individual flood control project is negligible when there are only a few, the addition of each new levee decreases the marginal effectiveness of the other levees. Thus, what each property owner or local community views as a harmless floodwall intent only on protecting developed or agricultural areas can actually increase the propensity for damage to its neighbors.

## Conclusion

The existence of modern flood works creates incentives for risky development within floodplains. Because there are diminishing marginal returns to the strengthening and heightening of levees, most are built under the premise that it will protect against a so-called 100-year flood. Yet the works themselves increase the destructive power of flooding when it occurs. Thus, the current system of engineering river systems to prevent flooding actually encourages development that stands more of a chance of destruction than if it were built in another zone. Obviously there are times when development must be done in a specific location. However, the current system's focus on localized flood control also prevents a holistic management system that could view an entire river system as one project. The Netherlands has already adapted such a holistic approach while maintaining modern construction principles (see Enserink and Bohannon 2005).

This would be an important first step towards mitigating the financial and personal costs of severe flood damage, but it is not the final solution. Working within natural processes and viewing complex river systems as both resilient and adaptive would allow a reduction in damages simply by acknowledging certain development areas are off-limits. If this were done, then the need for levees in designated floodplains would decrease, reducing the need for strong, costly levees in areas where no such floodplain can feasibly be restored. One might argue that market forces drive current development, but that is not accurate. Development occurs because the federal government has insured properties either through the NFIP or through its history of bailouts following natural disasters. The whole purpose of the NFIP was that insurance companies were no longer willing to guarantee against damages in high-risk floodplains, the natural result of market

forces. Recognizing the inherent contradictions within federal policy will help to mitigate future loss.

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