Table of Contents

Go Back

Extreme Event Policy Analysis: Identifying Stakeholders and Preferences for Natural Hazard Mitigation Policies

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Abstract

Extreme events can cause severe damage and potential harms to many people in a very short period of time. Considerable challenges confront policy makers who seek to change individual and community behaviors to mitigate disasters. Previous research efforts for extreme events and natural hazards have tested the impact of disasters on policy making by using each disaster as a discrete event, exogenous to the system. The model developed for this research develops an endogenous view of changes to extreme event policies through stock and flow feedback structures.

Floods are among the costliest natural hazards in the United States, account for the largest category of federal disaster declarations, and the hazard is broadly distributed across the United States. While the first piece of this research begins with floods, further segments will attempt to develop a generic structure for extreme event policy making and implementation. Future research will replicate this effort with other natural hazards, and with technological or social problems such as terrorism or aviation safety.

A key insight from the modeling process showed some tensions in extreme event "policy analysis." At times dominated by a traditional cost/benefit approach, these analyses leave out variables which could provide endogenous explanations for changes in policy over time. The modeling effort recognized the contributions of several disciplines that study different aspects of the "policy process." By taking a multi-disciplinary approach to extreme event policy making, this research intends to open new avenues for policy analysis.

Introduction[1]

In the summer of 1993, the United States experienced its most devastating flood in history. The Mississippi River at St. Louis, Missouri, was above flood stage for 144 days between April 1 and September 30, 1993. Over 9,300 km of levees were damaged following the 1993 flood. Although only 17 percent of the federal constructed levees failed during that summer in 1993, up to 77 percent of locally constructed levees were damaged.

The Mississippi River is one of the most heavily engineered natural features in the United States. The character of the floodplain has changed to accommodate agriculture and urbanization. Approximately 80% of the original wetlands along the river were drained since the 1940's. Wetlands act as natural storage reservoirs for floodwaters. They absorb water during heavy precipitation and release it slowly thus reducing run-off to streams and decreasing flood volumes. The river channel itself has been artificially constrained by levees and floodwalls. These structures serve to increase the volume of water that can be held in the channel and thus increase the size of the flooded area if the levee breaks.

The U.S. Army Corps of Engineers were given directions to construct flood control structures (dams, reservoirs, levees) on the Mississippi River following flood events in

[1] Data source for the introduction: David McConnell (1998). *Mississippi River Flood 1993*. University of Akron

the 1930's. Levees may fail because the flood water rises over the top of the structure or the levee collapses under the weight of the water. Levees and floodwalls protect people on the floodplain from most floods. However, they may not protect against the largest floods with recurrence intervals of more than 100 years. Floodplain residents may experience a false sense of security that can lead to more extensive development of flood prone lands (the "levee effect").

St. Louis was protected by a massive floodwall. The wall developed a leak but held up over the length of the flood. Over 50 propane tanks containing over a million gallons of gas in south St. Louis presented the threat of a massive explosion. A levee break south of the city allowed the river level to drop around St. Louis and reduced pressure on the propane tanks. Many of the smaller levees in rural areas failed.

Assessing the Damage

Approximately 10% of Midwest residents who lived in flood-prone areas had flood insurance prior to the 1993 floods. Nearly fifty people died as a result of the flooding, 26,000 were evacuated and over 56,000 homes were damaged. Economic losses that are directly attributable to the flooding totaled $10-12 billion.

The consequences of flooding were determined by land use patterns. The greatest economic losses occurred in cities on the floodplain. Des Moines, Iowa, located in the center of the flood region, became the largest U.S. city to lose its water supply when its water treatment plant flooded. More than 250,000 people lost drinking water for 19 hot summer days. Water pipes, contaminated by floodwaters carrying sewage and agricultural chemicals, had to be flushed out before the municipal water supply was reconnected. Economic losses in Des Moines totaled approximately $716 million.

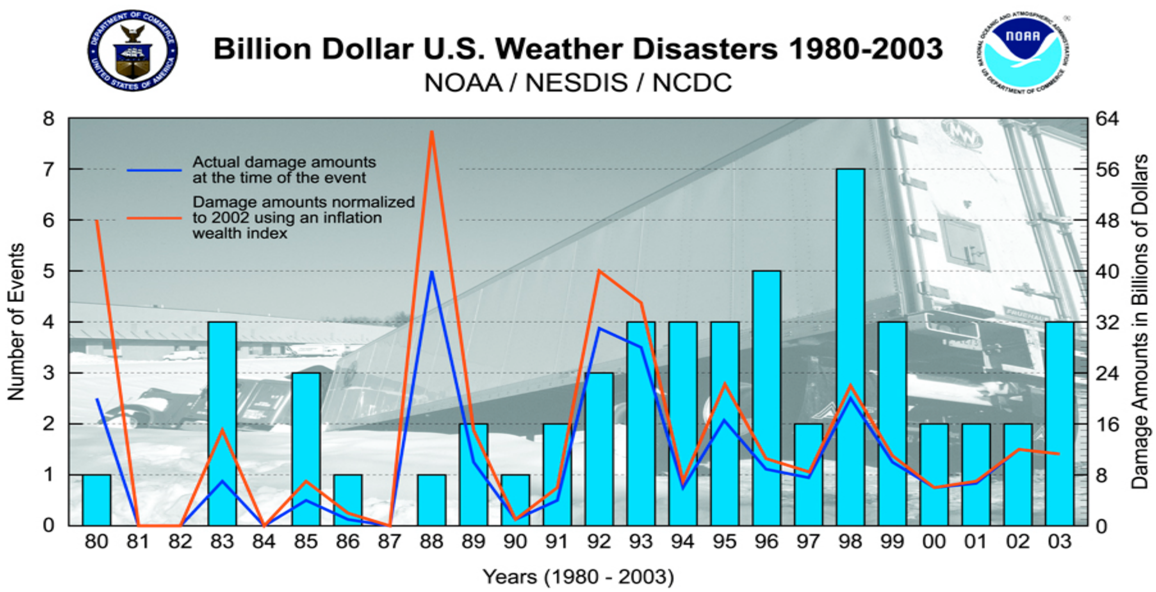
Problem Focus

Beginning with the enactment of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended in 1993 and in 2000, (codified at 42 USC 5121 et seq.) the promotion of natural hazard mitigation has been a key element of federal law.[2] Indeed, one can date federal mitigation policy to the structural requirements outlined in the National Flood Insurance Program (NFIP) as enacted in 1968 and as modified by the Flood Disaster Prevention Act of 1973 and the National Flood Insurance Reform Act (NFIRA) of 1994 (Federal Emergency Management Agency 2002). Despite these efforts, the problem appears to be getting worse. The United States has sustained 56-weather related disasters over the past 24 years in which overall damages reached or exceeded one billion dollars. The total normalized losses for the 56 events are approximately $340 billion. Of the 56 events during this 24 year period, 47 of these disasters occurred during the 1988-2003 period with total damages exceeding $210 billion.[3] Considerable

[2] Floods are among the costliest natural hazards in the United States, accounting for the largest category of federal disaster declarations (Birkland et al. 2003), and the hazard is broadly distributed across the United States. Therefore, I begin this research effort on the flood hazard. Future research will replicate this effort with other natural hazards, and with technological or social problems such as terrorism or aviation safety.

[3] Source: National Oceanic and Atmospheric Administration / U.S. Department of Commerce

challenges confront policy makers who seek to change individual and community behaviors to mitigate disasters.



Preliminary questions for consideration Are mitigation plans and policies being implemented as designed? Are mitigation efforts creating a "moral hazard" in the communities? Are there *negative externalities* for some types of mitigation?

In support of this perspective, natural hazards research has changed its focus over the years, moving from a linear disaster "stages" model (Haas, Kates, and Bowdon 1977) to a more dynamic decision-making process (Birkland et al. 2003; Mileti 1999; Rubin 1995) that more clearly reflects how preparedness, response, recovery, and mitigation are interrelated. The effectiveness of any one phase affects and is affected by the other phases (Rolfe and Britton 1995). Following the lead of prior research, the conceptual model developed for this effort represents an endogenous complex system of interactions between stakeholders who participate in several continuous processes.

<u>Initial Policy Options to be explored</u>

The natural hazard literature discusses four basic "stages" of an extreme event: preparedness, response, recovery, and mitigation. The initial policies to be explored in this conceptual model will focus on the *mitigation* stage, since these policies take the most time to develop and often have the greatest impact on a community's ability to withstand damage from an event. However, while mitigation capacity *development* and *implementation* occur in the mitigation stage, much of the *mitigation planning* may occur during recovery. In fact, the *time to develop* mitigation plans during the recovery phase vs. the *pressure to return to normalcy* may play an important role in determining how well local communities are prepared for their next event.

The model in development for this research will reflect the policy alternatives outlined below. While it is true that the federal government plays an important role in hazard mitigation, the administration of such policies happens at much lower levels of government. The conceptual model focuses on a more "community-centered" approach to hazard mitigation. In fact, mitigation requires more than federal mandates. State and localities must be involved, and success requires broad cooperation among numerous stakeholders. If these stakeholders' goals conflict with those of the proponents of mitigation, efforts to promote mitigation are likely to be thwarted. Briechle (1999) found, in general, that most stakeholder groups except building owners and managers have been more supportive than opposed to mitigation efforts, but by and large, most stakeholder groups are rated as "not involved" by local policy makers. This is consistent with generally low levels of interest in mitigation on the part of local officials (Alesch and Petak 1986; Briechle 1999), and makes for a difficult climate for mitigation to be accepted and promoted.

There are three general mitigation policy types to be explored in this model: structural policies, non structural policies and insurance policies. Each policy has several stakeholder groups that can influence or be influenced by a change in policy. In the following brief descriptions, I will identify the group that appears to be the *primary stakeholder group* for each policy alternative.

1. Structural Mitigation. These policies usually result in the strengthening of buildings and public facilities. In the cases of floods and hurricanes, this outcome can be attained a couple of ways. First, through strong implementation of improved building codes and engineering design, new and existing structures can be flood-proofed and wind-proofed. Second, this outcome can be accomplished by using structural approaches, such as flood controls (e.g., levees) and shoreline hardening to reduce risks from extreme events. The primary stakeholder groups for structural mitigation are homeowners associations and business interests (i.e., building owners) in potential hazard areas.

2. Non structural mitigation. These policies are designed to prevent development in hazard-prone areas. There are a couple of ways that a community can develop strong non structural mitigation policies. First, this outcome can be accomplished by maintaining and enhancing the functions of wetlands, dunes, and forests that reduce hazard impacts. Second, state and local governments may acquire property or development rights in hazard areas to limit development in these areas. The primary stakeholder groups for non structural mitigation include land developers and business entrepreneurs in hazard-prone areas.

3. *Hazard Insurance.* Events with low probabilities and high consequences present difficult challenges for actuarial scientists and risks analysts. Moreover, the rates resulting from these analyses are often contested and debated by land owners in the community. Insurance policies connect structural and non structural mitigation policies to assign risk to structures in hazard-prone areas. Often, as was the case in the 1993 floods, land owners do not take the proper insurance, in hopes that government relief will be available after the next event. In addition, those who take insurance and fail to maintain building code standards create an adverse selection situation for the insurer (whether it be public or private insurance). In order to maintain accurate assessments of potential damage and risk, federal and state governments attempt to provide the proper tools of implementation for building code enforcement and zoning policies in these communities. That is, where structural and non structural policies begin, insurance policies take over.

The administration of these efforts becomes a critical part in developing a community that can withstand future extreme events. The primary stakeholder groups for this policy are the insurance interests and government agencies responsible for implementing these regulations.

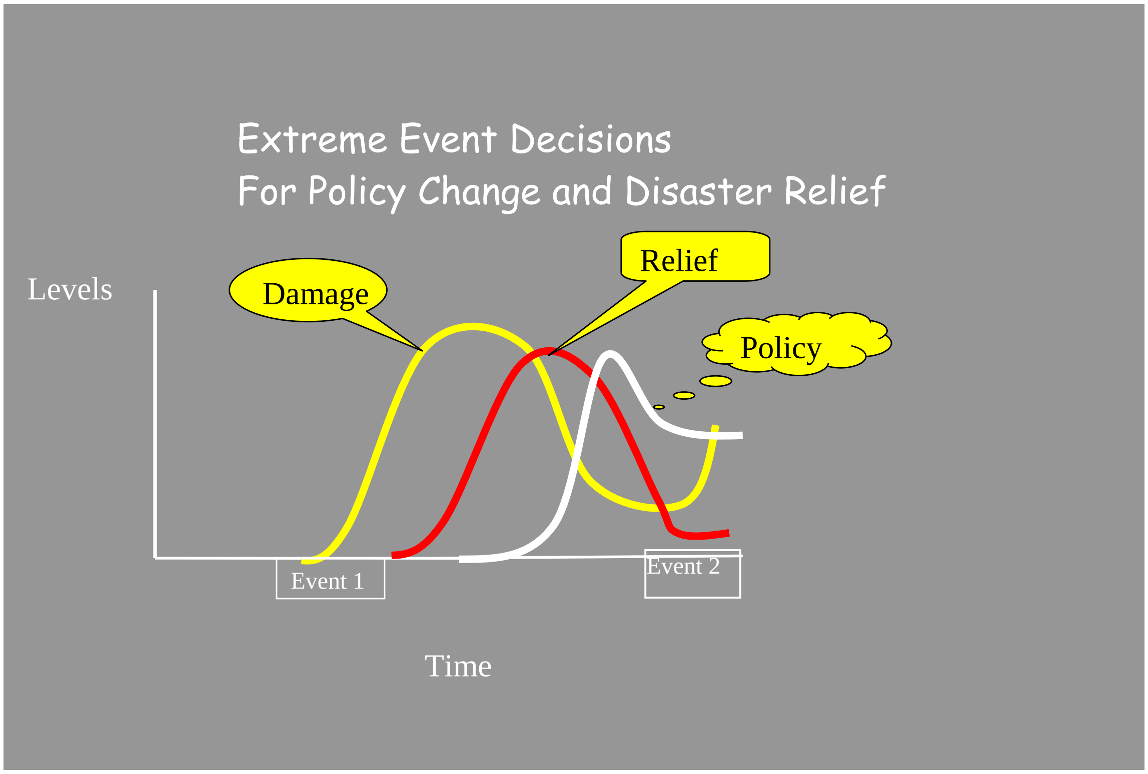
The early stages of the modeling process revealed a disconnect between traditional estimations of costs and benefits for *society* versus costs and benefits for the primary (or powerful) stakeholders in the system. Introducing political and economic power variables has slightly changed the focus of this research. In addition, examining support levels of local stakeholders helps identify which groups are more likely to participate in the process. In turn, this will help explain why some policies have the potential of sustaining commitment and capacity over time. It has been suggested that the participatory process itself may be as important as the outcomes it produces (Mileti 1999).

The Model

The hazard literature identifies a multi-faceted problem that can be rather cumbersome for any public policy analysis endeavor. To decompose the problem, the model developed for this research addresses harms and benefits for several stakeholders and interest groups in the system. This allows the analysis to compare the relative power of conflicting interests, in both policy development and implementation. There is often a tension in public policy analysis; to maintain objectivity while delivering a recommendation, influenced by the values of a single client. The model in development for this research maintains objectivity by including multiple perspectives on each potential policy *problem* and *solution* up for consideration. The research questions developed for this study identify problems which affect several key stakeholders in the system.

In the section which follows, the conceptual model will be presented in a series of causal loop diagrams. As the loops are identified, a discussion will follow on specific pieces of this multifaceted problem. Also, the research questions will be identified, as they pertain to the feedback loops in the model. In addition, relevant stakeholders will be identified, illustrating their potential political power at preliminary leverage points in the system. Finally, important stocks and flows will be identified in the model, with some discussion on how these accumulations may affect the development and implementation of hazard mitigation policies over time.

Reference Modes

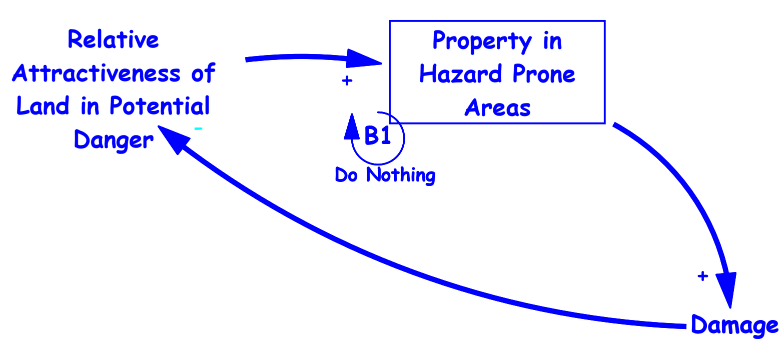


The reference mode for this model was developed from an examination of the hazard research literature. Where policies appear to "follow" an event, there is often some discussion about policy design and implementation challenges. These challenges reduce the *commitment* and *capacity* of the policy, which make the community susceptible to damage during future events. When the model is completed, actual levels of commitment and capacity will be key variables to observe under various scenario tests. However, the literature describes base case scenario, where policies after disaster are more *symbolic* than practical for implementation. In this model, symbolic policy efforts would weaken commitment and capacity over time, thus producing the "overshoot" behavior in the reference mode. As memory of the last event fades, policy goals could shift and there would be reason for commitment and capacity of local policy to slide below its optimal levels over time.

<u>Model Presentation: Causal Loop Diagrams</u>

Remembering (Forgetting) the Damage **(B1)**

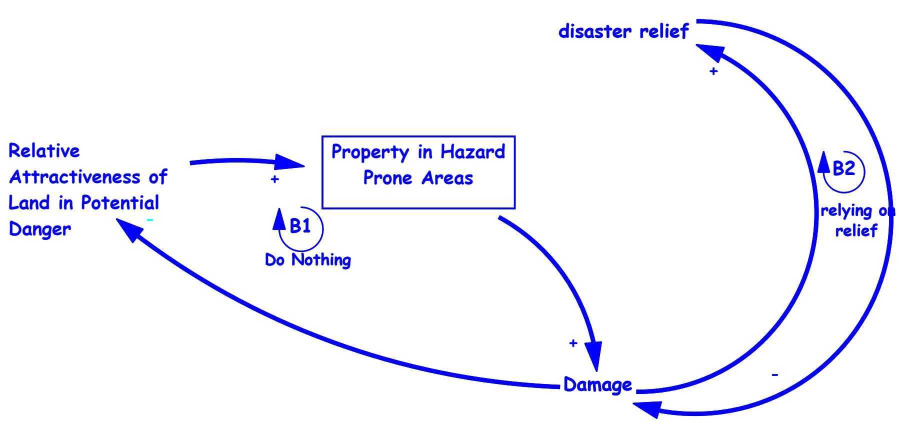
The center of this model revolves around the *Property in Hazard Prone Areas*, which can be thought of as the level of risk which a community is willing to accept. The reason for selecting natural hazards, such as floods and hurricanes, was to begin with a problem that had very little debate on the general area where danger may exist. As this model evolves into a generic structure on extreme events, a clear way to operationalize "potential danger" must develop in the modeling process. This would true especially in the case where the cause may be related to human error (e.g., oil spills) or human action (e.g., terrorism). For this first model on flooding, higher levels of risk are associated with physical location of the property. For floods, this is defined as building structures on the floodplain. For hurricanes, this is defined as building structures along the coastline.



The first loop represents what might happen if the government took no action either in preparation before or reaction to a disaster. As folks move to a hazard prone community, the probability of damage during an extreme event will increase. This will bring attention to problems in the community; in particular, in its ability to withstand damage during an event. This will decrease the relative attractiveness of the land and over time, reduce the population in potential disaster. This balancing loop would create a natural equilibrium residency level, leaving behind only those people who would be willing to withstand the impact of subsequent events. However, it is reasonable to assume that a *do nothing* policy is rare in most communities, as a primary purpose of government is to provide security to its people.

This loop also suggests that people have a *memory of recent damage*, which will impact the attractiveness of the land and their decision to leave or enter land in potential danger over time. Recent experience may influence whether or not hazard policies change, regardless of whether these changes lead to improved mitigation outcomes. The agenda setting literature suggests that natural disasters open “windows of opportunity” (Kingdon 1995), which are *potential* focusing events (Birkland 1997, chapter 2). The opening of such windows provides a decision making opportunity, but there is no linear relationship between agenda status and subsequent policy change (Zahariadis 1993). Therefore, the window may close before policies have time to develop. Research shows how memories of events fade rapidly (Birkland 1997), and local interest in hazard mitigation wanes thereafter. *Do local communities do anything to help keep this memory alive? Are there any ways to sustain interest in hazard mitigation without waiting for the next event to create a window of opportunity?*

Relying on Relief (B2)

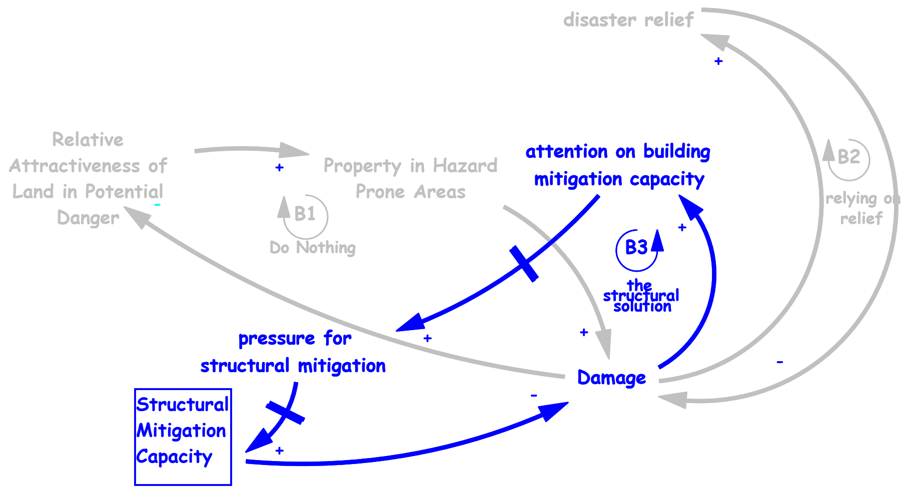


A local community in a hazard prone area, without the resources or capacity to withstand an extreme event, may be forced to rely on support outside the local community (e.g., state and federal relief funding). Such relief only provides temporary assistance to the community, designed merely to clean up the damage rather than prevent future damage. I suggest that this could be a potentially dangerous balancing loop, often providing a false sense of security and producing *short term* solutions to *long term* problems.

There is literature to suggest that certain interest groups might see this as a leverage point, especially if they can portray the damage as a *condition* rather than a *problem*. Some political constituencies deny the need for more disaster mitigation efforts (Alesch and Petak 1986; Briechle 1999; Rossi, Wright, and Weber-Burdin 1982), or believe that traditional structural mitigation policies, such as levees or other engineered solutions, are as effective as nonstructural mitigation in protecting lives and property.

The Structural solution (B3)

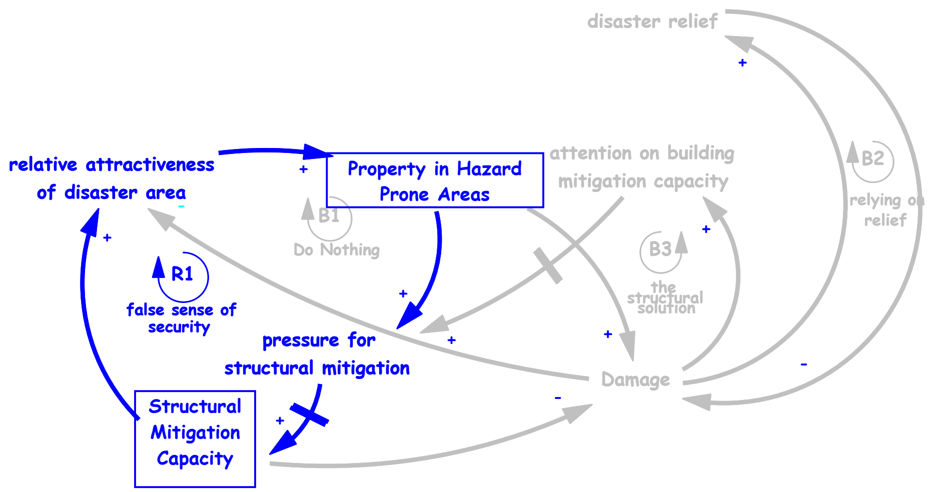
In the conceptual model under development, Structural Mitigation Capacity is a stock, with commitment to mitigation as an inflow to that stock. Implementation Challenges has been operationalized as an outflow to mitigation capacity.


disaster relief
Relative Attractiveness of Land in Potential Danger
Property in Hazard Prone Areas
attention on building mitigation capacity
B1
Do Nothing
B2
relying on relief
B3
the structural solution
pressure for structural mitigation
Damage
Structural Mitigation Capacity

Future damage can be reduced through strong structural mitigation policies. As described earlier, these structural mitigation policies include the implementation of improved building codes and engineering design. In addition, structural measures could include flood control measures, such as levees. Where mitigation planning and implementation are taken seriously, mitigation planning and plan implementation yield observed benefits (Burby 1998a; Burby 1994; Burby 1985; Burby, French, and Nelson 1998). However, there is some debate on whether this is a sound approach, as it may cause negative externalities for nearby communities. Schwab and Brower (1999) describe instances where beach property protected by groins and jetties create beach erosion for lots on the downside of the structure. In addition, the authors describe a similar danger with levees. Discharge, in excess of the river channel's normal capacity, is prevented from reaching its floodplain. In such a case, the flood waters have not been eliminated, they have merely been transferred elsewhere. The flow of water has no alternative but to continue until such place as it can either dissipate, often into the nearest community without containment works, or breach the levee, thus flooding the community it was designed to protect. At the moment, the model addresses the issue of negative externalities with a *relative attractiveness* variable. Therefore, one might imagine how communities might be forced into structural mitigation solutions just to keep up with the structures developed in other communities.

Stakeholders in the community also influence the quality of hazard mitigation policies by influencing a local community's commitment and capacity to implement mitigation policies. The definition of commitment for this model is similar to May and Birkland's definition (1994): "the will on the part of local elected officials to keep seismic safety on the governmental agenda and to work to adopt and enforce regulations." In this study, the definition is broadened to encompass floods. May and Birkland define capacity as "a function of political demand to address hazards given the general level of community resources." When a major disaster is declared, the federal government will play some role in the new policy development of a local community. However, to what degree the federal government is an active player in the process may determine how *responsible or accountable* the local community perceives itself.

False sense of security (R1): Moral Hazard with structural mitigation



The Army Corps of Engineers notes that its flood hazard mitigation efforts prevent billions of dollars in damage—$709 billion in constant dollars from 1928 to 2000 (United States Army Corps of Engineers 2001). While engineered flood control structures have clearly prevented damage from moderate floods, the Corps's estimates of the value of property protected by structural mitigation often fail to account for the extent to which flood control measures induce greater development in areas nominally protected by structures (Burby, French, and al. 1985; Stein et al. 2000; White 1945; White 1958; Wright 1996). In essence, such structural mitigation techniques may create a "moral hazard", which leads people to make inappropriate decisions based on the *sense of security* from these efforts - a sense that may, in a flood of record, be *false* (Williams 1998). The result would be fewer floods, with more damage to the community when catastrophic floods occur.

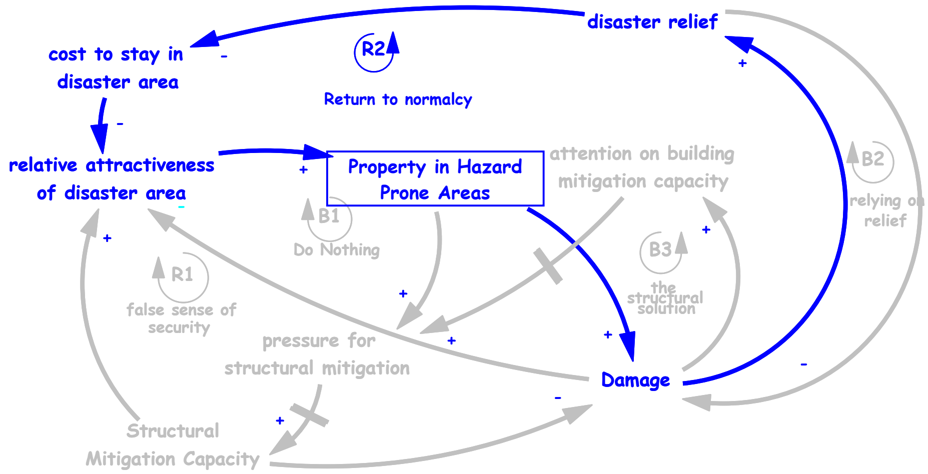
Practicing good structural hazard mitigation policies can produce a serious unintended consequence. Some structural mitigation policies increase the *relative attractiveness* of the land in hazard prone areas. That is, holding other effects constant (e.g., wages and employment), mitigation policies that focus heavily on structural mitigation policies over land use policies make the land more attractive for land developers to begin construction. The attractiveness of this land should be compared to the attractiveness of neighboring communities, either inland or beyond the floodplain.

***Return to Normalcy* (R2): the relief trap**

During the 1990s, weather related disaster relief expenditures were considerably higher than expenditures in the previous decade.[4] There is a potential danger in provided relief without providing enforceable sanctions and incentives along with it. The community may lose its *memory of the recent damage*, thus making it prone to harm in the future. This reinforcing loop keeps the perceived costs of the damage low, thus maintaining the relative attractiveness of the land. This thought sparks a few questions about the nature of the existing policy and whether or not "relief" can bring enforceable mitigation policies:

***The nature of existing policy**: Is it permissive? Prescriptive? Locally inspired? Or mandated by higher levels of government?*

[4] See the NOAA / NESDIS / NCDC timeline for a more detailed depiction of these weather related damage expenditures.

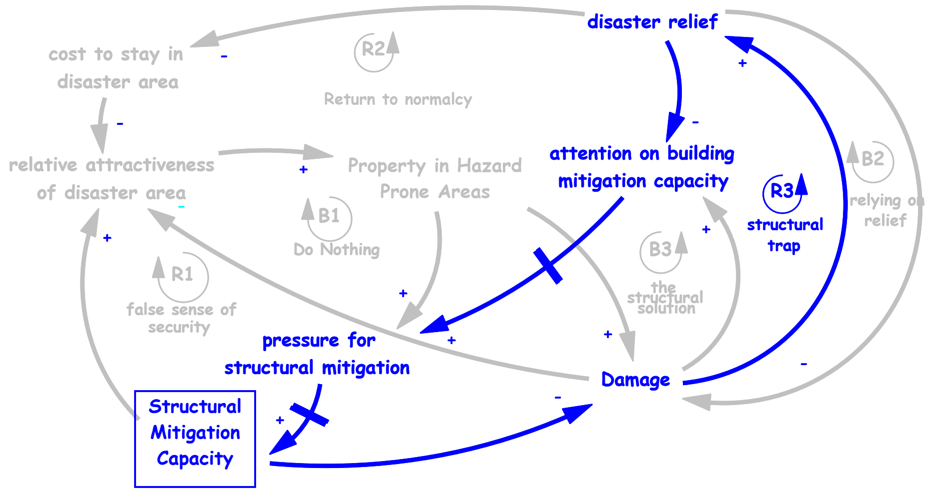


While hazards research often carries a prescriptive tone, which emphasizes a preference for non structural mitigation policies over other policy alternatives, existing policy does not necessarily reflect this prescription. Several policy implementation challenges arise if adopted mitigation policy is too lenient, is not defined well, or is not frequently updated to reflect changes in the physical and policy environment (Alesch and Petak 2001). Existing hazard policy has an important influence on the implementation of new policies and on the quality of mitigation outcomes. Research suggests that the absence of a recovery plan during a disaster often leads to sub-optimal, ad hoc decision making (Rubin 1995).

In addition, the window of opportunity affected by memories of a recent event could result from a pressure to "***return to normalcy***." Early hazard research identified this pressure as one of the strongest barriers to well-planned or implemented recovery (Haas, Kates, and Bowdon 1977). Specifically, this pressure develops immediately after disaster, where communities wish to recover as quickly as possible from the event, moving on with life as it was perceived to be, before the event (e.g., Francaviglia 1978). However, this pressure may reduce the community's attention on hazard mitigation learning, thus closing the window of opportunity prematurely. As a result, this pressure to return to normal may prevent an opportunity to develop improved non structural mitigation policies. Moreover, some research shows a tendency to relax planning, zoning and building regulations in the wake of pressure to return to the status quo ante, thereby allowing rebuilding to occur in the same disaster-prone area again (Godschalk 1985). Some indication of this pressure to return to normal could be observed through the media influence on public officials to "do something" immediately after an event (Rolfe and Britton 1995)

Structural Trap (R3)

The third reinforcing loop describes a potential problem for communities who need to take relief funds in order to build structural mitigation capacity. As stated earlier, relief often takes attention off the real problems underlying hazard damage. When this window of opportunity closes, the possibility of strong mitigation plan development is also dissipated. Without a strong plan, mitigation efforts may fade quickly and not sufficiently be able to protect the community. As a result, the community could run into this repeating "trap", where they are forced to take relief funding after each disaster, especially as memory of the damage from the last event begins to fade.


disaster relief
cost to stay in disaster area
R2
Return to normalcy
relative attractiveness of disaster area
Property in Hazard Prone Areas
attention on building mitigation capacity
R3
structural trap
B2
relying on relief
B1
Do Nothing
R1
false sense of security
B3
the structural solution
pressure for structural mitigation
Damage
Structural Mitigation Capacity

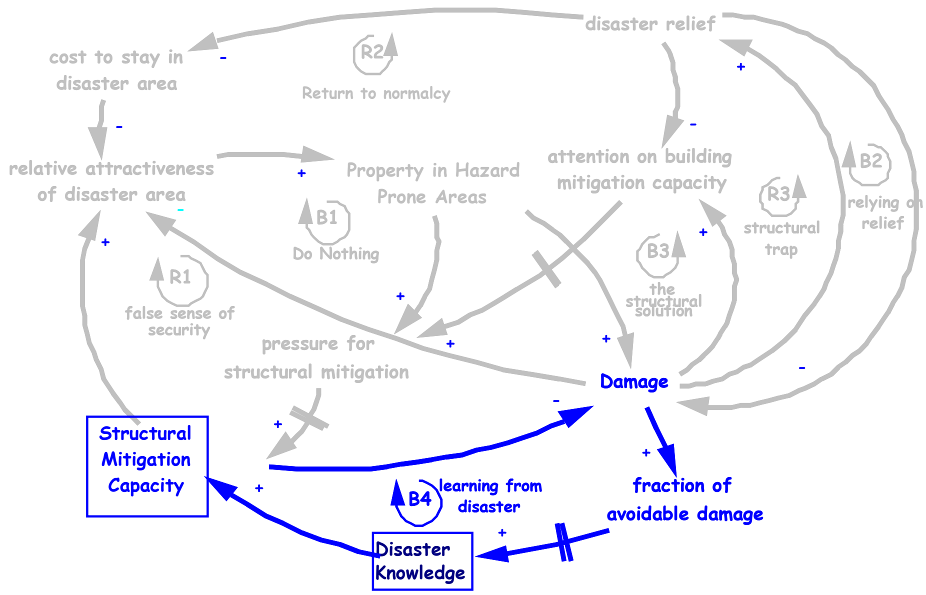
There are places in this loop which may become points of leverage for certain stakeholders and interest groups. In a moment, I will mention the effect of non-structural policies in the system. Land developers or business owners with power in the community will exercise that power by maintaining a *policy monopoly.* Such monopolies keep issues off the agenda (and preserve status quo policies) by containing the scope of the conflict (Schattschneider 1975). In this case, they could try to contain the issue by defining the problem so that the "relief solution" is perceived to be most efficient. At the same time, they could portray mitigation policies as costly alternatives whose benefits are uncertain. There is research to suggest that the community can take an active role in the process to increase its organizational capacity (Berke, Kartez, and Wenger 1993), and that communities should not rely solely on federal assistance, especially where federal policies promote structural mitigation policies and incentives for land development in hazard-prone areas over non structural land use policies (Burby 1998b).

Learning from Disaster (B4)

Perhaps one of the most important loops in model is the *Learning from Disaster* balancing loop. How much is learned from the most recent event will certainly impact the quality of future hazard mitigation research. Therefore, ***Disaster Knowledge*** becomes an important stock in this model, with *learning* as its inflow and the time to forget or fraction of research not used for mitigation development, as an important factor on the outflow. Perhaps slightly more difficult to conceptualize but still worth mentioning is the learning that happens from other communities damaged during an extreme event. This is addressed in model by including a *willingness to learn* from other communities as an influence on the inflow to the stock of *knowledge.*

Where these plans do exist, it may be wise to observe whether these plans were inspired locally or in response to a federal mandate. Research suggests that locally based, bottom-up approaches are preferred to the top-down mandates from the federal government (Geis 1996; Spangle 1991).

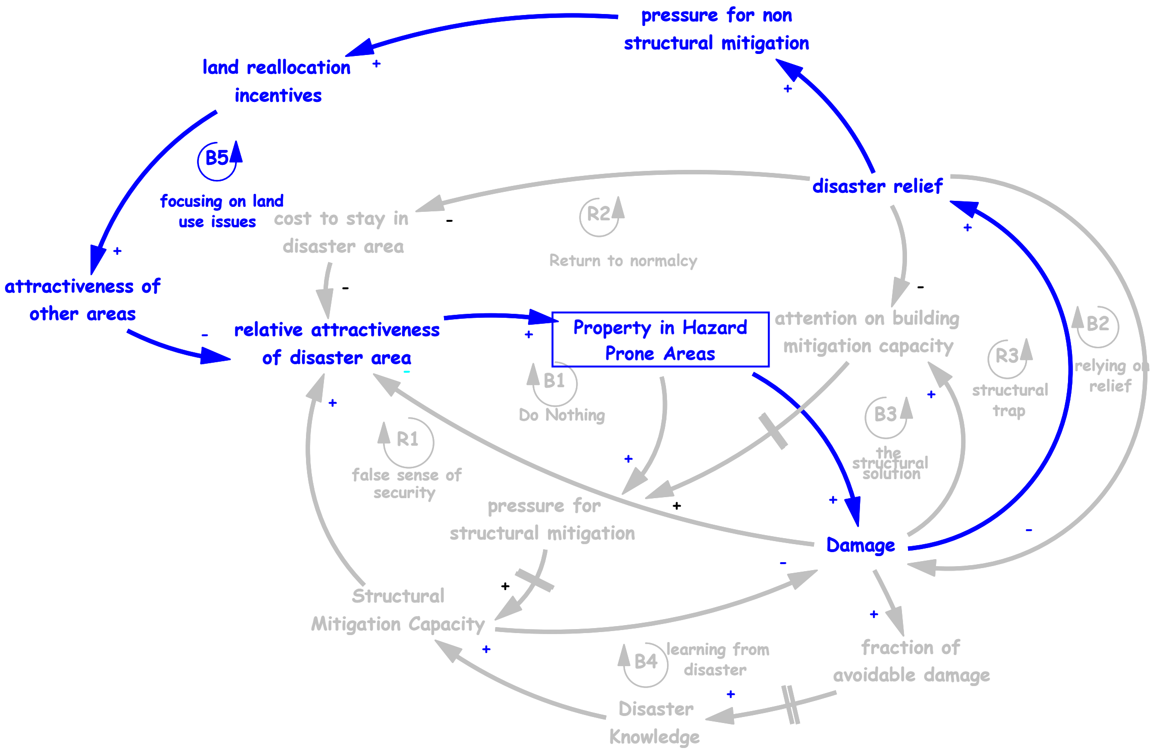
Natural hazard experience: *how long a period has passed between major disasters, or since the last major one in a community? How large were these disasters? Did existing structural and nonstructural mitigation techniques mitigate the hazard? If not, what techniques were adopted as result of the hazard?*



A community's experience with natural disasters creates a "window of opportunity" for learning that may result in development of improved disaster management and mitigation policies for the future, (Berke and Beatley 1992, 258), although such windows may close rapidly (Berke and Beatley 1992, 258) and research is not conclusive as to whether individuals or communities learn from disaster experience (Banerjee and Gillespie 1994; Dahlhamer and D'Souza 1997). This model will be used to assess whether disaster experience influences policy. That is, the quality of disaster learning will determine how quickly *knowledge* accumulates and how long it takes for this knowledge to be used effectively in mitigation planning. The quality of the experience gained from an event will possibly relate to the frequency or severity of the event**.** The learning process involves some understanding of how well current policies performed during the last event. Two ways to measure the success of structural and non structural mitigation policies might be to identify the level of damage, along with the specific types of damage that occurred during the event. Evidence of whether a community learns from problems, which caused damage in a recent hazard, can be identified by examining the structural and non-structural techniques adopted after the event. Such measures would provide at least a prima facie case for experience-triggered policy learning (May 1992).

Focus on Land use Issues (B5)

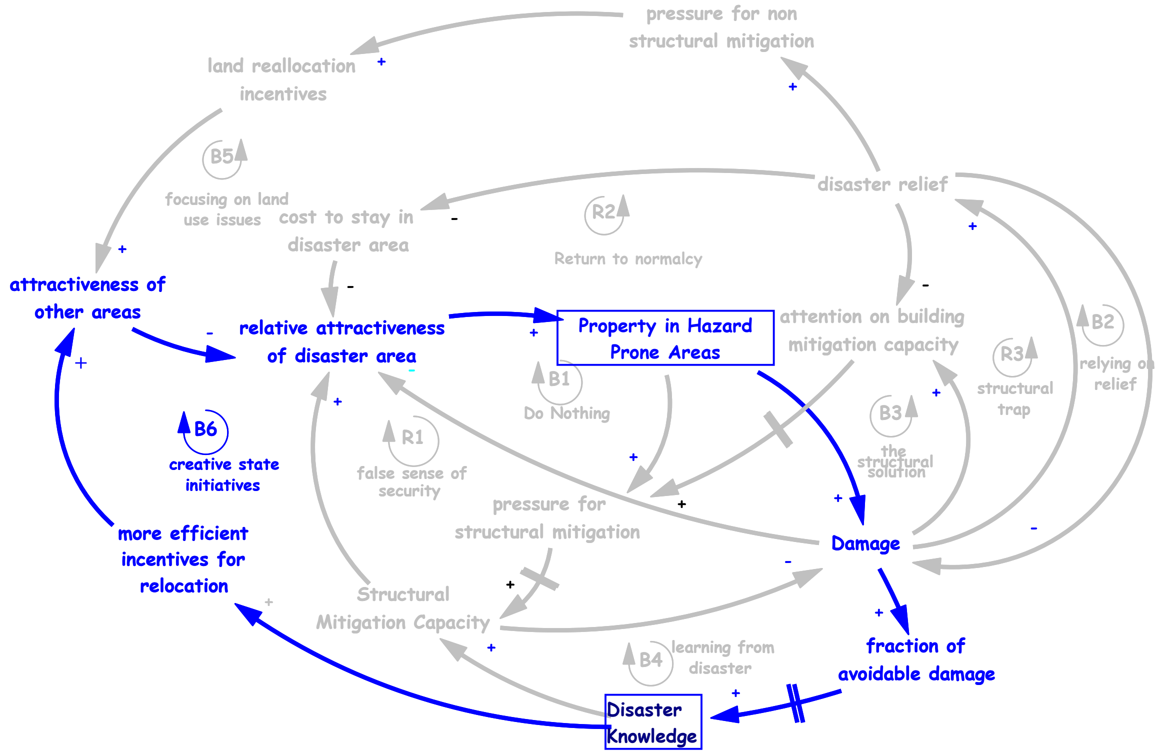
Non structural mitigation policies focus on land use issues (e.g., zoning, land development etc.). The literature suggests that these policies are the most effective ways to eliminate the threat of damage during a natural hazard. Since the 1993 floods, Iowa has removed more than 1,000 properties from flood hazard areas and protected over 20 critical facilities, such as hospitals. During repeat floods in 1999, the state of Iowa projects the benefit from just one project in Cedar Falls to be over $6.6 million in avoided damages (FEMA 2000).



The *Focus on Land Use Issues* balancing loop shows what might happen if government relief policies required enforceable incentives and sanctions for non structural policies. In reality, one might expect some heavy resistance from land developers and business owners. The path that policy takes from *disaster relief* is an important point of leverage in this model. If the problem is defined as one where people living in potential hazard have not been "protected", then structural mitigation solutions might dominated the agenda. However, if the problem is defined as a poor use of land or negligence in any way by folks living in potential hazard, then a fraction of the attention can go towards non structural mitigation policy. As a result, we would see some interesting behavior in the model. The pressure from mitigation policies to make other locations more attractive would reduce the potential for future damage. As a point of leverage, groups who wish to develop on hazard-prone land might also try to slow the implementation of these policies. An effective strategy to delay implementation would give the perception that the non-structural policies had failed. This observation during conceptualization sparked another question for this research.

Behaviors: *Does individual and community behavior with respect to development decisions change as a result of local implementation planning?*

***Creative State Initiatives* (B6)**

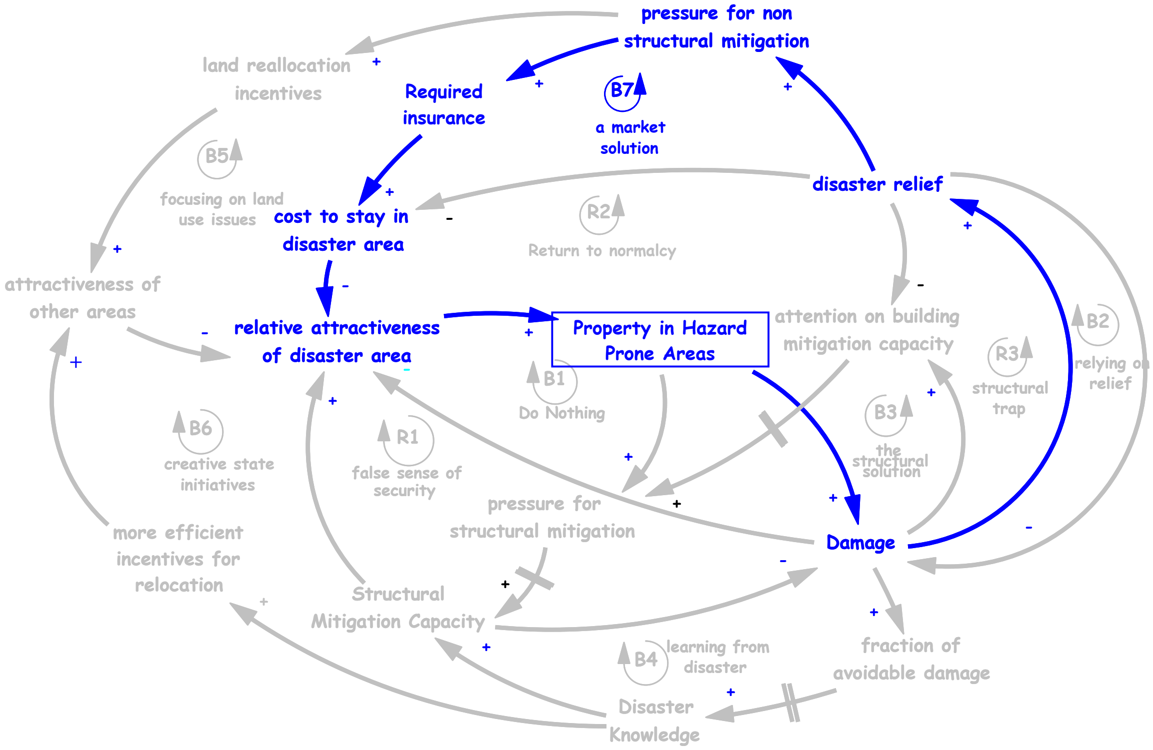


There is some debate over how well communities learn from natural hazard experience. However, during those events where opportunities for learning exist, the results could lead towards more creative and effective incentives and sanctions to control population growth in hazard areas. The balancing loop described here also represents learning from the *implementation challenges* in the system. Therefore, over time, a community with more "experience" might have betters ways to address the implementation issues for new alternatives under consideration.

Disaster Knowledge plays an interesting role in this system. Of course the accumulation of knowledge is critical to the success of any policy. However, how that knowledge is used can drive a loop to the point where one policy dominates over time. The positive effect of a disaster comes from learning after disaster. Once again, depending on the constituencies involved, knowledge can bring better incentives to make surrounding areas more attractive. Knowledge for *creative state initiative* allows the model to explore options that may be difficult to implement, especially where the land in potential hazard is an attractive place for development. The challenge comes when knowledge gained from disaster experience is rather technical and difficult to use or apply in "creative" non structural public policies.

Moreover, the nature of the policy can influence the policy environment. For example, there is substantial research to suggest that the public involvement is rather low in policies (e.g., hazard mitigation) that require technical decision making (Birkland 1996a; Birkland 1996b; Day 1997; Goldschalk 2003; Williams et al. 2001). This model will measure the relative stakeholder pressures and levels of involvement that will ultimately influence the level of capacity and commitment for hazard mitigation policies.

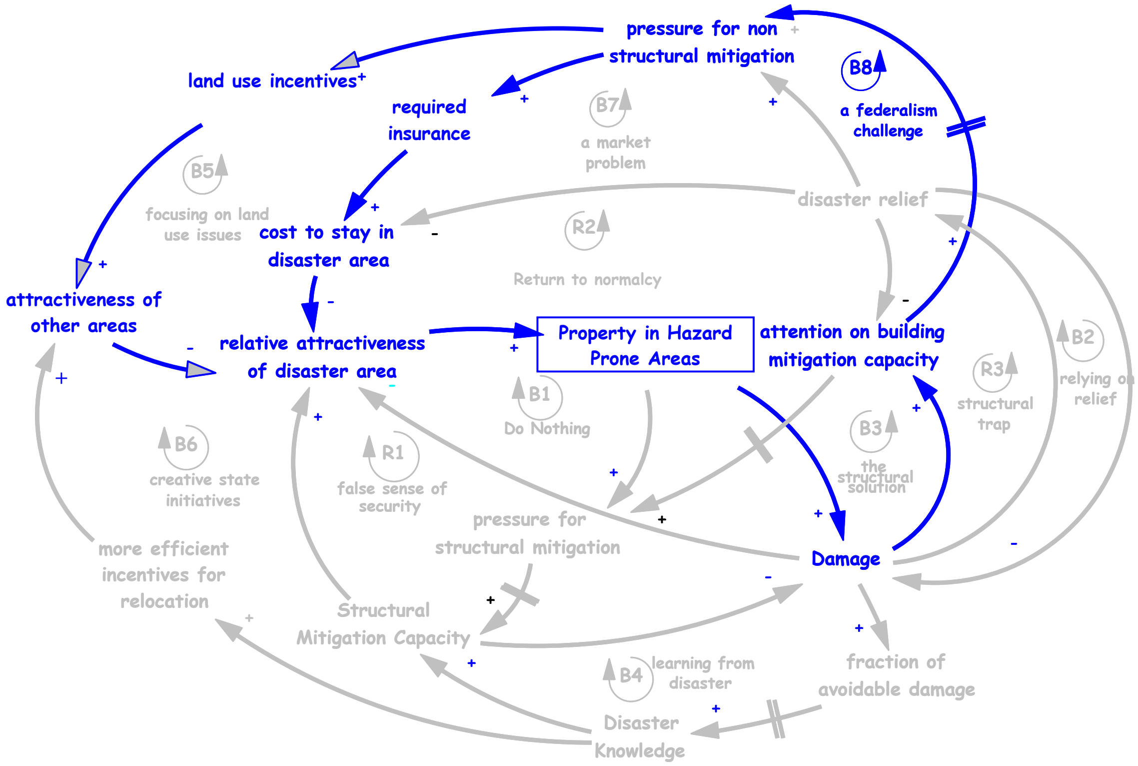
***Insurance/ Market solutions* (B7)**



The *market solution* in this case would be to allow homeowners and businesses to build in potential hazard locations, as long as they were willing to take the proper insurance and keep their building structures up to building code. This becomes a difficult policy to enforce. In the case of the Midwest floods of 1993, only 10% of the residents who lived in flood-prone areas had the proper insurance prior to the floods. Once again, the question falls back on implementation. To what degree can government intervene to help compliance of non-structural and insurance policies? At what point must the government just let go and allow the market to correct itself. From a *policy process* perspective, does the definition of the problem change over time to reflect the state and local government's perception of risk in its community?

In some cases, local government policy change is the result of mandates by the state or federal government (Berke and French 1994; Berke et al. 1996; Dalton and Burby 1994; Deyle and Smith 1995; May 1993; May 1994; May 1995; May and Birkland 1994). Other research suggests that the level of support for mitigation policies is characterized by an ongoing relationship between public and private stakeholders and their perception of the ***potential risk*** of a natural hazard (Alesch and Petak 2001). Therefore, if this perception of risk were to change over time, the specific policies pursued (e.g., non structural or structural mitigation) would also change.

Federalism challenge **(B8)**



A federalism challenge exists for implementation of non structural policies, and building commitment and capacity for such policies during times when the memory of damage has begun to fade. If the federal government wishes to minimize relief payments, it will apply pressure (incentives or sanctions) on the states and local governments who wish to use non structural policies. Once again, the real issue is whether these policies can be sustained over time and whether a lack of commitment to these policies will force different levels of government to abandon such policies. More questions evolved from the modeling process at this point.

The policy environment: *does the federal government actively encourage state and local governments to pursue mitigation? Do these levels of government work to build capacity and commitment at the local level? Do local stakeholders support or approve of efforts to mitigate hazards?*

A serious problem exists with respect to compliance of federal regulations. Godschalk et al. (1998) found that most state mitigation plans prepared under section 409 of the original Stafford Act were unconnected with the actual activities funded under section 404 of that act. With this in mind, the drafters of the Disaster Management Act (DMA) of 2000 required local governments to develop local mitigation plans to complement the State Mitigation Plans (Srinivasan 2003). This is particularly important if localities wish to receive pre-disaster mitigation funds made available in the DMA. In 2002, FEMA extended the deadline for the preparation of these plans to December 2004. Such plans are required if a community is to receive Hazard Mitigation Grant Program (HMGP) funds provided under the Stafford Act.

Discussion: Insights from the Modeling Process

The preliminary work conducted for this study used the extant literature on hazard research to build a conceptual model. This approach revealed potential problems in traditional public policy analysis. The multi-faceted problem presented in the literature describes circumstances where benefits are concentrated to small groups but the costs are dispersed among large groups of people. For example, in the case of floods, people who live on floodplains receive concentrated relief benefits, while the cost of relief is dispersed over an entire state (or nation) of taxpayers. These *distributive* policies are usually rooted in *client-oriented politics.*

The modeling process reveals a flaw in "traditional" policy analysis. Without some understanding of the policy process, it is difficult to know exactly how a community would be able to sustain such policies over time. This weakness in policy analysis is recognized because of the unique way system dynamicists conceptualize problems. These political forces, which rise and fade over time, are more noticeable in a model that provides an endogenous explanation of the behavior of key variables, such as commitment, capacity and knowledge at the community level.

There are several key concepts of the *policy process* that were highlighted in the model presentation. These concepts were necessary to help understand flaws in more traditional cost/benefit analysis. Costs and benefits need to be more specific for an analysis of public policy. There needs to be some recognition of political costs and benefits in any policy analysis model. A traditional cost/benefit analysis might leave out interest group influence on the ranking of alternative solutions. It might neglect to show how *policy monopolies* form to preserve a status quo policy. In addition, there are also important costs and benefits when there is issue expansion, which often redefines the problem over time. In summary, a more traditional policy analysis often leaves out interest group pressures that might affect leverage points in the system. This system dynamics conceptual model allows the analyst to represent theories of the policy process, traveling beyond the scope of traditional cost / benefit analysis and entering a *multi-disciplinary approach* to public policy analysis.

Of course, this work is still in its infant stages. This research will benefit from a deeper conceptual framework on the policy process. This might be done by including additional structures to represent the influence of *policy entrepreneurs* and *group mobilization* on extreme event policy and decision-making. There is an important question for future research. Do we find new or different points of leverage when we include stock and flow feedback structures for the *policy process*?

References

Alesch, Daniel J. , and William J. Petak. 1986. *The Politics and Economics of Earthquake Hazard Mitigation*. Boulder, Colo.: Institute of Behavioral Sciences, University of Colorado.

Alesch, Daniel J., and William J. Petak. 2001. Overcoming Obstacles to Implementation: Addressing Political, Institutional and Behavioral Problems in Earthquake Hazard Mitigation Policies. Buffalo, New York: MCEER.

Banerjee, Mahasweta-M., and -David-F. Gillespie. 1994. Strategy and Organizational Disaster Preparedness. *Disasters* 18 (4):344-354.

Berke, Philip, and Steven French. 1994. The Influence of State Planning Mandates on Local Plan Quality. *Journal of Planning Education and Research* 13 (4):237-250.

Berke, Philip R. , and Timothy Beatley. 1992. *Planning for Earthquakes: Risk, Politics and Policy*. Baltimore: Johns Hopkins University Press.

Berke, Philip R., Jack D. Kartez, and Dennis E. Wenger. 1993. Recovery after Disaster: Achieving Sustainable Development, Mitigation and Equity. *Disasters* 17 (2):93-109.

Berke, Philip, Dale Roenigk, Edward J. Kaiser, and Raymond Burby. 1996. Enhancing Plan Quality: Evaluating the Role of State Planning Mandates for Natural Hazard Mitigation. *Journal of Environmental Planning and Management* 39 (1):79-96.

Birkland, Thomas A. 1996a. Factors Inhibiting Comprehensive Federal Hurricane Policy. Paper read at The Coastal Society, July 14-17, 1996, at Seattle, WA.

Birkland, Thomas A. 1996b. Natural Disasters as Focusing Events: Policy Communities and Political Response. *International Journal of Mass Emergencies and Disasters* 14 (2):221-243.

Birkland, Thomas A. 1997. *After Disaster: Agenda Setting, Public Policy and Focusing Events*. Washington, D.C.: Georgetown University Press.

Birkland, Thomas A., Raymond J. Burby, David Conrad, Hanna Cortner, and William K. Michener. 2003. River Ecology and Flood Hazard Mitigation. *Natural Hazards Review* 4 (1):46-54.

Briechle, Kendra J. 1999. Natural hazard mitigation and local government decision making. In *The Municipal Yearbook 1999*. Washington, DC: International City/County Management Association.

Burby, R. J. 1998a. Cooperating with Nature: Confronting Natural Hazards with Land use Planning for Sustainable Communities. In *Cooperating with Nature: Confronting Natural Hazards with Land use Planning for Sustainable Communities*. Washington, D.C.: Joseph Henry Press.

Burby, Raymond J, ed. 1998b. *Cooperating with nature: Confronting natural hazards with land use planning for sustainable communities*. Washington, D.C.: Joseph Henry/National Academy Press.

Burby, Raymond J. and Linda C. Dalton. 1994. Plans can matter! The role of land use plans and state planning mandates in limiting the development of hazardous areas. *Public Administration Review* 54(3): 29-238.

Burby, Raymond J. and Stephen P. French. 1985. State and Regional Approaches to Flood Plain Land Use Management. In *Flood Plain Land Use Management: A National Assessment*. Boulder: Westview Press.

Burby, Raymond J., Steven P. French, and et al. 1985. *Flood Plain Land Use Management: A National Assessment.* Boulder, Colo.: Westview.

Burby, Raymond J., Steven P. French, and Arthur C. Nelson. 1998. Plans, code enforcement, and damage reduction: evidence from the Northridge earthquake. *Earthquake Spectra* 14 (1):59-74.

Dahlhamer, James-M., and Melvin J. D'Souza. 1997. Determinants of Business-Disaster Preparedness in Two U.S. Metropolitan Areas. *International Journal of Mass Emergencies and Disasters* 15 (2):265-281.

Dalton, Linda C., and Raymond Burby. 1994. Mandates, Plans and Planners: Building Local Commitment to Development Management. *Journal of the American Planning Association* 60 (Autumn):444-461.

Day, D. 1997. Citizen participation in the planning process: an essentially contested concept? *Journal of Planning Literature* 11 (3):421-434.

Deyle, Robert E., and Richard Smith. 1995. State Planning Mandates and Coastal Hazards: An Analysis of the Response of Florida Communities. Paper read at 37th Annual Conference of the Association of Collegiate Schools of Planning, October 19-22, 1995, at Detroit.

Federal Emergency Management Agency. 2002. National Flood Insurance Program: Program Description. Washington: FEMA. Internet: http://www.fema.gov/doc/library/nfipdescrip.doc. Accessed November 21, 2003.

FEMA. 2000. Planning for a Sustainable Future: The Link Between Hazard Mitigation and Livability. Washington, D.C.: FEMA.

Geis, Donald E. 1996. *Creating Sustainable and Disaster Resilient Communities*. Aspen, Colorado: The Aspen Global Change Institute.

Godschalk, David, Timothy Beatley, Philip Berke, David J. Brower, and Edward J. Kaiser. 1998. *Natural Hazard Mitigation*. Washington D.C.: Island Press.

Goldschalk, D.R. 2003. Urban hazard mitigation: creating resilient cities. *Natural Hazards Review* 4 (3):136-143.

Haas, J.E., R. Kates, and M. Bowdon, eds. 1977. *Reconstruction Following Disaster*. Cambridge: MIT Press.

Kingdon, John W. 1995. *Agendas, Alternatives and Public Policies*. 2nd ed. New York: Harper Collins.

May, Peter J. 1992. Policy Learning and Failure. *Journal of Public Policy* 12 (4):331-354.

May, Peter J. 1993. Mandate Design and Implementation: Enhancing Implementation Efforts and Shaping Regulatory Styles. *Journal of Policy Analysis and Management* 10 (2):634-663.

May, Peter J. 1994. Analyzing Mandate Design: State Mandates Governing Hazard-Prone Areas. *Publius: The Journal of Federalism* 24 (Spring):1-16.

May, Peter J. 1995. Can Cooperation be Mandated? Implementing Intergovernmental Environmental Management in New South Wales and New Zealand. *Publius* 25 (1):89-113.

May, Peter J., and Thomas A. Birkland. 1994. Earthquake Risk Reduction: An Examination of Local Regulatory Efforts. *Environmental Management* 18 (6):923-939.

Mileti, Dennis S. 1999. *Disasters By Design: A Reassessment of Natural Hazards in the United States*. Washington: Joseph Henry Press.

Rolfe, Jim, and Neil Britton. 1995. Organization, Government and Legislation: Who Coordinates Recovery? In *Wellington After the Quake: The Challenges of Rebuilding Cities*. Wellington, New Zealand: Wellington Earthquake Commission and the Centre for Advanced Engineering.

Rossi, Peter H., James D. Wright, and Eleanor Weber-Burdin. 1982. *Natural Hazards and Public Choice: The State and Local Politics of Hazard Mitigation*. New York: Academic Press.

Rubin, Claire B. 1995. Physical Reconstruction: Timescale for Reconstruction. In *Wellington After the Quake: The Challenge of Rebuilding Cities*. Wellington, New Zealand: Wellington Earthquake Commission and the Centre for Advanced Engineering.

Schattschneider, E. E. (1975). The Semisovereign People. Hinsdale, Ill, The Dryden Press.

Schwab, Anna K. and David Brower. 1999. *Sustainable Development and Natural Hazards Mitigation*. Raleigh, North Carolina: The Mitigation Initiative Group.

Spangle, William & Associates, Inc. 1991. *Rebuilding After Earthquakes: Lessons from Planners*. Portola Valley, California: William Spangle & Associates, Inc.

Srinivasan, Deepa. 2003. Battling Hazards with a Brand New Tool. *Planning* 69 (2):10-13.

Stein, Jeff, Peter Moreno, David Conrad, and Steve Ellis. 2000. *Troubled Waters: Congress, the Corps of Engineers, and Wasteful Water Projects*. Washington: Taxpayers for Common Sense and National Wildlife Federation.

United States Army Corps of Engineers. 2001. Corps Facts: Civil Works FY 2001 Program Statistics. Internet: http://www.hq.usace.army.mil/cepa/pubs/cwstats.htm. Accessed November 20, 2003.

White, Gilbert F. 1945. *Human Adjustment to Floods: A Geographical Approach to the Flood Problem in the United States*. Vol. Research Paper No. 29. Chicago: University of Chicago Department of Geography.

White, Gilbert F. 1958. *Changes in the urban occupancy of flood plains in the United States*. Chicago: Department of Geography, University of Chicago.

Williams, B.L., H.K. Suen, S. Brown, R. Bruhn, R.D. Blaquiere, and S.E. Rzasa. 2001. Hierarchical linear models of factors associated with public participation among residents living near the U.S. Army's chemical weapons stockpile sites. *Journal of Environmental Planning and Management* 44 (1):41-65.

Williams, Philip. 1998. Inviting trouble downstream. *Civil Engineering* 68 (2):50-54.

Wright, James M. 1996. Effects of the Flood on National Policy: Some Achievements, Major Challenges Remain. In *The Great Flood of 1993: Causes, Impacts and Responses*, edited by S. A. Chagnon. Boulder, Colo.: Westview.

Zahariadis, Nikolaos. 1993. To Sell or Not to Sell? Telecommunications Policy in Britain and France. *Journal of Public Policy* 12 (4):355-376.