Are We Learning to Make Better Plans?
A Longitudinal Analysis of Plan Quality Associated With Natural Hazards

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Abstract

Research examining the quality of local planning almost always treats plans and planning problems as isolated incidents occurring in the spectrum of public decision making. However, comprehensive plans and similar policy statements are in fact evolving instruments that undergo continual revisions and updates. Planning is an iterative approach to policy-making where communities seek to improve their plan's ability to address problems, particularly those that are recurring such as natural hazards events. This article examines the degree to which the quality of local plans change over an eight-year period with respect to natural hazards mitigation. Sixty local jurisdictions in Florida and Washington were sampled in 1991 and again in 1999 to determine the extent to which their plans' hazard mitigation components have changed and to identify the factors driving communities to adopt stronger hazard mitigation policies. Results indicate the plans of local jurisdictions improved over the study period and that several factors such as legal reform, repetitive damage to property, and citizen participation facilitate an adaptive learning process. Based on these results, this article discusses policy implications and provides recommendations for improving the learning capabilities of local communities to prepare plans that prevent natural hazards.

Introduction

While there is a growing body of research examining the quality of local planning, these studies almost always treat plans and planning problems as isolated incidents occurring in the spectrum of public decision-making. However, comprehensive plans and similar policy statements are evolving instruments that undergo continual revisions and updates. Plans must constantly adapt over time to the needs, knowledge base, and experiences of a particular community. Since comprehensive planning is, in reality, an iterative approach to policy-making, it is the goal of every community to improve its plan's ability to address problems, particularly those that are recurring such as floods, hurricanes, landslides, and other natural hazards. Scholars and practitioners, primarily due to data constraints, rarely study the question of whether planners are learning over time. A better understanding of the pace in which planners learn and the major factors driving this learning process will promote a more rapid improvement in the quality of adopted plans.

This article examines the degree to which the ability of local plans to mitigate natural hazards changed over an eight-year period. Conclusions are drawn from a multi-state study on hazards planning using longitudinal data to measure the change in the content and quality of comprehensive plans. A sample of sixty local jurisdictions in Florida and Washington were evaluated in 1991 and again in 1999. Analyses determined the extent to which the hazard mitigation components in the comprehensive plans for each jurisdiction have changed and identified the factors driving communities to adopt stronger hazard mitigation policies. Results indicate that the plans of local jurisdictions have improved over the study period and that factors such as legal reform, repetitive damage to property, and citizen participation facilitate an adaptive learning process.

The following section conceptualizes plan quality for hazard mitigation and identifies important explanatory variables based on past studies. The principles of adaptive management and policy learning are then presented as a theoretical framework for understanding how communities alter or adjust their plans over time. The next section describes the sample selection and data collection procedures used for this study. Findings are then reported in two phases. Phase one examines the degree to which plans have changed in terms of their ability to mitigate natural hazards. The second phase identifies the most significant factors explaining this change. Based on the results, policy implications and recommendations are suggested for improving the learning capabilities of local communities to prepare plans that prevent natural hazards.

Conceptualizing Plan Quality For Hazard Mitigation

The notion that a plan can indicate both the quality of the planning process and the strength of implementation has emerged in recent years (Talen, 1996; Hoch, 1998). Baer (1997) sets forth a conceptual model called "plan evaluation" and identifies a set of criteria for systematically evaluating plans. He focuses on a plan as a product or outcome of the planning process, as well as a blueprint for future actions. Chapin and Kaiser (1979; and Kaiser, Godschalk, and Chapin, 1995) identified the core characteristics of plan quality: a strong factual basis, clearly articulated goals, and appropriately directed polices. Specifically, the fact base refers to the existing local conditions and identifies the needs related to community physical development. Goals represent aspirations, problem abatement, and needs that are premised on shared values. Finally, policies are a general guide to decisions (or actions) about the location and type of development to assure that plan goals are achieved (Berke and French, 1994). These plan components can be measured through a series of indicators or issues which allow for quantitative assessment and analysis of plan quality.

Subsequent empirical studies have applied these core characteristics of plan quality primarily to natural hazard mitigation. Burby et al. (1997) studied local efforts to plan for and mitigate natural hazards in five states: North Carolina, Florida, California, Texas, and Washington. The study used the planning characteristics to determine if state mandates have an influence on plan quality. This work spawned additional articles that focused on the link between mandates and the quality of local plans (Burby and Dalton, 1994; Berke and French, 1994; Berke et al., 1996; Burby et al., 1997). These articles made important advances in understanding how to conceptualize and measure the quality of a local comprehensive plan as it applies to reducing the adverse effects of natural hazards such as floods, hurricanes, and earthquakes. In addition to clarifying how to measure plan quality, these studies yielded insights into the influences on plan quality. For example, Berke et al. (1996) examined the influence of commitment to planning and wealth on plan quality associated with natural hazards. Berke et al. (1998) examined the effects of population, while Burby and May (1998) looked at the significance of planning agency capacity on natural hazards plan quality.

Plan quality is increasingly being used both as an outcome variable for assessing the planning process and as a causal variable for assessing the plan implementation process. The ability to code and measure indicators within a plan has made it a widely used instrument with which to quantitatively assess the quality of management efforts. While previous research provides a conceptual and methodological basis for determining the quality of a plan, no study to date has examined how and why plan quality changes over time. Understanding how communities learn and adapt to changing physical and socioeconomic conditions may provide important insights into how plan quality can be strengthened to address repetitive hazardous events more effectively.

Policy Learning and Adaptive Management

An adaptive approach to management is considered by many scholars to be one of the most effective frameworks for facilitating policy learning (Holling, 1978; Schon, 1983; Lee, 1992). Planners must be able to react to constantly changing environmental conditions, sudden shifts in political interests and objectives, and a continuous barrage of new and often ambiguous information. Hazard mitigation plans and policies thus need to be flexible instruments, geared toward uncertainty and surprise. Adaptive management is an evolving concept in which policies are designed as hypotheses and management is implemented as experiments to test those hypotheses. In most cases, hypotheses are predictions about how existing conditions will respond to management actions. The rule of good experimentation, however, is that the consequences of the actions be potentially reversible and that the experimenter learns from the experiment (Holling, 1996). For example, development prohibitions in flood-prone areas can be designed in an experimental fashion. If a policy succeeds in meeting its objectives, the hypothesis is affirmed and human safety is protected. If the policy fails, an adaptive design still permits learning so that future decisions can proceed from a better base of understanding. In this sense, experiments often bring surprises, but "management is recognized to be inherently uncertain, the surprises become opportunities to learn rather than failures to predict" (Lee, 1993: p.56). By embracing the experimental ideals of basic science, adaptive management better equips planners and their organizations to deal with changing socioeconomic, demographic and physical conditions across the landscape.

In its broadest sense, adaptive management ensures that organizations responsible for adopting plans are responsive to the variations, rhythms, and cycles of change in the system (both ecological and human) and are able to react quickly with appropriate management techniques (Westley, 1995). The process is relatively straightforward: new information is identified, evaluated, and used to adjust strategies or goals (Lessard, 1998). Adaptive management is a continuous process of action-based planning, monitoring, researching and adjusting with the objective of improving future management actions (Holling, 1995). The result is organizational processes that place less emphasis on exercising control and manipulating resources and more emphasis on enabling responsive action (Lee, 1993).

May (1992a; 1992b; 1998) describes adaptive management as an "instrumental" form of policy learning where the planner takes a rational-analytic view to improve designs for reaching existing policy goals. Instrumental learning results from feasibility testing of policy interventions or conducting systematic policy experiments. In many cases, however, instrumental lessons are less rigorously drawn from others' experience or the results of trial and error experimentation. Instrumental policy learning is closely aligned with learning in the theory of the state (Hall, 1993). Based on the work of Heclo (1974), Sacks (1980), and others, the most important influence in this type of learning is previous policy. The goals and objectives that policymakers pursue at any given time are largely influenced by "policy legacies" or "meaningful reactions to previous policies" (Wier and Skocpol, 1985). As Hall (1993) summarizes, the principal factors affecting policies at time 1 is policy at time 0.

Understanding adaptive management within the context of hazard mitigation planning is ideal because hazards are recurring events spaced out through time. Planners have an opportunity to learn and improve from one flood or hurricane to the next, since these events tend to recur in the same geographic area. If plans are regularly updated, the policy instruments themselves can reflect the learning that takes place within the planning organization and community at large. Hazard mitigation tends to be viewed as a technical skill that belongs to experts or planning professionals who can control policy experiments. Under this assumption, policy change concerning hurricanes, floods, and other natural disasters may then be based on instrumental forms of learning.

Most of the discussion on adaptive management has assumed that the experimenter (i.e. planner) is a rational individual supported by a responsive management structure ready to test hypotheses and implement the results of the experiment. Yet, in the local planning arena, the experimenter usually is not a lone scientist, but a member of an organization within a larger community composed of a network of relationships. Local comprehensive planning in both Florida and Washington is achieved with the participation of a diverse set of stakeholders including environmental NGOs, neighborhood groups, development associations, businesses, etc. Because participation programs are required in each state, decision-making authority does not lie solely in the hands of the planner. Adaptive management may be based on the principles of scientific experimentation, but it is ultimately about collective human values and a political culture that tolerates learning from mistakes. In short, humans and their organizations must be willing to learn.

To accommodate the reality of our pluralistic society, scholars have derived an alternative form of learning called "social policy learning." Social learning comes from a redefinition of policy goals and objectives that may entail an alteration of belief systems, core values, or assumption of relevant publics (May, 1992a). Social learning is needed to redesign institutions to expand citizen involvement in the policy-making or planning process (Ventriss and Luke, 1988). This type of learning comes from a plurality of interests and influences, rather than a single expert or individual (Heclo, 1974). According to May (1992) "policies with publics" have greater potential for learning because their adoption involves the constant questioning of assumptions and existing policy outcomes by competing advocacy coalitions. When there exist facilitated policy dialogues among multiple interests, more complex and fundamental learning tends to take place (Lowry et al., 1997). Innes et al. (1990; 1994) adds to social learning theory by arguing that learning occurs through collaboration and consensus building. Drawing from Habermas' (1984) critical theory and the concepts of communicative action, Innes suggests that collaborative planning provides a forum for the local community to mutually debate, rationally consider, and reach consensus on public issues relevant to plan making. Learning occurs through "discourse" where participants gain information on how proposals will affect them while at the same time planners better understand the public's values and interests. Mutual learning through citizen participation often enhances the planning process and leads to a more desirable outcome that meets the needs of all parties.

Sample Selection, Data, and Analysis

Sample Selection

There were several reasons for selecting Florida and Washington as study sites for examining change in plan quality associated with natural hazards. First, both states are vulnerable to several types of hazards (primarily hurricanes and associated flooding in Florida and flooding and landslides in Washington). Second, both states mandate local jurisdictions to adopt comprehensive plans that give attention to natural hazards mitigation. Third, local plans have undergone significant reforms during the eight-year study period due to legislative changes prompting development of new or updated plans.

Under the 1985 *Local Government Comprehensive Planning and Land Development Act*, local jurisdictions in Florida are required to adopt a comprehensive plan subject to review and approval by the state Department of Community Affairs (DCA). Each local jurisdiction either completed or was in the process of completing an Evaluation and Appraisal Report (EAR) during the eight-year study period, which requires localities to incorporate change in state and regional policy that occurred in the interim period as well as respond to changes in community circumstances. Communities are required to conduct an EAR every seven years to improve upon their comprehensive plan. The 1985 Act was updated in 1993, but is still the primary instrument driving local resource and land-use decisions. In 1990, Washington passed its Growth Management Act (GMA), which requires local government to prepare new comprehensive plans to replace existing local zoning and development regulations. Most Washington jurisdictions evaluated in the study had completed an updated plan under the GMA by 1999.

Although both states require the adoption of comprehensive plans that address natural hazards mitigation, each mandate has a different emphasis. Florida exemplifies a prescriptive and coercive mandate requiring that specific elements and goals are included in the plan. In contrast, Washington's mandate is more incentive-based, where state oversight has no authority to review plans for consistency or impose sanctions for failure to comply with state requirements. Washington's mandate is also more focused on citizen participation and a "bottom-up" approach to decision making. The differences in planning practices between the two states provided a better opportunity to identify factors contributing to learning and policy change.

A random sample of 60 local governments was studied to determine the degree to which the quality of plans associated with hazard mitigation changed between 1991 and 1999 and identify the factors contributing most to this change. The sample of places studied was initially selected for use in an investigation of the impacts of planning mandates on the quality of the hazards elements of comprehensive plans (see Burby and May, et al. 1997) and used again here to facilitate the use of longitudinal data. The sample of localities was selected to ensure some degree of comparability among places in different states. For this reason, sample frames of cities and counties were constructed in each state to meet the following criteria: population of 2,500 or more in 1990 (to ensure a minimum capacity for plan making) and potential for significant exposure to natural hazards (location in a coastal jurisdiction in Florida and west of the Cascade mountains in Washington, where flood hazards are ubiquitous). Large cities, such as Miami and Seattle, were also excluded because it is believed that these jurisdictions have very different contextual factors that may skew the sample. From the sampling frame, 30 jurisdictions in each state were selected at random and evaluated against a plan coding protocol to measure their ability to mitigate natural hazards. The protocol evaluated plans for five categories of natural hazards: floods, hurricanes, landslides, earthquakes, and "other."

Measuring Plan Quality for Hazards Mitigation

Plan quality was measured by incorporating hazard mitigation measures into existing conceptions of what constitutes a high quality plan. As was done in past studies of local plans and hazard mitigation (Godschalk et al., 1998; Berke et al., 1998; Godschalk et al., 1999), plan quality was conceptualized as consisting of three components: a strong factual basis, clearly articulated goals, and appropriately directed polices.

Together these three plan components enable a local plan to mitigate the negative effects of natural hazards and protect human life. Indicators (items) within each plan component further specify the conception of plan quality (Appendix A). The fact base component includes background data on the location and extent of hazard damage including the delineation of hazard magnitudes, exposed populations, structural loss estimates, and evacuation clearance time data. Indicators in the goals plan component cover economic impacts (e.g. reduce property loss and minimize fiscal impacts), physical impacts (e.g. reduce property loss, maintain water quality), and public interest impacts (e.g. protect human safety and increase public awareness of hazards). The policies plan component is the most extensive of the three. It includes actions associated with increasing awareness, regulations, incentives, reducing structural loss, and recovery.

Each indicator was measured on a 0-2 ordinal scale, where 0 is not identified or mentioned, 1 is suggested or identified but not detailed, and 2 is fully detailed or mandatory in the plan. In the factual basis component of the protocol, several items have more than one indicator. For example, hurricane vulnerability zones can either be mapped, catalogued, or both. In these cases, an item index was created by taking the total score and dividing it by the number of sub-indicators (i.e. an item that received a 1 for mapping and 1 for cataloging was given an overall issue score of 1). This procedure assured that items remained on a 0-2 scale and favored plans that supported their descriptions with clear maps.

Measures of overall plan quality were calculated by creating indices for each plan component and overall plan quality (as done by Berke et al., 1996, and Berke et al., 1998). There were three steps in the construction of the index for each plan component. First, the scores for each of the indicators (I_i) were summed within each of the plan components. Second, the sum of the scores was divided by the total possible score for each plan component ($2m_j$). Third, this fractional score was multiplied by 10, placing the plan component on a 0-10 scale. That is,

$$PC_j = \frac{10}{2m_j} \sum_{i=1}^{m_j} I_i$$

, where PC_j is the plan quality for the j^{th} component, and m_j is the number of indicators within the j^{th} component.

A final step involved calculating a total plan quality score (TPQ) by adding the scores of each component. Thus, the maximum score for each jurisdiction's plan is 30. That is,

$$TPQ = \sum_{j=1}^{3} PCj$$

Analysis

Plan quality indices were analyzed in two phases. First, a paired test of means demonstrated the degree and significance of change between 1991 and 1999. Second, multiple regression analysis identified the most influential factors contributing to policy learning and change between the two time periods. Contextual data was obtained through a survey of planning directors and planning staff. Explanatory variables include plan quality for 1991, population growth, the number of citizen groups participating in the planning process (citizen participation), the change in demand for development in hazard prone areas, reported repetitive property losses in 1990 (chronic loss), change in the number of planning staff devoted to hazard mitigation (capacity), and the change in commitment of elected officials to mitigate natural hazards (commitment). Several statistical tests for reliability were conducted to ensure the OLS estimators were Best Linear Unbiased Estimates (BLUE). Tests for model specification, multicollinearity, and heteroskedasticity revealed no violation of regression assumptions.

Results and Analysis

Overall, plan quality for hazard mitigation increased significantly between 1991 and 1999 (Table 1). Washington improved most dramatically with its mean score rising from .94 to 2.21 over the eight-year study period. This result was expected because Washington's 1990 GMA amounts to a more significant reform in comprehensive planning than to Florida's EAR process. Under Washington's GMA, jurisdictions were required to prepare plans under an entirely new system, whereas Florida communities were only expected to review and revise their existing plans. Florida also has a stronger tradition and history of local planning so it can be inferred that jurisdictions have established policy momentum, leaving less room for improvement when updating their plans.

The fact base is the only plan component in the combined sample that did not improve significantly during the study period. While Washington plans showed a marked increase (before the 1990 GMA, plans in Washington barely included fact base elements), fact base scores hardly changed in Florida. In general, the fact base of a plan is the most difficult component to overhaul. Updates require additional studies, analysis of existing environmental conditions, map preparation, and data gathering based on long-term monitoring programs. Although policy learning may advance at a rapid pace, fact base elements take longer to "catch up" to the other plan components due to the necessary commitment of time and financial resources. The learning threshold is therefore on average higher for fact base than goals and policies plan components. A slower learning curve for a fact base should not be overlooked because this component acts as the foundation of a plan, driving goals and policies to mitigate natural hazards. Without supporting data and analysis, a plan may falter when it comes to implementation and overall effectiveness.

A significant improvement in goals related to mitigating natural hazards was driven almost entirely by updates in Washington plans. Plans in this state made the most major improvements for goals to protect human safety and minimize the fiscal impacts of natural disasters. Another factor contributing to positive change in the goals of Washington plans is recognition of the connection between hazard mitigation and the preservation of natural areas.

Of all plan components, policies improved the most, which is the strongest indicator that policy learning and adaptive management is taking place. Localities in both states strengthened their ability to mitigate and recover from natural hazards including floods and hurricanes. Florida made its strongest advances in emergency preparedness. The addition of policies regarding evacuation, sheltering, and separate emergency plans demonstrates a more proactive stance towards hurricane planning than before 1991. Local jurisdictions in Florida also showed an increased commitment to discouraging development in hazardous areas as well as participating in federal flood insurance programs. Hurricane Andrew, which made landfall in south Florida in 1992, combined with increasing pressure from the Federal Emergency Management Agency (FEMA), most likely sparked interest in improving preparation for possible future disasters. Improvements in Washington's policies were more focused on protecting areas subject to flooding through educational awareness, permitted land use, setbacks, and locating public facilities in areas not susceptible to natural hazards. These policies correspond with Washington's change in goals, and deal with floods which are the most prevalent hazard in the state.

After determining the degree of policy change between 1991 and 1999, the next phase of the study used OLS multiple regression analysis to explain the major factors contributing to this improvement (Table 2). The strongest predictor of plan quality in 1999 was plan quality in 1991. This result supports the theory that states build on past policy efforts and establish "policy legacies" (Wier and Skocpol, 1985) that perpetuate into the future. I consider this phenomenon policy inertia or momentum institutionalized by local planning agencies. Once a jurisdiction sets a tradition of strong planning, it tends to carry on to other plan updates, staff changes, and even shifts in political regimes. While a local agency will most likely continue to produce high quality plans over time (particularly for repeated events such as natural hazards), there may be less room for dramatic improvements.

This notion may explain why plan quality in Washington increased far more than in Florida. The starting point in Washington was lower, making it easier to accrue quick gains, particularly with a new growth management act in place. Furthermore, plan quality scores at the upper end of the scale are relatively more difficult to achieve. In other words, jurisdictions can easily grab the "low hanging fruit" at the bottom of the plan quality spectrum, but need exponentially more time, resources, and commitment to attain the highest scores. One could suspect that after initial gains (from a new legal reform, major hazard, or some other event), plans will tend to improve more slowly over time, even though the data for this study is not geared to test such a hypothesis.

Increasing chronic loss or damage to properties is also a statistically significant predictor of hazards plan quality in 1999 at the .05 level of significance. This effect is especially apparent in Florida where hurricane damage is most often associated with personal property loss. In general, site-specific issues seem to generate high interest in policy action and citizen participation in the planning process. For example, Fort Lauderdale was able to generate public interest in the development of its comprehensive plan partly because its zoning reform process dealt with site-specific land use issues. Residents tend to be more receptive when the discussions revolve around specific properties. Not only can they visualize potential changes on a map, but the issues on the table may have an immediate impact on their lives (Brody, 2001). In comparison, the vague policy issues usually addressed during the development of a comprehensive plan are more difficult for communities and their stakeholders to understand and become involved with. Thus, attaching the threat of natural hazards to specific properties, as done with repetitive loss accounting, may raise public interest in such events and trigger subsequent policy change over time.

Other researchers have noted that direct experience with natural hazards focuses attention and facilitates behavioral and policy change. These "focusing events" help generate public interest and jump-start the policy making process (Birkland, 1998). Turner et al. (1986) argued that the personalization of a hazard event is an essential precondition for action. Lindell and Prater (2000) found that personal experience, such as property damage or physical injury is a significant predictor of seismic hazard adjustment. They observed that chronic accessibility to earthquake hazards provide frequent reminders that the threat must be addressed by taking action.

[put in lindell/prator; prator/lindell; turner, (berkland)

The change in demand for development in hazard prone areas is another factor contributing to a change in hazards plan quality between 1991 and 1999. Increasing demand for development in vulnerable areas significantly reduces the resulting quality of plans associated with mitigating natural hazards. Political and economic pressures to develop in profitable, but vulnerable areas may overwhelm the public need to protect critical natural resources, personal property, and at times even human life. Change in demand for development is an especially powerful predictor of 1999 plan quality in Florida, where political economy issues are the most prevalent. The pressure to allow development on prime coastal real estate for residential and tourism purposes is so great that it often appears that sound planning for natural hazards is cast aside. High-density urban development on beachfronts of Fort Lauderdale, Clearwater, and other coastal cities demonstrates the strength of the financial will to develop vulnerable areas without considering the natural environment or public safety.

In the combined sample (Florida and Washington together), citizen participation in the planning process leading to 1999 plans has a strong positive, but statistically non-significant effect on 1999 hazards plan quality. However, looking at each state individually reveals that citizen participation in Washington is the strongest predictor of plan quality and policy change compared to all other variables in the model. This result supports the notion that local jurisdictions learn both instrumentally and socially. As described above, in terms of citizen participation, Washington's mandate is far more substantive. Its "bottom-up" approach to local planning involves participation by a diverse group of stakeholders. Local planning agencies are required to begin public participation "early" and to ensure that it is "continuous" during the planning process. A wide range of participatory techniques is also designated to ensure that citizens are involved in the development of the comprehensive plan. The stronger Washington citizen participation requirements resulted in greater attention to participation by Washington localities than by those in Florida and a greater number of stakeholders taking part in the planning process (Brody et al., forthcoming). Based on the results in Table 2, it appears that a participatory planning process which focuses on collective, participatory decision making has a major impact on the ability of jurisdictions to learn and improve their plans over time. Stakeholder groups bring valuable knowledge and resources to the planning process. These factors can boost the collective capacity of participants, resulting in stronger, more enduring plans (Brody, forthcoming) and demonstrate an initial link between citizen participation and the level of emergency preparedness of local jurisdictions.

Finally, the statistical significance of the intercept is meaningful in this model. A positive shift in the intercept indicates that revisions made to plans over the eight-year study period caused significant improvement in their quality even when accounting for the other variables in the model. While the number of updates or planning reforms was not a measured variable in the regression equation, we believe that the significance of the constant is driven primarily by revisions made to the plans between 1991 and 1999.

There are several other variables included in the regression equation that are not significant predictors despite theoretical and empirical evidence to the contrary. Specifically, it was expected that increased planning capacity for hazards and increased political commitment to mitigate and plan for hazards would contribute to an improvement in plan quality from 1991 to 1999. The non-significance of these variables needs to be examined because it raises the question of how much time must pass before these factors play a role in policy learning. If the study period was ten, fifteen, or twenty years, would that be enough time for political commitment to filter down to the staff level? Would it be enough time for an increase in hazards planning staff to improve the quality of adopted plans? These questions suggest that there might be a learning time threshold for every factor explaining policy learning. It is not the purpose of this study to calculate these time thresholds, but calling attention to their existence is an essential part of understanding and facilitating adaptive management and policy learning processes for hazards mitigation planning.

Conclusions and Implications for Policy Learning

The results of this study indicate that planners are in fact learning to make better plans over time. Overall, both Florida and Washington significantly increased the quality of their local comprehensive plans associated with natural hazards mitigation between 1991 and 1999. Plans in Florida showed particular improvements in emergency preparedness such as evacuation and sheltering capabilities. Communities in Washington strengthened their policies to protect areas subject to flooding through permitted land uses, setbacks, and locating public facilities outside of hazard prone areas. Results also suggest that communities learn incrementally at different rates depending on the initial quality of their plans and the extent of legal reform mandated by the state. Most importantly, planners seem to learn for different reasons. For example, the increase in the quality of plans in Florida appeared to be driven primarily by both a previously established policy making momentum and repetitive loss to specific properties. In contrast, the boost in planning capacity associated with citizen participation was the strongest predictor of improvement in the Washington plans.

Although policy learning may be contingent upon a number of variables, the results of this study provide important insights into the way planners and their communities learn. These insights may assist other states in mitigating the adverse affects of natural hazards or other low probability, high consequence events. First, the creation and maintenance of "policy legacies" or planning inertia is an underlying catalyst for learning. If planners are able to set a precedent of excellence for one plan update, it may establish a policy momentum that increases the speed of learning and leads to a tradition of improvement in plan quality. Second, linking planning problems to specific sites or properties may stimulate communities and planners to improve upon their plans. It often is difficult for residents to become engaged in abstract policy issues usually addressed during the development of the comprehensive plan. However, residents seem to be more interested in contributing to the planning process when they are aware that hazards affect their personal property and safety (Brody, 2001). This type of awareness can be achieved through targeted information dissemination and the way problems are presented to the public during the planning process. Third, encouraging citizen participation and social learning environments during the planning process can enhance plan quality and overall emergency preparedness. Stakeholder groups can boost collective planning capacity by bringing knowledge, expertise, and resources to the planning process. Stakeholder participation also helps educate the public through involvement in the process, which can facilitate and increase the pace of collective learning. An inclusive planning process may therefore result in more effective and enduring plans to reduce the negative impacts of natural hazards. Finally, anticipating the political and economic forces underlying development may prevent a decrease in plan quality over time. Placing appropriate development restrictions on properties that are vulnerable to hazard events and also have increasing demands for development can strengthen plan quality and establish a tradition of balancing economic development with hazard mitigation.

These insights can help communities become more proactive in their approach to hazard mitigation and increase their learning over time.

Although this study provides initial evidence on the extent and causes of plan improvement over an eight-year period, more research must be conducted to improve understanding of how and why planners learn. Specifically, more time periods should be evaluated to further define policy-learning thresholds and understand the factors triggering an increase in the pace of learning. Precise identification of the predicted amount of time it takes for specific factors such as planning capacity or commitment to influence policy learning and plan improvement would greatly assist hazards planners. Also, in-depth case studies on specific communities would generate observational data and lessons learned that complement empirical results.

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Appendices

(Insert Appendix Tables A and B About here)

Table 1: Change in Hazard Mitigation Plan Quality Between 1991 and 1999

	1991 Plan Quality	1999 Plan Quality	t-test	p-value
Total Plan Quality	2.47	3.68	5.18	.000
FL	3.94	5.09	2.81	.008
WA	.94	2.21	5.69	.000
Fact Base	.92	1.17	1.51	.135
FL	1.49	1.70	.68	.496
WA	.32	.61	2.88	.007
Goals	1.02	1.34	2.55	.013
FL	1.55	1.66	.69	.493
WA	.47	1.00	2.95	.006
Policies	.52	1.17	8.04	.000
FL	.90	1.72	6.75	.000
WA	.13	.60	4.88	.000
N:	29[a]	30		

Notes:
[a] One jurisdiction in the sample did not have a plan in 1991.

Table 2: Factor Explaining Plan Quality Change Between 1991 and 1999

	Standardized Regression Coefficients		
	Combined	Florida	Washington
1991 Plan Quality	.60***	.42**	.26*
Chronic Loss	.37***	.51**	.16
Citizen Participation	.14	.15	.44**
Population Growth	.22	.02	.24
Change in Planning Capacity	-.11	-.04	-.10
Commitment	.09	-.003	.004
Change in Demand for Development	-.20**	-.25**	.05
Constant	.01*	.01*	.50
N:	59	30	29[a]
F-value:	11.95	2.06	3.44
Prob. >F	.000	.09	.01
Adjusted R2	.57	.20	.38

Notes:
Dependent variable is plan quality for 1999
[a]One Washington jurisdiction did not have a plan in 1991
* p < .10 ** p < .05 *** p < .01

Appendix A: Plan Coding Protocol

Factual Base

A. Type of Data

1.1 Delineation of location of hazard
1.2 Delineation of magnitude of hazard
1.3 Number of current population exposed
1.4 Number and total value of different types of Public infrastructure (water, sewer, roads, storm water drainage) exposed.
1.5 Number and total value of private structures exposed
1.6 Number of different types of Critical facilities (hospitals, utilities, police, fire) exposed
1.7 Loss estimations (number and total value) to public structures
1.8 Loss estimations (number and total value) private structures
1.9 Emergency shelter demand and capacity data
1.10 Evacuation Clearance Time Data

Goals

A. Economic Impacts
2.1 Any goal to reduce property loss
2.2 Any goal to minimize fiscal impacts of natural disasters
2.3 Any goal to distribute hazards management cost equitably

B. Physical Impacts
2.4 Any goal to reduce damage to public property
2.5 Any goal to reduce hazard impacts that also achieves preservation of natural areas.
2.6 Any goal to reduce hazard impacts that also achieves preservation of open space and recreation areas.
2.7 Any goal to reduce hazard impacts that also achieves maintenance of good water quality

C. Public Interest
2.8 Any goal to protect safety of population
2.9 Any goal that promotes a hazards awareness program
2.10 Other (specify)

Actions

A. *General Policy*
3.1 Discourage development in hazardous areas

B. Awareness
3.2 Educational Awareness
3.3 Real Estate Hazard Disclosure
3.4 Disaster warning and response program
3.5 Posting of signs indicating hazardous areas
3.6 Participation in flood insurance programs
3.7 Technical assistance to developers or property owners for mitigation
3.7 Other (specify)

C. Regulatory
3.8 Permitted Land Use
3.9 Transfer of Development rights
3.10 Cluster development

3.11 Setbacks
3.12 Site Plan Review
3.13 Special Study/ Impact Assessment for development in hazard areas
3.14 Building Standards
3.15 Land and Property Acquisition (Eminent Domain)
3.16 Impact Fees
3.17 Retrofitting of private structures
3.18 Other (specify)

D. Incentives
3.19 Retrofitting of private structures
3.20 Land and property acquisition
3.21 Tax Abatement for using mitigation
3.22 Density Bonus
3.23 Low interest loans
3.24 Other (specify)

E. Control of Hazards
3.25 Storm water management/ watershed treatment
3.26 Maintenance of structures
3.27 Other (specify)

F. Public Facilities & Infrastructure
3.28 Capital Improvements
3.29 Retrofitting Public Structure
3.30 Critical Facilities
3.31 Other (specify)

G. Recovery
3.32 Land Use Change
3.33 Building design change
3.34 Moratorium
3.35 Recovery Organization
3.36 Private acquisition
3.37 Financing Recovery
3.38 Other

H. Emergency Preparedness
3.39 Evacuation
3.40 Sheltering
3.41 Require Emergency Plans
3.42 Other (specify)

Appendix B: Concept Measurement

Name	*Type*	*Measurement*	*Scale*	*Source*	*Mean*	*Std. Dev.*
1999 Plan Quality	Dependent	Sum of three plan components: factual basis + goals + policies	0-30	1999 Sample of Plans	3.65	1.97
1991 Plan Quality	Independent	Sum of three plan components: factual basis + goals + policies	0-30	1991 Sample of Plans	2.46	2.27
Chronic Loss	Independent	NFIP repetitive loss properties for 1990	Ordinal	Federal government	.58	.76
Demand for Development	Independent	Change in degree of demand for land in hazardous areas, 1991-1999	-4-+4	Survey	.13	1.5
Citizen Participation	Independent	Proportion of thirteen groups participating in planning process leading to 1999 adopted plans	0-1	Survey	.41	.24
Commitment	Independent	Commitment of local elected officials to mitigate and plan for natural hazards, 1991-1999	-2-+2	Survey	.10	1.16
Capacity	Independent	Change in number of planning staff to deal with hazards, 199101999	Continuous	Survey	.2	1.41
Population Growth	Independent	Sq. rt. of percentage growth in population, 1990-1998	Interval	US Census	3.57	1.95