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Do planners matter? Examining factors driving incorporation of land use approaches into hazard mitigation plans

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Local hazard mitigation plans help communities organise a comprehensive set of policies and actions to reduce long-term risks from natural hazards. Land use policies hold the greatest long-term risk reduction potential, but are under-utilised. Using multivariate regression models, we assessed the influence of involvement of local planners on hazard mitigation planning committees on the inclusion of land use policies into three principles of plan quality, controlling for state and local factors. Results indicate a need for greater involvement of local planners and stronger emphasis by federal and state officials on integrating land use planning approaches into mitigation plans. Findings may be relevant to other areas of public policy with important land use dimensions for which non-planning agencies and professions have lead responsibility or historical dominance, such as transportation and climate change.

Keywords: Plan evaluation; plan quality; hazard mitigation; land use; participation

1. Introduction

Economic losses due to natural hazard events, such as floods, droughts and hurricanes, have been growing dramatically for decades (Mileti 1999; Cutter 2001; Pielke *et al.* 2008). Meanwhile, confidence increases that climate change exacerbates existing threats from natural hazards (Karl, Melillo and Peterson 2009; IPCC 2012). Catastrophes resulting in billions of dollars in losses may become more frequent (Peacock *et al.* 2008). Countering these trends is the aim of hazard mitigation efforts, which consist of "advance action taken to reduce or eliminate the long-term risk to human life and property from natural hazards" (Godschalk *et al.* 1999, 4). Development management through land use approaches is widely recognised as the most effective approach to hazard mitigation, but is under-utilised (Burby *et al.* 1999; Mileti 1999; National Research Council 2006; Berke and Smith 2009). Land use approaches can direct people and property into more (or less) hazardous areas and thereby reduce hazard risks by controlling the timing, location, type, intensity and other characteristics of development (Godschalk, Brower, and Beatley 1989; Olshansky and Kartez 1998; Burby *et al.* 1999).

Local hazard mitigation planning in the United States is of mediocre quality in general and land use approaches have been used to a limited degree (Berke and French 1994; Burby and Dalton 1994; Berke *et al.* 1996; Burby and May 1997; Brody 2003; Tang *et al.* 2008; Kang, Peacock and Hussein 2010; Olonilua and Ibitayo 2011). Factors influencing

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the quality of hazard mitigation planning include the state planning policy context, local community characteristics, and features of the planning process (Berke and French 1994; Burby and Dalton 1994; Berke *et al.* 1996; Burby and May 1997; Deyle and Smith 1998; Brody 2003; Burby 2003; Norton 2005). Studies focusing on these factors assessed the quality of mitigation planning done before a major shift in the federal policy framework for mitigation.

In 2000 the Disaster Mitigation Act (DMA) created requirements for local governments to develop hazard mitigation plans to remain eligible for certain federal disaster funds. Typically, the plans are stand-alone documents. Prior to passage of the DMA, stand-alone mitigation plans were less prevalent. Instead, some communities chose to integrate hazard mitigation issues into local comprehensive plans (Berke *et al.* 1996; Burby and May 1997). Therefore, uncertainty exists whether the factors found to drive the quality of pre-DMA mitigation in comprehensive plans have similar influence on stand-alone hazard mitigation plans.

The DMA also shifted the professional discipline that has primary responsibility for mitigation planning. Comprehensive planning, which inherently addresses land use policies, usually is the responsibility of local planners (Berke, Godschalk, and Kaiser 2006). Local planners typically have training and experience with using land use policies to manage where development occurs, but may not have much experience with planning for natural hazards. Therefore, in the pre-DMA framework, understanding factors prompting local planners to focus attention on hazards when developing comprehensive plans was critical (Dalton and Burby 1994; Berke *et al.* 1996; Burby and May 1997; Brody 2003).

Under the DMA the federal oversight agency is the Federal Emergency Management Agency (FEMA) and local emergency managers typically have primary responsibility for leading the processes for developing stand-alone mitigation plans. Emergency management has its roots in a post-Second World War civil defence culture of preparing for and responding to military attacks and evolved to handle similar functions for natural hazards (NEMA 2011). Managing development is not a core responsibility of most local emergency managers. The DMA requires a participatory planning process, but it does not require involvement of local planning agencies or trained land use planners (FEMA 2004, 2008). Local planners can bring expertise about the range of land use policies available to regulate development in hazardous areas to hazard mitigation planning processes. They may also have unique familiarity with the technical and political feasibility of new or modified hazard mitigation-relevant land use policies in their communities. A recent case study of hazard mitigation efforts in Lee County, Florida, highlights the importance of planning agency involvement and participation of individuals with land use planning backgrounds (Godschalk 2010). Yet, there has been limited research on connections between emergency managers and local planners (Kartez and Faupel 1994). Thus, an under-studied but potentially critical influence on the inclusion of land use policies is whether or not planning agency representatives serve on mitigation planning committees.

In this paper, we seek to answer two research questions arising from the uncertainties created by the DMA. First, does inclusion of local planners on hazard mitigation planning committees lead to the incorporation of more land use approaches in hazard mitigation plans? Second, do the state planning policy context, planning process features, and local community characteristics found to influence the quality of hazard mitigation planning in comprehensive plans also influence the incorporation of land use approaches in hazard mitigation plans?

The paper first describes hazard mitigation planning and the DMA. It then explains the conceptual framework and the research design and methods. Next, it presents findings of regression models explaining the incorporation of land use approaches into local mitigation plans. Finally, it summarises conclusions and policy implications.

2. Hazard mitigation planning and the Disaster Mitigation Act of 2000

Hazard mitigation plans are key tools available to local governments for co-ordinating the efforts of interdependent organisations working to reduce and eliminate risks (Godschalk, Kaiser, and Berke 1998; Godschalk *et al.* 1999; Berke and Smith 2009; Berke, Smith, and Lyles 2012). Core purposes of creating a hazard mitigation plan are identifying existing capabilities (e.g. policies, programmes and actions) to reduce risks and developing a set of proposed policies and actions that can be used to achieve long-range goals (Godschalk, Kaiser, and Berke 1998; Berke and Smith 2009). Mitigation planning can be closely tied to comprehensive planning goals and objectives, provide co-benefits such as providing open space, and promote long-term efforts to make communities more sustainable and resilient (Godschalk *et al.* 1999; Berke and Smith 2009). In addition to land use approaches, there are other risk reduction approaches that can be included in hazard mitigation plans, including property protection (e.g. building codes and retrofitting), education and awareness programmes, protection of natural features that provide mitigation benefits (e.g. wetland preservation), and structural controls of hazards (e.g. levees and sea walls) (FEMA 2008).

Local hazard mitigation plans must be approved by FEMA to comply with the DMA and are typically developed through multi-jurisdictional planning processes. In terms of future-oriented policies and actions, FEMA requires identification and analysis of a "comprehensive range of specific mitigation actions and projects being considered" (FEMA 2008, 56). Each jurisdiction must propose its own distinct policies or actions. FEMA does not dictate which specific policies or actions are included, meaning jurisdictions can choose whether to include land use approaches (FEMA 2004, 2008). As of 2012, more than 26,000 local jurisdictions have complied with the DMA and more than $103 million in federal mitigation grants have supported these efforts (Department of Homeland Security Office of Inspector General 2012).

3. Incorporation of land use approaches into hazard mitigation plans

3.1. Land use approaches to hazard mitigation

Land use approaches to hazard mitigation provide risk reduction benefits by concentrating buildings and infrastructure in less hazardous areas (Burby 1998; Mileti 1999). Categories of land use approaches to mitigation include building standards, development regulations, critical and public facilities policies, land and property acquisition, taxation and fiscal policies, and information dissemination (Olshansky and Kartez 1998). Similarly, Godschalk and colleagues categorised the control of new development (including building standards), promotion of retrofitting of existing development, acquisition, protection of public facilities and infrastructure, promotion of awareness/knowledge, and other approaches. At the state and local levels, traditional land use tools such as zoning ordinances and design standards are more common than innovative approaches such as density transfer provisions and financial incentives (Olshansky and Kartez 1998; Godschalk *et al.* 1999). A narrower conceptualisation of land use approaches is used here because our interest is solely on land use approaches that have a direct impact on

Table 1. Descriptions of land use approaches useful for the mitigation of natural hazard risks.

Land use approach	Description
Development regulations	
Permitted land use	Provision regulating the types of land use (e.g. residential, commercial, industrial, open space, etc.) permitted in areas of community; may be tied to zoning code.
Density of land use	Provision regulating the density of land use (e.g. units per acre); may be tied to zoning code.
Subdivision regulations	Provision controlling the subdivision of parcels into developable units and governing the design of new development (e.g. site stormwater management).
Zoning overlays	Provision related to using zoning overlays that restrict permitted land use or density of land use in hazardous areas; may be special hazard zones or sensitive open space protection zones.
Setbacks or buffer zones	Provision requiring setbacks or buffers around hazardous areas (e.g. riparian buffers and ocean setbacks).
Cluster development	Provision requiring clustering of development away from hazardous areas, such as through conservation subdivisions.
Density transfer provisions	
Density transfer	Provision for transferring development rights to control density; may be transfer of development rights or purchase of development rights.
Financial incentives and penalties	
Density bonuses	Density bonuses such as ability to develop with greater density in return for dedication or donation of land in areas subject to hazards.
Tax abatement	Tax breaks offered to property owners and developers who use mitigation methods for new development.
Special study	Provision requiring impact fees or special study fees on development in hazardous areas; may indicate fees required to cover costs of structural protection.
Land use analysis and permitting process	
Land suitability	Hazards are one of the criteria used in analysing and determining the suitability of land for development.
Site review	Provision requiring addressing hazard mitigation in process of reviewing site proposals for development.
Public facility locations	
Site public facilities	Provision related to siting public facilities out of hazardous areas in order to maintain critical services during and after hazard events.
Post-disaster reconstruction decisions	
Development moratorium	Provision imposing a moratorium on development for a set period of time after a hazard event.
Post-disaster land use change	Provision related to changing land use regulations following a hazard event; may include redefining allowable land uses after a hazard event.
Post-disaster capital Improvements	Provision related to adjusting capital improvements to public facilities following a hazard event.

reducing development in hazardous areas (Table 1). We do not include building standards, which do not impact the location of structures, or information and education programmes, which have indirect influence by increasing attention to hazards that can inform land use decisions.

3.2. Factors that explain plan quality

As shown in Figure 1, the conceptual framework includes three organising dimensions that are generic to any planning process (Berke *et al.* 1996; Burby and May 1997; Berke *et al.* 1999; Burby 2003; Norton 2005). *Planning outputs* are the intermediate planning products and actions, such as plans, agreements and implementation of plan provisions, which in turn generate changes to the underlying conditions and result in the planning outcomes. *Planning processes* are the co-ordinated activities taken by stakeholders to develop and implement the planning outputs to achieve planning outcomes. *Planning contexts* are the legal, physical, socio-economic and other conditions under which planning processes take place.

The *output of the planning process* of interest in this paper is the quality of hazard mitigation plans (i.e. *plan quality*), particularly with regard to the incorporation of land use approaches into hazard mitigation plans. This dimension is conceived across multiple principles of plan quality (Baer 1997; Berke, Godschalk and Kaiser 2006; Berke and Godschalk 2009). Principles of plan quality are considered to be universal and can be applied across multiple planning domains (e.g. comprehensive planning, transportation planning, and hazard mitigation planning). There is an emerging consensus around core principles of plan quality (Baer 1997; Berke and Godschalk 2009).

We focus on three principles that address existing policies, future policies and policy implementation. First, the fact base principle holds that plan quality is improved when a plan "provides the empirical foundation to ensure that key hazard problems are identified and prioritised, and mitigation policy-making is well-informed" (Berke, Smith, and Lyles 2012, 140). High quality mitigation fact bases should assess the hazards prevalent in an area (e.g. hurricanes and floods), vulnerable community assets (e.g. population, structures and natural resources), and policies and programmes that already exist that can be used to reduce hazard risks (Berke and French 1994; Godschalk *et al.* 1999; Tang *et al.* 2008; Berke Smith, and Lyles 2012). Existing land use policies and programmes enable

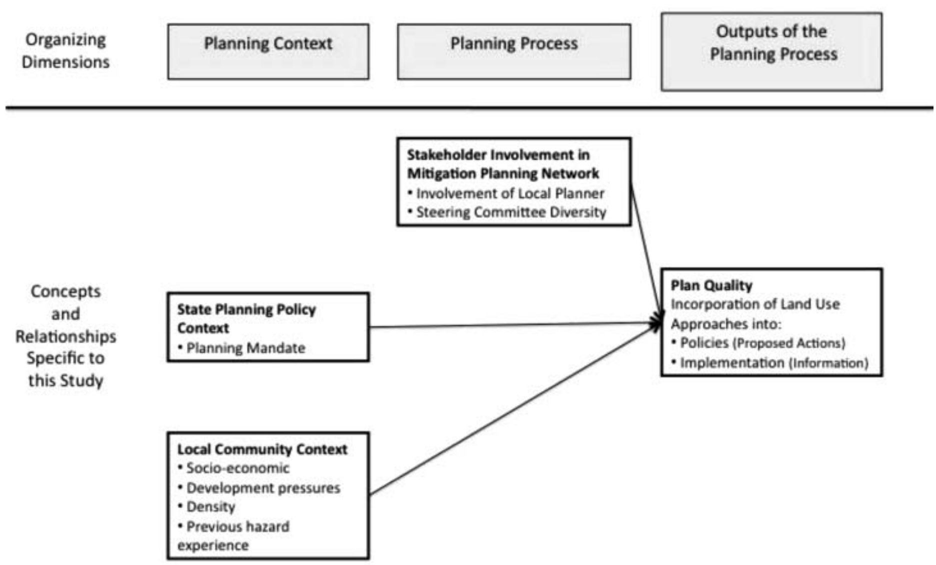

Figure 1. Conceptual framework for explaining the inclusion of land use approaches into hazard mitigation plans.

jurisdictions to direct development out of hazardous locations. Second, the *policies* principle holds that plans should include policies that serve as a guide for future actions taken to meet plan goals and objectives (Berke, Godschalk, and Kaiser 2006; Kang, Peacock, and Hussein 2010; Berke, Smith, and Lyles 2012). Adopting new or modifying existing land use approaches can strengthen a community's ability to guide development away from hazardous locations. Third, the *implementation* principle holds that plans should include clear information about how a proposed policy will be implemented (Brody 2003; Berke, Godschalk and Kaiser 2006; Berke and Godschalk 2009). It consists of identification of the organisations responsible, a timeline for action, and the costs for the specific policies (or actions) included in the plan (Berke, Smith, and Lyles 2012). Here, we focus on whether implementation information is provided for each proposed land use policy and programme included in the plan. This approach of assessing the incorporation of policy options across three principles of plan quality has not been used previously but provides the benefit of fine-grained assessment of how clearly a plan articulates how the policies will be implemented.

Involvement of stakeholders in *planning processes* is conceptualised as driving the incorporation of land use approaches into mitigation plans in two ways. The first is involvement of a *local planner* on the official mitigation planning committee. Local planners bring training and expertise related to land use planning policies and familiarity with other relevant local planning efforts, which emergency managers may lack. Previous studies have not investigated the influence of involvement of local planners on plan quality. The second is *the diversity of stakeholder group*s represented on the official planning committee responsible for developing the plan. Burby (2003) found that involvement of more groups in comprehensive planning processes led to higher hazard mitigation-related plan quality.

The overall *planning context* in which the planning process takes place includes the *state planning policy context*. This dimension consists of whether or not a jurisdiction is subject to a *state mandate* requiring local communities to adopt a comprehensive plan. State comprehensive planning mandates lead to stronger treatment of hazards in comprehensive plans (Burby and Dalton 1994; Dalton and Burby 1994; Berke *et al.* 1996; Burby and May 1997). Differences in mandate characteristics can be related to differences in plan quality (Berke and French 1994; Burby and May 1997). States that mandate a comprehensive plan with an element focused on hazards are distinguished from states that mandate a comprehensive plan but do not require a hazards element. State comprehensive planning mandates may be largely irrelevant to the quality of hazard mitigation plans because the DMA framework has created a separate policy stovepipe. Alternatively, comprehensive planning mandates may foster stronger local capacity and commitment to land use planning in general that can be leveraged for hazard mitigation planning.

The overall planning context also includes *local community characteristics*, four of which are considered. First, jurisdictions have varying degrees of long-term *experience with natural hazards*. Disaster events can lead to more attention being given to natural hazards in public policy and planning (Godschalk, Brower, and Beatley 1989; Berke and Beatley 1992; Birkland 1997, 2006; Burby 2003). The influence of previous experience with hazards on utilising land use approaches in particular is mixed, with some statistical models detecting positive relationships, some negative relationships, and some no relationships (Burby and Dalton 1994; Burby 2003; Brody, Kang, and Bernhardt 2009). Second, jurisdictions face differing development pressures due to *population growth*. Nationally, coastal population increased by more than 50 million persons, or 45%, between 1970 and 2010, with 11 million of those people locating in coastal areas between 2000 and 2010 (NOAA 2012). Population growth can result in higher hazard-related plan quality (Norton 2005), although other research has not detected a relationship (Brody 2003). Third, jurisdictions vary in their *density*, which indicates their degree of urbanisation. Evidence indicates higher density results in lower hazard-related plan quality, which may reflect additional pressure to develop in hazardous areas as the proportion of undeveloped land in a community decreases (Burby and Dalton 1994; Dalton and Burby 1994). At least one other study detected no relationship (Berke *et al.* 1996). Fourth, jurisdictions vary in *levels of wealth*, which can support a government's capacity to plan (e.g. hire staff). Previous studies have found positive relationships between median home values and hazard-related plan quality in some regression models, although those same studies have detected no relationships in other models (Burby and Dalton 1994; Dalton and Burby 1994; Berke et. al 1996).

4. Research design and methods

4.1. Sample selection and plan collection

A cross-sectional design incorporating state and local controls into multivariate regression models was used to explain the incorporation of land use approaches into hazard mitigation plans adopted under the DMA. Plans from 175 local coastal jurisdictions were randomly selected in six states: California, Florida, Georgia, North Carolina, Texas and Washington. We focused on coastal jurisdictions, as defined by states under the Coastal Zone Management Act, because they generally experienced high population growth rates, development pressures, and vulnerability to hazards in the years before plans in our sample were adopted (Beatley, Brower, and Schwab 2002; NOAA 2004, 2012). States were selected to vary on two dimensions: (1) presence of a state comprehensive planning mandate, and (2) the quality of the state mitigation plan (Table 2). Thirty jurisdictions with populations more than 2500 and less than 750,000 were randomly selected in each state, with the exception of Georgia, where 25 jurisdictions were selected.[1] We limited the population range to avoid skewing the sample with jurisdictions that had very limited, or very large, planning capacities (Brody 2003). Plans were collected from local and state mitigation officials and government websites in 2009 and 2010.

Table 2. Planning policy characteristics used to select states from which to sample local plans.

Variable	California	Florida	Georgia	North Carolina	Texas	Washington
State hazard mitigation plan quality*	Strong	Strong	Weak	Strong	Moderate	Moderate
State planning context**	Moderate	Strong	Weak	Strong	Weak	Moderate

Notes: *State mitigation plan quality was measured using plan quality data for five plan quality principles (i.e. Fact Base, Mitigation Strategy, Implementation and Monitoring, Planning Process, and Co-ordination with Local Planning) (Berke, Smith and Lyles 2012). Plan quality z-scores for each of the principles were added to generate an overall score. All coastal states were ranked from 1 to 30. The top six scores were considered 'Strong', the bottom six scores 'Weak' and the middle 18 scores 'Moderate'.
**State hazard mitigation planning context consisted of three measures from the IBHS/APA 2008 Survey of State Land Use and Natural Hazards Planning Laws: (1) state requires local jurisdictions to adopt a plan; (2) state requires a hazard-related element, and (3) state requires vertical consistency (Schwab 2009). Three yes scores was considered a 'Strong' state, two yes scores a 'Moderate' state, and one or no yes scores a 'Weak' state.

4.2. Coding protocol

A coding protocol was developed to evaluate incorporation of land use approaches in hazard mitigation plans. Protocol items were drawn from FEMA's requirements (FEMA 2004) and previous studies of hazard mitigation plan quality (e.g. Godschalk *et al.* 1999; and Berke, Smith and Lyles 2012) and incorporated into a content analysis software package. The full coding protocol is available at www.ie.unc.edu/cscd/projects/dma.cfm. Comparable plans for jurisdictions in states other than the six included in this study were used to pre-test and modify the protocol and procedures (Krippendorff 2004).

Sixteen specific land use-related policies for mitigation were assessed for the fact base, policies and implementation principles (Table 1). For the fact base principle, each of the policies was measured on an ordinal scale, in which 0 indicated the approach was *not included*, 1 indicated a *brief, general description*, and 2 indicated a *clear and detailed narrative description*, with lists, tables, figures and maps if applicable. For the policies principle, a binary scale was used, in which 0 indicated the land use approach was *not included* in the future-oriented mitigation strategy in the plan and 1 indicated the approach was *included*. Three types of implementation information – identification of a responsible organisation, timeline and cost – were assessed. The binary scale (i.e. included or not included) was used for all three types of information. In a multijurisdictional plan, all items were only coded if the content related to the individual jurisdiction for which the item was being coded.

4.3. Content analysis procedures

Procedures for content analyzing the plans follow recommendations in the communications and plan quality literature (Krippendorff 2004; Berke and Godschalk 2009). A team of seven trained coders was used, with two coders independently analysing each plan. Instructions and rules were used to ensure recorded scores were consistent and reliable. Coders resolved disagreements in their scores using a reconciliation process. Coders discussed each item on which they disagreed, referred back to the plan to determine which score was correct, and recorded the final score. As suggested by Krippendorff for content analysis in general and Berke and Godschalk for plan quality studies, we assessed reliability of the pre-reconciled data for each individual coding item rather than providing a single average reliability score for all the items (Krippendorff 2004; Berke and Godschalk 2009). Individual item percent agreement scores for our study were between 74.9–100.0%, meaning each individual item's percent agreement score was within the range of average scores from previous plan quality studies (Berke and Godschalk 2009).[2]

4.4. Creation of plan quality dependent variables

One index variable and two count variables were created for use as dependent variables in statistical models. Creation of the fact base index consisted of converting the score for each land use policy to a 0 to 1 scale by dividing by two, adding the 16 scores into an overall sum, dividing by 16, and multiplying it by 10 to put it on a 0 to 10 scale (Berke and Godschalk 2009). The summary statistics indicate a low mean land use fact base score (0.94) and a maximum score (5.625) that is near the midpoint of the 0 to 10 range possible (Table 3). The count variable for the policies principle was created by adding the binary score for each land use approach for each jurisdiction, resulting in a count

Table 3. Descriptions, measurement, summary statistics, and sources for dependent variables used in analyses.

Variable	Definition	Summary statistics	Source
Fact base principle	An index of land use-related policies for which the capability is assessed in the plan. Maximum possible value is 10.0. Coding scale: 0 denotes policy was not included; 1 denotes a brief, general description; and 2 denotes a clear and detailed narrative description.	Mean: 0.94 s.d.: 0.89 Range 0.00 to 5.63	Plan content analysis
Policies principle	The count of the number of 16 land use-related policies proposed in the plan. Maximum possible value is 16. Coding scale: 0 denotes policy was not included; 1 denotes policy was included.	Mean: 1.14 s.d.: 1.46 Range: 0 to 10	Plan content analysis
Implementation principle	The count of the number of items of implementation information (responsible agency, cost and timeline) for the 16 land use actions. Maximum possible value is 48. Coding scale: 0 denotes implementation information item was not included; 1 denotes it was included.	Mean: 1.59 s.d.: 2.25 Range: 0 to 12	Plan content analysis

between 0 and 16. Table 3 shows a low mean land use policies score (1.14) and a maximum count (10) well into the higher end of the possible range of 0 to 16. The count variable was created for the implementation principle by adding the binary scores of the total number of items of implementation-related information present for the sixteen land use actions. Table 3 shows a low mean (1.59) and a maximum value of 12 for the implementation count.

4.5. Data collection for independent variables

Independent variables were selected based on the conceptual framework and a review of findings from more than a dozen regression models predicting plan quality in studies identified by Berke and Godschalk (2009). Table 4 presents the measurement, summary statistics and data sources for the independent variables. Whether or not a state has a *planning mandate with a hazard element required*, *a mandate without a hazard element required,* or *no mandate* was measured. We defined *local planners* as those individuals representing a county or municipal planning agency or department and the individuals responsible for planning and zoning. Zoning-oriented officials were counted as planners because they bring a land use-orientation to the hazard mitigation planning process, but building department officials, floodplain managers, and code enforcement officials were not. A distinction was made between the participation of a *jurisdiction's own planner* and

Table 4. Descriptions, measurement, summary statistics and sources for independent variables used in analyses.

Variable	Measurement	Summary statistics (n = jurisdiction)	Source
Local planning process			
Local planner	Three-level categorical measure of the level of local planner involvement in planning process (planner from local jurisdiction, planner from an other jurisdiction, or no planner)	Juris-Spec.: n = 62 Other-Juris.: n = 64 No Planner: n = 49	Plan content analysis [a]
Diversity of Groups	Number of 22 different categories of stakeholder groups represented on planning steering committee.	Mean: 7.47 s.d.: 3.85 Range: 0 to 18	Plan content analysis [a]
State policy context			
Planning mandate	Three-level measure of whether State requires local comprehensive plan for local jurisdictions (mandate with hazards element; mandate with no hazard element; no mandate)	Mandate w/ Haz: n = 90 Mandate w/o Haz: n = 30 Non-Mandate: n = 55	Institute for Business and Home Safety (2009)
Local community characteristics			
Population density	The number of persons per square mile of land area	Mean: 775.7 s.d.: 935.5 Range: 3.7 to 7,825.2	US Census (2000)
Population growth	The percent change in population in the 10 years prior to the date of plan adoption	Mean: 17.1 s.d.: 26.9 Range: -18.0 to 163.4	US Census (2000)
Community wealth	Median value of owner-occupied homes in dollars	Mean: $167,120 s.d.: $165,737 Range: $30,400 to $1,000,001	US Census (2000)
Previous disaster experience	Number of Presidentially-declared disasters in the 10 years prior to the date of plan adoption	Mean: 3.30 s.d.: 2.21 Range: 0 to 10	Public Entity Risk Institute

Note: [a] The source for this variable was double-coding content analysis conducted in May and June 2011. It supplemented the main plan content analysis described in the methods, but employed the same independent, double-coding and reconciliation procedures (Krippendorff 2004).

a planner from some *other jurisdiction* that participated in the planning process. Involvement of 22 different stakeholder groups on the official planning steering committee was used to measure the *diversity of the types of groups*. *Population density* (logged) prior to plan adoption was used to measure urbanisation. The *population growth rate* in the 10 years prior to plan adoption was used to measure development pressure. The median owner-occupied home value prior to plan adoption was used to measure *community wealth*. The number of presidentially-declared disasters over the 10 years prior to the adoption of the plan was used to measure *previous experience with disasters*.

4.6. Analytical procedures

Three multivariate regression models were used to test the relationships between independent variables and the incorporation of land use actions into mitigation plans. For the fact base index variable, an ordinary least squares regression model was used. Ordinary least squares regression models are inappropriate for the policies and implementation count variables because the assumptions of a continuous, normal distribution are violated by count data. Poisson models were used instead. Model coefficients, robust standard errors, and *p*-values are reported for all three models. For the ordinary least squares model, the F-statistics, Multiple R-squared and Adjusted R-squared are reported, while for the Poisson models, the Wald's Chi-Squared and Akaike Information Criterion are reported. Models were checked for heteroskedasticity, multi-collinearity and robustness of the results to outliers, none of which were found to be a concern. Quasi-Poisson models for the policies and implementation principles indicated over-dispersion was not a concern.

5. Findings

5.1. State planning policy context

Table 5 indicates strong positive relationships ($p < 0.05$) between comprehensive planning mandates with and without requirements for hazards elements and incorporation of land use approaches into the fact base and implementation principles. With regard to the fact base, operating under state planning mandates may have led jurisdictions to adopt higher numbers of land use actions prior to their hazard mitigation planning process, thereby resulting in more land use approaches available to be assessed. In addition, jurisdictions that have previously used participatory processes to prepare a comprehensive plan may have higher levels of awareness of land use policies, including among emergency managers leading hazard mitigation planning processes. Comprehensive planning processes may also have led to stronger connections between emergency managers and the local planners with primary responsibility for land use policies. Higher levels of awareness of land use planning and stronger connections between emergency managers and local planners may make it more likely that land use approaches will be assessed and included in the fact base. The positive relationships of mandates in the implementation model may be attributable to the same mechanisms just described for the fact base. In addition, participation in comprehensive planning processes may cause emergency managers to recognise the importance of providing specific, credible information about how policies will be implemented.

Notably, there is little confidence ($p > 0.1$) in the relationships detected between mandates and proposed policies (policies principle). The lack of statistically significant relationships may be due to jurisdictions developing their policies and actions to gain eligibility for project-oriented FEMA post-disaster grant funding rather than developing comprehensive mitigation policies. Looking at the types of mitigation policies and actions included in the mitigation plans in the 175-jurisdiction sample used in this study is revealing. For discrete projects that are fundable through FEMA grants mean scores on a 0 to 10 scale are 6.0 for emergency services (e.g. buying generators), 3.4 for property protection (e.g. retrofitting buildings) and 3.3 for structural controls (e.g. levees). Each of these means is more than three times that for preventative land use policies and programmes (1.0 on a 0 to 10 scale), which are more dependent on local political commitment than external funding.[3]

Table 5. Results of multivariate regression models explaining incorporation of land use policies into local hazard mitigation plans

	Fact base principle OLS coefficient (Standard Error)	Policies principle Poisson coefficient (Standard Error) *IRR*[a]	Implementation principle Poisson coefficient (Standard Error) *IRR*
Intercept	0.588 (0.234)*	1.035 (0.365) *2.81***	0.110 (0.324) *1.11*
Planning process			
Jurisdiction planner [b]	0.197 (0.144)	0.866 (0.226) *2.38****	0.512 (0.224) *1.67**
Other planner [b]	0.183 (0.162)	0.092 (0.244) *1.10*	0.290 (0.235) *1.34*
Diversity of groups	0.004 (0.018)	−0.039 (0.023) *0.96.*	−0.043 (0.018) *0.96**
State policy context			
Mandate with hazards [c]	1.074 (0.144)***	0.252 (0.182) 1.29	0.522 (0.225) *1.69**
Mandate w/o hazards [c]	0.684 (0.170)***	−0.168 (0.300) 0.85	0.606 (0.311) *1.83.*
Local community context			
Population density	−0.031 (0.033)	−0.120 (0.056) *0.89**	0.005 (0.046) *1.00*
Previous disasters	−0.071 (0.031)*	−0.188 (0.043) *0.83****	−0.129 (0.040) *0.88***
Population growth	−0.001 (0.002)	0.001 (0.003) *1.00*	−0.017 (0.007) *0.98**
Community wealth	−3.1e-7 (4.1e-7)	−3.9e-8 (5.5e-7) *1.00*	−8.4e-7 (5.5e-7) *1.00*
Proposed actions			
Land use actions [d]	NA	NA	0.336 (0.059) *1.40* ***
n	175	175	175
F-statistic	12.92 on 9:165 DF		
F-statistic p-value	0.0000		
Multiple R-Squared	0.2864		
Adj. R-Squared	0.247		
Wald Chi-Squared		111.50	142.41
Wald Chi-Squared *p*-value		0.0000	0.0000
AIC		468.53	503.37

Notes: Significance codes: ***significant at $p < 0.001$; **significant at $p < 0.01$; *significant at $p < 0.05$; '.'significant at $p < 0.1$

[a] An incidence rate ratio (IRR) is an exponentiation of the Poisson model regression coefficient. An IRR value greater than 1.00 denotes a positive relationship between the independent and dependent variables, while a value less than 1.00 denotes a negative relationship. An IRR of 1.25, for example, can be interpreted as indicating that a one-unit increase in the independent variable is associated with a 25% increase in the expected count of the dependent variable. An IRR of 0.75 indicates that a one-unit increase in the independent variable is associated with a 25% decrease in the expected count of the dependent variable.

[b] The reference category is involvement of no planners.

[c] The reference category is no state mandate for local comprehensive planning. California, Florida and North Carolina are Mandate with hazards states, Washington is a Mandate without Hazards state, and Georgia and Texas are no Mandate states.

[d] The number of land use actions proposed in the plan is included to control for the number of opportunities to provide implementation information.

5.2. Planner and stakeholder involvement in the planning process

The relationship of local planner involvement to inclusion of land use approaches varies by the type of planner and the plan quality principle. Neither the jurisdiction's own planner nor the other jurisdiction planner was related to assessment of existing land use policies in the fact base ($p < 0.05$). The jurisdiction's own planner variable is statistically significant and positive for both the policies ($p < 0.001$) and implementation ($p < 0.05$) principles. Controlling for other variables in the model, the expected count of land use policies was 2.4 times higher (the Incidence Rate Ratio) for jurisdictions with their own planner on the hazard mitigation planning committee than for jurisdictions with no planner on the committee. The expected count of implementation information for land use policies was 1.7 times higher. No relationships were detected for other jurisdiction planners ($p < 0.1$). Simply having a planner from any one of the jurisdictions involved in a multi-jurisdictional planning process is not adequate for prompting a jurisdiction to propose new land use policies or strengthen existing ones. Instead, what appears to be important is jurisdiction-specific knowledge of what types of land use policies are politically feasible or technically possible more so than generic land use-oriented knowledge or skills.

Relationships between the diversity of stakeholder groups involved on the steering committee and incorporation of land use policies were only detected for the policies and implementation principles. Each additional group involved decreased the likelihood of inclusion of an additional land use policy and inclusion of additional implementation information, although the coefficients are quite small for both. Involving more types of groups may lead to competition for specific projects related to particular disciplinary affiliations (e.g. public works, public health, transportation, etc.), thereby reducing attention given to land use policies requiring broader-based discussion of regulatory priorities.

5.3. Local community characteristics

The only local community characteristic variable to have a consistently statistically significant relationship with incorporation of land use approaches in the fact base, policies and implementation programme ($p < 0.05$) was the number of presidentially-declared disasters in the 10 years prior to plan adoption (Table 5). The finding may indicate that as communities are hit repeatedly with disasters they focus less attention in the fact base of their plans on reviewing land use approaches available to reduce long-term risk and are less likely to include an additional land use policy or additional implementation information. Jurisdictions repeatedly focusing on securing external assistance for recovery may be ignoring land use approaches in favour of discrete projects eligible for federal grant funding in the wake of disasters, as discussed above. In addition, local officials in those jurisdictions may be consumed by managing and implementing large-scale post-disaster grants. The other three local community characteristic variables were not consistently statistically significantly related to the dependent variables.

6. Discussion

We now can answer the two research questions posed earlier. First, there is strong evidence that involvement of planners is related to the incorporation of land use policies in local hazard mitigation plans. Local planners are critical partners for integrating land use approaches into mitigation efforts. As explained below, a jurisdiction incorporates more land use policies into the future-oriented parts of its mitigation plan when represented by its own planner.

Planner involvement appears to be influential on the future-oriented proposal of land use policies and inclusion of implementation information. This finding reinforces the case of Lee County, Florida, showing strong connections between local planners and emergency managers can lead to deeper integration of land use and mitigation planning efforts (Godschalk 2010). Without local planners at the table, emergency managers and other officials on mitigation committees may not think to propose land use approaches or may be hesitant to commit to policies planners will have to implement. With local planners at the table, other stakeholders on the committee may come to recognise the importance of complementing other mitigation approaches with land use policies. Meanwhile, the lack of influence of planners on the fact base principle suggests that some other factor can result in emergency managers, or perhaps consultants involved in mitigation planning, having enough familiarity with local comprehensive planning to know to assess existing land use policies and programmes in mitigation plans.

The relationship between planners and incorporation of land use policies and implementation information depends on a jurisdiction having its own planner on the mitigation planning committee. Plausible explanations for why jurisdictions need to have their own planner involved are that jurisdiction's own planners bring locally specific knowledge (e.g. land use patterns, site-specific hazards and details of existing regulations), local regulatory responsibility (e.g. site and plan review), and knowledge about the values and positions of other local decision makers (e.g. elected officials and planning commissioners) on land use issues. These types of assets may enable a jurisdiction's planner to identify a feasible set of mitigation-oriented land use policies and provide the planner confidence and credibility for including potentially controversial or technically complex policies. It is a concern that in our large, multi-state sample only 35% of the jurisdictions (n = 62) were represented by their own planner. As long as the majority of local jurisdictions fail to include their planners in mitigation efforts, it appears that land use policies will continue to be under-utilised in mitigation plans.[4]

The answer to the second research question is that most of the variables found to influence the quality of mitigation planning in comprehensive plans appear to be influential on DMA-compliant, stand-alone hazard mitigation plans. All of the variables except median house value were related to inclusion of land use approaches into at least one principle of plan quality (see Table 5). Yet, the patterns of relationships for the individual variables are not uniform across all principles of quality and some relationships differed from prior research in important ways.

For the state planning policy context variable, the positive relationships between state mandates for local comprehensive planning and the fact base and implementation principles fit with previous research (Berke and French 1994; Burby and Dalton 1994; Dalton and Burby 1994; Berke *et al.* 1996). Comprehensive planning mandates can exert influence by building local planning capacity and commitment (Burby and May 1997), probably by building awareness among emergency managers and consultants of the need to assess existing land use policies and include specific implementation information. However, the lack of strong relationships of mandates to proposed land use policies indicate that the influence of mandates is limited. This finding contrasts with a strong positive influence of mandates on the adoption of land use policies for mitigation in comprehensive plans (Burby and Dalton 1994.) This apparent limitation on comprehensive planning mandates' abilities to build local capacity and commitment reinforces the importance of involving jurisdiction's own planners in mitigation efforts.

We find negative relationships between the number of different stakeholder groups and incorporation of land use into the policies and implementation principles. These findings contrast with Burby's (2003) detection of a positive relationship between the number of groups involved in comprehensive planning processes and inclusion of land use-oriented mitigation measures. An explanation for the divergence may lie in differences in the purposes of hazard mitigation plans and comprehensive plans, as viewed by local governments. Comprehensive planning efforts are focused on setting policy (Berke, Godschalk, and Kaiser 2006). More diversity in stakeholders in comprehensive planning processes may lead to participants pushing to broaden the scope of policy issues to consider, including hazards (Burby 2003). Evidence indicates that hazard mitigation planning under the DMA fails to substantially depart from historically reactive, project-oriented approaches to reducing disaster risks (Smith, Lyles and Berke 2013; Berke, Smith and Lyles 2012). Thus, more diversity in mitigation planning processes may lead to participants increasingly focusing on their own disciplinary silos in order to promote potential projects rather than collaborating to identify needed land use policy changes.

For the local community characteristics the pattern of findings varies, aligning with previous research in some places, but not others.[5] The negative relationships of the number of presidentially-declared disasters to all principles indicates that as communities are hit by more major disasters they are less likely to integrate land use policies focused on limiting development of unsafe locations into their plans. Communities are not using the 'windows of opportunity' that open following a disaster event (Birkland 1997, 2006) to push for major changes to where development is located within their borders as part of their mitigation plans. This finding aligns with Burby and Dalton's (1994) conclusion that in the wake of repeated losses there is limited local support for land use policies focused on guiding the location of future development. However, our findings do not fit with findings that chronic losses are related to adoption of more land use-oriented measures in comprehensive plans and repeated flood losses lead to adoption of more non-structural measures, including land use policies (Burby 2003; Brody, Kang, and Bernhardt 2009). The muddled picture of the influence of previous disaster experience may be indicative of different concepts and measures (e.g. chronic losses, repetitive losses, and number of major disaster event) used rather than directly contradictory findings.

There are limitations to these analyses. First, the cross-sectional research design is less powerful than a longitudinal design. Tracking evolutions in plan quality, planner involvement, and the other variables over time would enable further refinement of the conceptual model. Second, the three-level measure of planner involvement is an admittedly coarse metric. Unfortunately, detail in mitigation plans about the involvement of stakeholders in development of the plans is highly variable and, generally, very thin. More information about how planners actually participated in planning processes, especially on the strength of connections between local planners and emergency managers and planners' training, experience and skills, would increase understanding of how planners influence mitigation planning (Kartez and Faupel 1994). More information is also needed about planners' commitment, training and knowledge applicable to hazards planning (Burby and May 1997; Smith 2009) and the type of roles they assume in their work (Stevens 2010). It is also important that future research identifies and examines the factors that contribute to the involvement of local planners in hazard mitigation planning processes. Third, the three-level measure of state planning mandates (i.e. mandate with hazards element, mandate without hazards element and no mandate) is also coarse. Quantitative measures of the requirements of state planning mandates and about how they are implemented by state agencies would be useful (Berke and French 1994; Burby and May 1997; Deyle and Smith 1998).

7. Conclusion and policy implications

Planner involvement appears to have a strong positive influence on incorporation of land use approaches into Disaster Mitigation Act-compliant hazard mitigation plans. Jurisdictions propose more land use policies in mitigation plans and include more implementation information for those policies when their own planner is on the mitigation planning committee. Including local planners with place-based knowledge about the practical and political feasibility of potential land use policies appears to be critical. These findings may be relevant to planning processes in transportation, climate change, and other public policy domains that have important land use dimensions but are traditionally led by non-planning professions.

This study also shows that the factors previously found to drive the quality of hazard-related comprehensive plan quality are also important for DMA-compliant mitigation planning. However, we did find important differences in the apparent influence of those factors on incorporation of land use approaches into mitigation plans. Most significantly, no relationship was found between comprehensive planning mandates and proposal of more land use policies in mitigation plans. Thus, the extent to which local capacity and commitment built by planning mandates can be leveraged for hazard mitigation planning appears to be limited. In addition, as jurisdictions experience more major disasters they assess fewer existing land use policies, propose fewer land use policies, and include less information for proposed land use policies. A critical question is how can federal and state officials help frequently impacted communities consider more land use policies to break out of the cycle of repeated losses?

This paper also contributes to our theoretical understanding of the linkages between planning contexts, planning processes and planning outputs. Our multivariate regression models indicate that variables measuring multiple conceptual dimensions appear to have independent influences on hazard mitigation planning outputs. These findings are consistent with previous studies that have found that understanding intergovernmental policy implementation of hazard mitigation is improved by accounting for state and local contextual factors, as well as features of the planning process (Berke *et al.* 1996; Burby and May 1997; Brody 2003). Future research on these factors and their inter-relationships will extend the knowledge needed to develop high quality hazard mitigation plans.

We see three main policy implications of our findings. First, federal and state mitigation officials need to be more proactive in building local capacity and commitment. FEMA recently announced a new 'Whole Communities' initiative intended to strengthen local mitigation stakeholder networks (FEMA 2011). Local emergency managers should increase efforts to involve local planners for all participating jurisdictions, who in turn should reciprocate through active participation. Second, state and local officials need to be highly cognizant of the state policies and local community characteristics that increase inclusion of land use policies in mitigation plans. Federal and state officials can target capacity and commitment building efforts to reinforce and complement features of existing state planning policies and make up for locally constraining conditions. Third, the very low scores for land use incorporation into the fact base, policies and implementation principles of plan quality in our large, multi-state sample of plans indicate federal and state officials must be more proactive and aggressive in focusing local attention on preventative land use approaches to mitigation. FEMA should require jurisdictions to explicitly identify how they are using land use policies to reduce hazard risks now and how they plan to do so more effectively in the future. FEMA's emerging revisions to federal guidance for local mitigation plans provide a golden opportunity to do so.

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Notes

1. Only 25 jurisdictions were included in the sample for Georgia because that is the total number of coastal jurisdictions in the state that met the minimum population threshold.
2. We also assessed the reliability of our data using Krippendorff's alpha, as recommended by Berke and Godschalk (2009). Krippendorff's alpha is a more general agreement measure than percent agreement and is considered preferable for measuring reliability (Krippendorff 2004, Chapter 11). Alpha scores can range from 1.00 to -1.00, with lower scores indicating lower reliability. Individual item Krippendorff alpha scores in our dataset ranged from 0.80 to -0.06. We have elected to keep all of the plan coding data for two main reasons. First, Krippendorff recommends precaution in accepting or rejecting measured reliabilities under certain conditions, including when there is insufficient variation in the sample; that is when a potential score is rarely present in the dataset (Krippendorff 2004, Chapter 11). Many of the land use policies (i.e. policies such as density transfer provisions that are very useful for risk reduction are infrequently used by communities to do so) were rarely observed in our dataset, meaning our dataset meets this precautionary condition. Second, as noted in the text, our reliability scores using the traditional method were within the range of scores in the plan quality literature. Of more than 40 peer reviewed plan quality studies published to date, none have reported Krippendorff's alpha. Thus, there are no planning-specific benchmarks against which to compare our Krippendorff's alpha scores.
3. These data were generated through the same content analysis process described in the Research Design and Methods section. For more information on the items used for these indexes, see www.ie.unc.edu/cscd/projects/dma.cfm
4. A potential concern is that the relationship detected for the planner variable is in fact a spurious relationship because jurisdictions with more resources or larger populations may have a greater ability to have their own planners engaged in hazard mitigation planning. Inclusion of the median house value, as done by Burby and Dalton (1994), Berke *et al.* (1996) and Berke *et al.* (1999), addresses this concern somewhat by accounting for the resources available for a larger planning staff from the tax base. As an additional test, all three models were run including each jurisdiction's population prior to plan adoption as an independent variable. The population variable (logged) was not found to be statistically significant in any model in the fact base or policies models, but was in the implementation model (coefficient -0.107; p-value 0.032). Inclusion of the population variable did not affect the sign, magnitude or significance of any variables in the fact base, policies or implementation principles models in a way that would impact the interpretations presented in this paper.
5. The negative relationship of population density to land use policies fits with previous findings that as density increases the amount land available for development decreases, raising pressure to develop in hazardous locations (Burby and Dalton 1994). As density increases, communities may opt instead to pursue structural approaches (e.g. levees and seawalls) to try and protect vulnerable areas. We did not detect a relationship for community wealth (i.e. median house value), as has been found previously (Burby and Dalton 1994; Berke *et al.* 1996; Berke *et al.* 1999).

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