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Impacts of Local Government Perceptions of Disaster Risks on Land Resilience Planning Implementation

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Abstract: Local government managers play a critical role in sustainability and climate adaptation planning, and in relation to land-use policy, but little is known about how managers' hazard risk concerns influence the implementation of resilience policy or how this relationship may vary across different landscapes and types of hazards. Linking managers' disaster concerns to their planning choices is particularly relevant to resilience planning for adaptation to climate change, since greenhouse gas emissions are global but the harms produced by climate change are local. Moreover, climate adaptation planning encompasses risks from multiple hazards. For a sample of cities in the state of Florida, USA, we report the findings of empirical analysis of the relationships between local government managers' hazard-specific climate-related disaster concerns and their resilience-planning priorities for four types of hazards: river flooding, sea-level rise, storm surge and hurricane/tornado winds. Drawing on data from a survey of local disaster managers and policy data on the implementation of adaptation-planning actions, the link between managers' concerns and plan implementation is identified and compared across communities and across types of hazards. The pooled logit regression results reveal that the differences observed among these hazards persist even after controlling for objective risks and relevant community characteristics. We discuss the nature of the differences across four hazards and explore the implications of the findings for the literature on land use and climate adaptation and for the education of local government managers.

Keywords: local government; land use; climate adaptation; urban resilience; municipal managers; urban sustainability; implementation

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1. Introduction

Local government managers play a critical, although poorly understood, role in sustainability and climate adaptation planning, policy, and programs [1,2]. The increased frequency and intensity of natural disasters due to global climate changes have made their role even more critical.

A substantial body of literature probes how the institutions and powers of local government executives influence sustainability policy [2–9], but much less is known about how managers' perceptions or attitudes influence local implementation of these actions. In recent decades, several useful frameworks have been developed for understanding what influences local decisions to engage in planning and implementing adaptation policies in relation to climate-related hazards, but they assume that the hazard risk assessments that

are inputs to these decisions are based on objective risks, not the perceptions of the policy actors involved.

In 2009, the World Bank commissioned a research team of leading scholars on the urban climate risk to put forth a general framework designed to assist policy-makers in assessing and responding to the risks associated with climate change in cities [10]. In this urban climate risk framework, risk is defined as the product of hazards, adaptative capacity and vulnerability. The authors maintained that hazards have been a primary focus of existing research, leading to the neglect of other considerations. The adaptive capacity depends on the system of governance in place and the vulnerability of a city is determined by the internal characteristics of the city, such as the population, residents' incomes and size of disadvantaged populations. The urban climate risk framework has received much attention because of its general applicability across countries and cultures. Nevertheless, conspicuously absent from this framing is the role of local government managers' perceptions of hazard risks and how these concerns might influence anticipatory and precautionary actions to address the impacts of a changing climate.

The neglect of managers' hazard risks and concerns in conceptual and empirical models is especially unfortunate, given that governmental attention, constraints on administrators' discretion and turnover of local government officials have been linked to environmental and sustainability policies [11]. Some studies maintain that stakeholders in government positions prefer even less direct governmental involvement in disaster resilience [12]. While several studies have investigated the influence of local government attention to environmental issues [13], they have not focused on local officials' understandings of climate risk.

Evidence from local government leaders in China suggests that the personal characteristics of officials influenced environmental policy. When the audit requirements that constrained their discretion were implemented, it led to greater emphasis on the actual environmental governance and implementation [14]. Moreover, city-level political competition and political turnover have been found to have positive influences on responsiveness to environmental issues in liberal democracies [15] and authoritarian systems [13].

What little evidence we have of how managers' perceptions or attitudes influence local implementation of planning policies for climate adaptation is based on climate mitigation, not climate adaptation [5]. The literature on local climate change mitigation reports evidence that the concerns and priorities of local government managers influence sustainability policy decisions. One conclusion of this work is that differences in managers' attitudes need to be accounted for more fully in order to explain the variation among cities in their climate mitigation plans [7,16,17].

We argue that local managers' attitudes are even more important for understanding climate adaptation and resilience planning than for mitigation, since greenhouse gas emissions are a global phenomenon but the harms produced by climate change and the disasters and extreme weather events that result from climate change are typically quite localized and location-dependent. These impacts vary substantially across geographic regions and subregions.

A second limitation of the extant research is its tendency either to focus on a single type of hazard or to combine a large set of hazards into an aggregate index of climate risk. Adaptation planning and management often encompass multiple risks, such as river flooding, coastal flooding, hurricanes and severe storms, and sea-level rises. The risk of a particular hazard is often location-specific and varies across regions and even among communities within the same region. Thus, there is a need to identify and isolate risks from multiple individual hazards, rather than relying on aggregate indicators. There is a well-documented need for spectrally tailored analysis of climate hazards [18,19]. Campbell and Fainstein [20] argue that most city managers do not adequately address climate change in their management strategies because city-specific risks remain undefined.

Thus, this research contributes to the literature on hazard risk and local adaptation planning policy by beginning to fill two significant lacunas in the extant research. First, it

extends and modifies the urban climate risk framework by adding the hazard risk concerns of local government officials, in addition to more objective scientific assessments of the hazard risk. The impacts of managers' perceptions of hazard risks are then tested while controlling for objective risk measures and population characteristics.

Second, it identifies previously unrecognized hazard-specific differences in managers' risk perceptions that influence adaption planning and policy. The analysis that follows investigates the relationships between local government managers' concerns regarding various climate-related disaster risks and the specific resilience planning efforts directed to river cresting, coastal flooding, high winds, and storm surge for a sample of cities in Florida, USA.

The next two sections discuss the role of local land-use planning in climate hazard adaptation and describe the conceptual framework that guides the empirical analysis. The conceptual framework reviews the literature on local climate resilience planning and the roles of local government managers to advance a general hypothesis. The methods section describes the sample, survey instrument, data collection, and analyses. The results report risk concerns that are systematically related to the implementation of resilience policies. The concluding section discusses the implications of the findings for the local climate adaptation and resilience literature and for practice.

1.1. Land-Use Decisions and Climate Adaptation

Coastal regions are the interfaces where the land meets the ocean, comprising integrated systems with social and ecological landscapes [21]. A range of climate change and hazard impacts are particularly acute in urbanized coastal areas, where there is a dynamic and complex interaction of natural systems, land-use patterns, and socioeconomic systems in contexts that are highly heterogeneous [22]. Thus, disaster resilience-planning actions play a key role in connecting landscapes, cities, and adaptive land-use planning [23,24].

There is widespread agreement that climate change will continue to increase in frequency and intensity and affect greater numbers of communities [25–28]. More and more cities are applying a disaster resilience approach to frame their responses to climate change [13,14], although the public is sometimes unaware of the initiatives that have been approved [29]. A key consideration in whether local governments use a resilience approach to climate planning and land-use policies is the extent to which policy decision-makers' assessments of disaster risk influence local planning [30–32].

The perceptions of experts can shape the choices of resilience planning and policy actions [33,34]. At a global level, land-use change can influence disaster risk positively or negatively [35–39]. Local policy-makers can seek to harden infrastructure to maintain current and projected future land uses, or they can alter planning and land use regulations to restrict land uses and to redirect growth [40,41].

Resilience to extreme events can shape land-use and development patterns [42–45]. Social-ecological systems [46,47] are rapidly changing due to the interactions between natural hazards like tropical storms and hurricanes, urban settlement patterns, and development. These changes make coastal areas increasingly vulnerable to a variety of hazards due to the sensitivity of their natural environments. These complex and dynamic human–environment interactions can be studied using a resilience approach [47].

Torsten and Patt [48] draw upon insights from the literature on psychology and behavioral economics and offer a socio-cognitive model of land-use policy decisions to adapt to climate change that separates out the psychological steps to taking action in response to perception. Based on case studies conducted in Germany and Zimbabwe, they find that decision-makers' risk perceptions were identified as a major bottleneck in the adaptation process [48].

Keenan [49] reports a survey of officials engaged in land-use planning activities in local governments in the United States that evaluated multi-hazard planning activities. Large cities were reported to be more engaged in resilience planning, "which is consistent

with the logic of having greater resources and greater vulnerabilities to a greater diversity of hazards".

1.2. Conceptual Framework

Out of necessity, local governments around the globe play a critical role in adapting to climate-induced hazards. Many US city governments have adopted policies designed to increase their resilience to natural disasters and human-caused extreme events [50–52]. In fact, Gerber [53] argues that local governments in the United States have become central actors in addressing climate change as a hazard management challenge.

In disaster management, local governments are not only the first to detect and respond to a disaster, they are the key players in implementing resilience programs on the ground to minimize the impacts of disaster. The involvement of local government stakeholders is widely recognized as a critical component of successful disaster risk resilience planning [54].

1.2.1. Hazard-Specific Risks

Local preparation for and ability to plan for and mitigate damage from disasters vary significantly between different types of hazards, even in the same area. When an extreme event hits a community, it is the planning, hardening, and fortification for that specific type of disaster—not the overall resilience—that counts the most. Nevertheless, many studies have treated adaptation to disasters and extreme events monolithically, focusing on the overall community resilience and adaptation planning. Thus, it is necessary to unpack how a community's adaptive capacity differs across multiple hazards and a community's adaption policy portfolio. Since local government managers play such key roles in climate adaptation planning, policy, and programs [1,2], we identify how their understanding and concern about various hazards may be linked to the implementation of adaptation planning.

An extensive body of literature examines local climate adaptation planning, including place-based planning roles [55] and the types and forms of resilience in local planning [56]. In particular, local autonomy and capacity and the resilience potential of local government actions have been explored [16,57,58]. Despite the acknowledged importance of local government leaders in creating resilient communities, little is known about how urban resilience strategies are implemented in practice or how urban resilience activities are steered and directed [59].

City governments implement specific actions in pursuing a more resilient city and the intensity with which cities pursue these activities can vary tremendously [60]. Studies of climate adaptation planning have found that several factors influence the climate adaptation planning actions of local governments. These include the objective likelihood of a disaster occurring [61–63], population size [64–67], population income [68], the scope of economically and socially vulnerable populations, and political and administrative capacity [60,65,69–75].

These studies make important contributions to our understanding of local resilience planning, but they do not pay adequate attention to how the local managers' concerns about various disaster risks influence resilience and adaptation planning. This relegation of managerial risk concerns to a secondary role in empirical studies of resilience planning efforts is particularly unfortunate since, even within the same area, the perception of environmental risk by department managers varies substantially [76] and local government managers have the ability to shape the priorities and implementation of community plans in order to address extreme events and natural disasters [1,2,77,78].

1.2.2. Managers' Risk Perceptions

Local government managers' perceptions of risks to their community from various hazards may play a critical role in accounting for the variation in a community's preparation for different types of disasters. Our conceptualization of the adoption of resilience actions in local government assumes that the objective risk and hazards that a community is exposed

to will operate as the primary motivators of policy actions, but we also anticipate that local managers' hazard-specific concerns will shape disaster-planning efforts.

There is considerable evidence that who holds office makes a difference to city climate adaption as well as mitigation. When managers and public officials change, sustainability policies shift [5,13,79]. Case studies conducted in multiple cities link objective indicators of climate risk to city administrators' perspectives on hazard management.

Studies of urban climate change mitigation report evidence that local government managers' concerns and priorities influence city climate mitigation strategies [5,7,16,17]. With the exception of Shi et al. [65], no study has systematically analyzed the importance of different determinants of the adaptive capacity across a large number of cities, as has been performed for climate mitigation and sustainability policy [75].

Recent research reaffirms the need to understand the local context and individual motivations when planning for disasters and adapting to climate change [80]. Moreover, a study of local government officials in Taiwan found that officials who perceived the implications of climate change to be more severe were more likely to recognize the importance of adaptation plans [81].

Figure 1 summarizes this simple model. The key innovation is including managers' hazard-specific disaster concerns in addition to objective hazard risks.

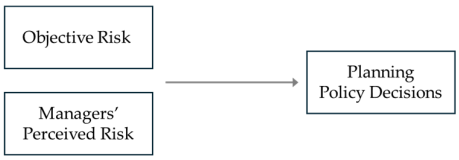

Figure 1. Linking managers' hazard concerns to planning policy implementation.

This model is tested using the following equation, with planning efforts as the dependent variable. The full pooled GLM equation indicates that the expected value of the log-transformed planning efforts is modeled as a linear combination of the intercept, managers' risk perceptions, and objective hazard risks.

$$log(E(Y_i)) = \beta_0 + \beta_1(Risk\ Perception_i) + \beta_2(Objective\ Risk_i) + \epsilon_i$$

where:

Y_i is the planning efforts for the ith observation.
$Risk\ Perception_i$ is the managers' risk perception for the ith observation.
$Objective\ Risk_i$ is the objective hazard risk for the ith observation.
β_0 is the intercept.
β_1 is the coefficient for the managers' risk perceptions.
β_2 is the coefficient for the objective hazard risks.
ϵ_i is the error term for the ith observation.

In addition to the objective risk and managers' perceptions, we need to control for relevant community characteristics. Local governance and population factors have often been linked with land-use decisions, particularly those related to sustainability, particularly the city size, income, administrative capacity, and economic resources. Drawing from the urban climate risk framework [10] and previous empirical studies of land-use planning adoptions [79], we include the local governance structure to capture the economic and political capacity for adaptation and relevant population. Based on this framework, we advance the following hypothesis:

> *Local government managers' perception of the risk that specific hazards might seriously and negatively affect their municipality in the next 10 years in terms of physical and economic damage will be positively related to disaster resilience planning.*

To the extent to which previous studies have examined managers' concerns regarding climate risk, they have either focused on overall or general resilience planning or focused

exclusively on a single risk. Guided by the conceptual framework in Figure 1, we test this hypothesis with a systematic examination of the managers' perceptions or concerns regarding the climate risk across multiple individual hazards and examine how these managerial perceptions link to specific disaster resilience efforts. The following section details the design, measures and analytic techniques applied to test the hypothesis:

> *Local disaster resilience planning policy implementation will be positively related to managers' perception that specific hazards might seriously and negatively affect their municipality in the next 10 years in terms of physical and economic damage.*

2. Materials and Methods

Florida provides an ideal testbed for examining the relationship between managerial risk perceptions and disaster resilience. First, there is substantial variation in the disaster risks because of the frequency and variety of disasters occurring in the state. Second, there is great variation in the vulnerability due to the diverse coastal landscapes. Third, there is great variation in the population and income among coastal communities. Fourth, the state government has long-standing requirements for cities to report the provisions of their comprehensive plans related to disaster adaptation and resiliency and to report amendments to these plans. Fifth, Florida has a strong tradition of professional local government management. Data on disaster resilience planning targeted toward river flooding, coastal flooding related to sea-level rises, storm surges, and wind damage from storms, as well as managerial perceptions, were collected from a sample of local government administrators in Florida's coastal communities.

The primary instrument used for data collection was an internet survey of the population of coastal cities in Florida. In 2018, the Florida League of Cities (FLC) conducted a survey of all the coastal Florida municipal governments regarding disaster resilience and climate adaptation. Surveys were directed to the local manager responsible for disaster resilience planning. In many larger city governments, there was a position with designated responsibility for disaster resilience, or the responsibility belonged to the planning director. In small municipalities, the city manager's office often filled this role. Completed surveys were received from 62 cities, a 24.9 percent response rate.

2.1. Hazard Level Variables

Each manager's perception of risk to the community from the hazard, the implementation of plans to address the hazard, and a measure of the objective risk for the community from that hazard were measured individually for each hazard in each city.

To measure the managers' risk perceptions, the questionnaire included a set of four questions that queried local managers regarding their perceptions of the risk to the community from inland flooding from river cresting, rising sea levels, expanded storm surge zones, and hurricane/tornado high winds. The questions were worded such that for each of the four hazards, managers were asked about their concern that a specific hazard "might seriously and negatively affect your municipality in the next 10 years in terms of physical and economic damage". The order of the questions was randomly presented to respondents. Each respondent indicated their level of concern on a 5-point scale from not concerned to extremely concerned.

To measure the implementation of plans to address the hazard, these managers were also asked about their city's implementation of actions to address these risks. The State of Florida specifies elements of Florida municipal governments' comprehensive plans and defines planned actions to address each hazard, but implementation is the responsibility of the local government. The implementation actions directly linked to the four hazards examined here are identification and planning for community areas that experience repeated flooding; creation of a coastal land-use inventory and land-use map; construction of a vulnerability assessment for storm surge; and changes to codes to require climate-proof ongoing public infrastructure improvements and development efforts. Respondents identified the extent to which these specific planning activities have been undertaken by their government. For

each of the four planning activities, we identified whether they have been implemented by the respondent governments. This binary variable was coded 1 if the activity had been implemented and 0 if it has not been implemented.

To measure the objective risk for the community from each of the four hazards identified in the survey, we added objective measures of the level of risk of loss and damage related to each of the four hazards examined here. In the US, the Federal Emergency Management Agency (FEMA) constructs local-area natural hazards risk scores for flooding, storm, and wind hazards as components of the National Risk Index. These are matched to the corresponding hazards in the survey. Because FEMA does not report a local-area risk index for sea-level rises, we take the NOAA estimate of the sea-level rise risk for future populations. Each of the four indices has a unique component and so they are scaled differently. To ensure comparability across the four hazards, we calculated standardized z-scores to provide a standardized measure of the magnitude of objective risk across the four hazards. These four hazard-specific objective risk factors parallel the subjective risk perception of city disaster managers measured by the survey instrument responses.

2.2. City-Level Variables

City-level variables were added to each observation to control for the local governance system and population characteristics that have been strong predictors of city-level climate policy actions in previous research [8]. Larger cities have greater resources and greater vulnerabilities to a greater diversity of hazards [49]. The professionalism of governance is measured by the municipal form of government. In the US, two forms of government dominate: under a council-manager form of government, a professional public manager is hired as chief executive to run the city based on best management practice and with a long-term orientation; conversely under a mayor-council form of government, the executive is an elected politician with a more short-term election-focused orientation [15,82–89]. The form of government information is compiled by the Florida League of Cities. This variable is coded 1 for the council-manager form of government and 0 otherwise.

The city population size has proven to be the best predictor of local climate mitigation [15,89,90]. Smaller communities face many barriers to adaptation planning [64]. Larger governments tend to have more stable tax bases and resources, which are necessary to take action themselves and to access to environmental intergovernmental climate networks [60,78,83]. We measure the city size based on the 2010 US Census or population.

Economic resources are also salient. More affluent communities hold obvious advantages in supporting adaptation actions and household income has been a predictor of sustainability policy actions [15,88,89]. Community economic resources are measured by the 2010 median income as reported by the US Census. Racial minorities are often the populations most vulnerable to hazards [91,92]. Racial minorities are measured with the proportion of the population that is non-white reported in the 2010 Census.

2.3. Analysis Methods

Descriptive statistical analysis is applied to identify managers' risk perceptions and their distribution across cities. Perceptions of the four hazards are examined separately and compared. Next, the descriptive analysis is extended to policy implementation for adaption policies linked to the four hazards. The proportions of cities implementing or not implementing each are identified and compared. A correlation analysis follows. First, the bivariate relationships between managers' perceptions are examined. Then, the analysis is repeated when controlling for the measures of objective risk. Finally, a full model of policy implementation that includes hazard-level and city level variables is estimated as a GLM with a probit link that applies clustered robust standard errors for the estimates.

3. Results

3.1. Descriptive Analysis

After examining the patterns of risk perception and plan implementation across cities, we report the test results of statistical tests testing our hypothesis that disaster resilience planning is positively related to local government managers' perceptions of hazard risks.

Table 1 reports managers' levels of concern regarding flooding, sea-level rises, storm surges, and high winds. Managers reported their levels of concern that each of the four hazards might seriously and negatively affect their municipality in the next 10 years in terms of physical and economic damage. All four of these hazards are concerns for resilience managers of coastal cities in Florida. Almost three-fourths reported at least some concern regarding all four. Over half (58 percent) of the managers were very or extremely concerned regarding damage from high winds. Almost 47 percent were very or extremely concerned about storm surges.

Table 1. Managers' reported level of concern across four hazards.

Hazard	Not Concerned	Slightly Concerned	Moderately Concerned	Very Concerned	Extremely Concerned
Major short-term flooding	2.4%	21.4%	31.0%	22.6%	22.6%
Rising sea levels	26.0%	18.4%	26.2%	14.5%	14.5%
Expanded storm surge zones	25.3%	16.0%	12.0%	26.7%	20.0%
High winds	1.2%	9.4%	30.6%	35.5%	22.4%

Table 2 reports the status of the city's hazard plan implementation. The results clearly indicate that implementation of these programs is far from universal. For each of the four policies, the majority of city governments have either not implemented or only partially implemented the appropriate policies.

Table 2. Hazard plan policy implementation status.

Policy Implementation	Not Implemented or Incomplete	Implementation Complete
Required official identification of community areas that experience repeated flooding plan status	52.1%	47.9%
Conduct a vulnerability assessment for storm surge plan status	80.8%	19.2%
Create land use and inventory map of coastal uses plan status	77.8%	22.2%
Changed code to require climate proof ongoing public infrastructure improvements and development efforts plan status	75.0%	25.0%

3.2. Hypothesis Tests

We provide preliminary support for our hypothesis in the correlation analyses reported in Table 3. Managers perceived climate risks to be positively related to the implementation of hazard reliance-planning actions. Both the bivariate relationships and the multivariate relationships controlling for objective risks reported positive effects. Column one of Table 3 reports the bivariate correlation between managers' risk perceptions and disaster policy-planning implementation. The coefficients indicate that a manager's level of hazard concern is positively and significantly correlated with the level of implementation of a vulnerability assessment for storm surges, creation and use of a land-uses map for coastal land uses, and code changes for climate-proofing public infrastructure. The exception is the positive relationship between managers' perceptions of flooding risks and implementation of plan

requirements to identify areas that experience repeated flooding, which does not achieve statistical significance.

Table 3. Correlation of managers' perceptions with implementation when controlling for risk.

Policy Implementation	Bivariate Correlation with Manager Perception	Correlation with Manager Perception Controlling for Objective Risk
Required official identification of community areas that experience repeated flooding plan status	0.09	0.08
Conduct a vulnerability assessment for storm surge plan status	0.34 **	0.31 **
Create land use and inventory map of coastal uses plan status	0.38 **	0.36 **
Changed code to require climate proof ongoing public infrastructure improvements and development efforts plan status	0.54 **	0.49 **

** significant at 0.05.

Both managers' concern and program implementation might be a response to the objective risk of damage from a particular hazard. To account for this possibility, the second result column of Table 3 reports the partial correlation coefficient, controlling for the measures of objective risk. The policy responses to managers' concern for sea-level rises, storm surges, and damage from high winds remain strong and robust. Each of these relationships remains statistically significant.

The standard errors include measures of hazard-specific objective risks as well as city-level factors. The dependent variable is again the indicator of the plan implementation status. The analysis follows an approach often used in studies of city service delivery modes where there are service-level-dependent and -independent variables and city-level control variables. Applying this approach, we pooled the data for analysis to control for the hazard types [93,94]. The data are stacked so that there are four observations for each city.

The model was estimated as a GLM with a probit link. Plan implementation, the dependent variable, as well as the objective hazard risk z score, and the measure of managers' concern differ by hazard and vary within the four observations of each city. City-level variables are added to each observation to control for the form of city government, population, median income, and percent of the population that is non-white [8]. Since these measures are the same for each of the four observations of each city, we need to correct the standard errors post estimation.

The results reported in Table 4 offer strong support for the hypothesized relationship between the city administrator's concern about risks from specific hazards and the implementation of planning policies addressing the hazard. The coefficient estimates for managers' hazard concerns are positive and remain significant even after accounting for the measures of objective risk for each hazard and city-level control variables. The coefficient for the municipal form of government did not achieve statistical significance. Among the controls for community demographic characteristics, only the median income was significant. This finding is consistent with research linking resilience programs to city fiscal capacity [65].

Table 4. Estimates of adaptation plan implementation.

Parameter	B	Std. Error	t
(Intercept)	−4.018	1.134	−3.543
Manager's Hazard Concern	0.686 **	0.160	4.299
Objective Hazard Risk	0.120	0.213	0.563
Council Manager Government	0.732	0.387	−1.894
2019 Population	0.00012	0.00014	0.794
Median Income	0.00198 **	0.00090	2.196
Percent Nonwhite	−0.0290	0.972	−0.030
Nagelkerke Pseudo R^2 = 0.18			

** significant at 0.05.

4. Discussion

This paper begins to fill the lacuna in our understanding of how public managers' understanding of risks from multiple hazards influences policy implementation. The analysis of local governments in Florida's coastal communities examined the relationship between local government managers' concerns regarding various climate related disaster risks and specific resilience planning efforts directed toward river cresting, coastal flooding, high winds, and storm surges for a sample of cities. The pooled GLM model estimation that combining all four hazards offers strong support for the hypothesized relationship between managers' risk perceptions and policy implementation. These relationships remain strong even when communities' levels of objective risks from a hazard are controlled.

This analysis provides confirmatory evidence that supports for our hypotheses that managers' perceptions of risk predict the implementation of hazard resilience-planning policy actions. In fact, the analysis in Table 4 suggests that managers' concern has greater influence on policy implementation than the objective risk. These results have implications for the literature addressing the factors shaping local government disaster resilience. Pervious work has linked local government managers' perception to climate change mitigation policy, but not to climate change adaptation [65,79,80]. Mitigation and adaptation differ in important ways, but we find they are influenced by public managers' perceptions in a similar manner.

These results highlight the importance of managers' understanding of the risks and consequences of climate change and disasters in their communities. This has potentially important implications for professional education and training. While local government managers can be drawn from many fields and specializations, most managers have training in either planning or public administration. Undergraduate and graduate programs in planning very often have required components on climate, infrastructure and hazards. The same is not true for public administration, as these components are typically not part of the core curricula. The salience of managers' understanding of these issues, as indicated by the findings of this analysis, suggests that reform of public administration curricula might be warranted.

Local government managers have been seen as critical to urban resilience, but much of the literature has focused on the formal powers of local executives, the organization structure of municipal departments, or whether a city has a council manager- or mayor-council form of government [3,79,80]. In contrast, the results presented here indicate that it is not the form of government but instead the perceptions of individual managers responsible for resilience and adaptation that cause the differences in the implementation of resilience plans.

Previous research has also been limited by its focus on either a single type of hazard or an aggregate index of overall climate risk vulnerability. The approach here, which unpacks perceptions and hazard risks across multiple risks, offers a more robust and powerful tool for identifying managerial influences on policy actions. Adaptation planning and management often encompass multiple risks that can be location-specific. Thus, there is a

need to identify and isolate risks from multiple individual hazards rather than to rely on aggregate indicators.

The primary limitation of this research is its reliance on cross-sectional data. Going forward, the creation of longitudinal datasets promises to non-incrementally advance our understanding of the manager's role in addressing local climate change impacts. There is also a need for future research to investigate factors beyond the objective risk that shape local managers' perceptions of the disaster risk across multiple hazards. The finding that differences in the perceptions of community disaster risks among local government managers affect resilience implementation begs the question of what accounts for these differences in managers' perceptions. This knowledge might be particularly valuable when there is divergence among local officials in areas sharing the same objective hazard risks.

In conclusion, this paper sheds light on the critical role that public managers' perceptions of multiple hazard risks play in shaping the implementation of resilience-planning policies. The analysis of Florida's coastal communities demonstrates a significant relationship between managers' risk perceptions and resilience-planning efforts, even when controlling for objective hazard risks. This evidence underscores the importance of managers' understanding of climate-related risks in influencing policy actions, with implications for professional education and training. While planning programs often incorporate climate and hazard components, public administration curricula may benefit from similar reforms to enhance managers' preparedness for climate change adaptation.

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