

Floodplain Managers' Perceptions of Community Flood Concern, Mitigation, Preparedness, and Response in the United States

Introduction

Since the start of the new millennium, there has been a growing interest in understanding the methods communities use to manage their flood risks (Sadiq et al., 2019; Tyler et al., 2019). This interest largely stems from increases in the frequency and scope of flood disasters in recent years (Tyler et al., 2019). Studies show floods are the costliest and most destructive weather-related hazard, causing 82 deaths and costing the United States nearly \$8 billion each year, on average (National Oceanic and Atmospheric Administration [NOAA], 2018). Numerous examples of flood disasters showcase the impact floods have on both inland and coastal communities. The 2016 Louisiana Floods, for instance, killed thirteen individuals as nearly 30 inches of rain fell over a three-day period (National Weather Service [NWS], 2016). Similarly, Hurricane Harvey in August of 2017, dropped more than 60 inches of rainfall in Southeastern Texas over eight days (United States Geological Services [USGS], 2018). Hurricane Harvey caused an estimated 125 billion in damages and killed 68 individuals, the highest death toll from a hurricane in Texas since 1919 (NOAA, 2018). Moreover, Hurricane Harvey, which made landfall three times (Boman et al., 2020), impacted community institutions, such as the closure of 181 schools in Texas, affecting students, families, and those that work in the school system (Lambiese & English, 2021). The devastating impacts floods have on communities is not unique to the United States, however. Floods killed more than 220,000 individuals globally between 1980 to 2013, and the global direct economic losses from floods exceeded one trillion dollars during the same time period (Winsemius et al., 2016). “Societies have to manage and live with flood risk. Real-time forecasts, warning and well-functioning emergency plans help in saving both lives and livelihoods” (Boutkhamouine et al., 2020, p. 215).

A recent review of the community flood risk management literature indicates that scholars have largely focused on how communities can reduce their flood risks (Sadiq et al., 2020). This includes identifying the specific structural (e.g., constructing dams and levees) and non-structural (e.g., local ordinances and flood insurance) mitigation strategies that are the most effective at reducing communities' flood losses. The Federal Emergency Management Agency's (FEMA) Community Rating System (CRS) program represents another area of inquiry that has received significant empirical attention (Sadiq et al., 2020). The CRS is a federal, voluntary program that provides incentives to communities to engage in additional floodplain management activities by offering reductions in flood insurance premiums. The vast majority of community flood risk management studies published to date have employed quantitative data from a variety of secondary data sources (Sadiq et al., 2020). Albeit insightful, there is a need to obtain the perspectives of those in charge of managing community's flood risks—floodplain managers (Tyler et al., 2019).

The purpose of this study is to understand floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods. We examine these perceptions using both quantitative and qualitative data gathered from interviews with 200 floodplain managers in the United States. We specifically explore the following research questions: (1) What are floodplain managers' perceptions of their community's concern for floods? (2) What are floodplain managers' perceptions of their community's ability to mitigate, prepare, and

respond to floods? (3) What factors support and undermine floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods? It is important to note from the outset that studies examining perceptions are inherently subjective. Nonetheless, studies have demonstrated subjective, perception-based measures are particularly helpful when evaluating performance (e.g., Adams et al., 2005) because they provide additional context to objective-based measures, such as internal performance measures (Shingler et al., 2008).

Understanding floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods will provide additional context to already developed flood performance measures, such as the number of flood mitigation measures a community is adopting, thus providing a more comprehensive understanding of communities' ability to manage flood risks. Additionally, answers to the research questions will contribute to the broader community flood risk management scholarship in meaningful ways. For example, the results from the quantitative analyses offer insights on communities' level of concern about flood hazards as well as current flood mitigation, preparedness, and response capabilities in the United States. The qualitative results provide information on why floodplain managers selected their ratings for flood concern, mitigation, preparedness, and response. Practically, this provides floodplain managers and policymakers with knowledge of the factors supporting and undermining communities' ability to manage floods hazards.

In the following section, we review the literature on flood risk management. Then, we discuss the data and methods, including the interview process and variable measurements. Next, we describe the analytical technique and present the results of both the qualitative and quantitative analyses. We conclude by discussing the implications of the results and offering some questions for future researchers to explore.

Literature Review

Flood Risk Management

It is expected that climate change and sea level rise will exacerbate flooding, which increases the vulnerability to and potential impacts of flood events (Church & White, 2011; McBean & Henstra, 2003; Nicholls & Cazenave, 2010; Solomon et al., 2007; Vitousek et al., 2017). These impacts include flooding events that damage homes, individual and community assets, and loss of a region's coastal wetlands (Nicholls et al., 1999). Given the potential to disrupt and diminish the quality of life of individuals and communities, environmental hazards are increasingly becoming salient issues for government (Lindell & Prater, 2000; Terpstra & Lindell, 2013; Brody et al., 2008).

Schanze (2006, p. 6) defines flood risk management as a "holistic and continuous societal analysis, assessment, and reduction of flood risk." This management process is comprised of actors that make decisions regarding the pre-flood, flood event, and post-event. This process is similar to the functions of a local emergency management department; however, the key difference between the two functions is that local emergency management focuses on all disasters and emergencies, while flood risk management focuses on a community's floodplain management program. Under the guise of flood risk management, there are three components that structure management activities: risk analysis, risk assessment, and risk reduction.

Risk analysis refers to the process of determining a flood hazard, the flood vulnerability, and flood itself. For example, floodplain managers may use instruments such as risk maps. Maps

have been found to improve responses to past disasters like the 2010 Haiti earthquake (Turk, 2020). In the context of flooding, maps can provide information like flood probability, flow velocity, and water level to enable those interested in flood impacts to better predict the probability of flooding.

Risk assessment, the primary focus of this research, “is a process to identify potential hazards and analyze what could happen if a hazard occurs” (Ready.gov, 2021). The term denotes the process of managing information and signals about uncertain events (Slovic, 1987; Wachinger et al., 2010). It is assumed that flood risk perceptions can provide useful insights into the development of flood risk management (Bubeck et al., 2012). This information is often derived from personal experience, indirect experience, various alerts and signals, and other contextual and situational factors. Risk perceptions are claimed to be a motivating factor to avoid, adapt, or ignore risks (Leventhal, 1970; Lindell & Hwang, 2008; Rogers, 1975; Sun & Xue, 2020).

Understanding the perceptions of floodplain managers that influence decision making in flood management may yield improvement of a city’s participation of in risk reducing programs such as the Community Rating System (CRS). Risk reduction refers to the use of interventions to manage flood events (Intergovernmental Panel on Climate Change [IPCC], 2013). Flood management approaches to reduce the impacts associated with flooding have traditionally been through structural measures (e.g., dikes, levees), nonstructural measures (e.g., forecast warnings), and policy instruments (e.g., land use planning). Practitioners that engage in flood risk management realize that the sustainability of long-term flood defense structures will not be adequate to cope with the more frequent and intense flood events (Treby et al., 2006). This is because the impacts of flooding are expected to exceed the design capacity of many structural measures (Brody et al., 2010; Coulthard & Frostick, 2010).

Within the flood risk management system, floodplain managers are government employees who oversee a community’s flood risk management program. They oversee specific floodplain management functions, such as predicting flood events, identifying consequences for a community and marginalized groups, and enforcing a community’s flood prevention ordinance (Tyler et al., 2019). A primary function of many floodplain managers is managing the strategies related to structural and non-structural measures. For example, many floodplain managers serve as coordinators in participating CRS communities, thus overseeing activities to engage and implement flood reduction activities to receive discounts on flood insurance premiums. While the administrative responsibilities of floodplain managers differ widely across states, they are often given the power to identify and enforce floodplain regulations (FEMA, 2018). Increased participation in the CRS may improve the overall access and affordability of private household adaptive behaviors (e.g., flood insurance) to reduce vulnerability in coastal communities (Landry & Li, 2012).

Factors that Impact Flood Perceptions

To achieve better flood risk management, scholars have suggested a further exploration of the perceptions of floods, flood concern, and flood mitigation. The extant literature has largely focused on communities where the unit of analysis is individuals or households who reside in a flood risk area. The literature suggests that perceptions of flood concern and mitigation are influenced by a variety of factors such as personal characteristics, experience with flooding, proximity to a large body of water and flood concern.

Personal characteristics. Individual's knowledge of flooding, climate change, and sea level rise varies across populations such as differences in culture, geographies, and gender (Leiserowitz, 2006; McCright, 2010; Sundblad et al., 2009). Personal characteristics analyzed throughout studies have generally focused on gender, age, race and ethnicity, and income. For example, women have been shown to have more concern over the risks associated with natural hazards such as flooding and the effects of climate change (Brody et al., 2010; Leiserowitz, 2006) while men have been shown to be less concerned with natural hazards and climate change (Flynn et al., 1994). Other studies have found that women, in general, are more likely to view the world as risky and seek to take measures to reduce the impacts of environmental hazards through voluntary action. On the contrary, men are more likely to invest in low cost, nonstructural efforts such as supporting government policies.

The perceptions of various races and ethnicities have also garnered interest in the risk perception literature. Researchers have found natural hazards have disproportionate impacts on race and ethnic minorities (Pastor et al., 2006). Perhaps, this is partly why ethnic minorities tend to have higher perceptions of natural hazards than non-White ethnicities. In a study by Blanchard-Boem (1997), the researchers reported that blacks were more likely to report a concern over an earthquake damaging their home than non-black ethnicities. Turner et al. (1980) studied the risk perceptions variance among racial groups concerning earthquakes in California. Differences were discovered amongst racial groups where blacks were more fatalistic about their concern of earthquakes while Mexican Americans and whites were equal about their fatalistic feelings. Contrary to other studies, in a study of floods in South Carolina, there were no significant differences found among racial groups (Ives & Furuseth, 1983; Turner et al., 1980).

Experience with flooding. Personal experience affects how individuals learn about and perceive risks. Arguably one of the most consistent predictors in risk perception research, past experience, contends to be the most influential construct in psychometric studies. Previous hazard experience generally is found to heighten flood concern (Lara et al., 2010; Miceli et al., 2008). An individual's experience with a hazard can be defined by both the frequency and level of damage experienced by the individual, their family members, and their immediate social network (Lindell & Hwang, 2008).

Proximity to water. Proximity or distance from a risk plays a role in shaping perceptions of flood risk and concern (Tyler et al., 2021). The physical exposure to environmental hazards, such as a river or low-lying area, are often correlated to flood risk perceptions. For example, Lindell and Hwang (2008) examined the relationship between hazard proximity and risk perception of households in Texas. Their findings revealed that people who reside farther away from large bodies of water (e.g., rivers, coastlines, and other alike) reported less concern over perceived severity and consequences of floods and hurricanes.

One assertion concerns how individuals choose their residency by maximizing space, accessibility, and environmental amenities (Fujita, 1989). This implies that some individuals may accept risks based on the recreational benefits associated with living near access to water. This proposition was also suggested by Wachinger et al. (2013) where individuals choose to accept the risks of living near bodies of water where 1) individuals understand their risks but the recreational benefits outweigh the associated risks (e.g., private boating, fishing), and 2) perceived social benefits (e.g., living in or near wealthy communities to sustain a perceived social status).

Data and Methods

This study uses data from floodplain managers in 200 communities in the United States. These 200 communities were selected through an in-depth matching procedure describe below, which is based on whether the community participates in the CRS program. Therefore, 100 of the communities in the sample participate in the CRS, and the remaining 100 do not. We identified two conditions for communities to be considered for selection as part of the CRS-participating communities' group: (1) the community had to be participating in the CRS in 2013; and (2) the community had to have observed values for all covariates. The covariates in this study include several flood-risk variables like flood damage and the population-weighted flood risk for the county as well as socioeconomic variables, such as population density, proportion of the population that is White, and median housing value. The data for these covariates were gathered from FEMA, the Spatial Hazard Events and Loss Database for the United States (SHELDUS), and the US Census. Out of the 1,172 communities in the CRS, we identified 1,169 communities that had data on all observed covariates and could be randomly selected to participate in the study.

To identify the 100 non-CRS matches, we used a sample of 21,804 communities that are able to participate in the CRS but do not. We then used propensity score matching (PSM) to identify 100 non-CRS matches as well as the four nearest neighbors for all 100 non-CRS matches since it was unlikely that we would be able to secure interviews for the first 100 selected. By using this matching procedure, we are able to ensure that each pair of CRS and non-CRS participating community is as identical as possible regarding their probability of participating in the CRS. While some matches are county-to-county, other matches are city-to-city, county-to-city or city-to-county.

Questionnaire and Interview Process

To solicit data, we designed two questionnaires. The first questionnaire was designed for CRS communities; the other questionnaire was designed for non-CRS communities. Among other things, these questionnaires were similar and gathered basic demographic data as well as data on floodplain managers' perceptions of their flood management decision making, including their decision to participate or not participate in the CRS. There were differences between the two questionnaires too. For example, we asked CRS coordinators in CRS communities about why they participate, why they continue to participate, and their levels of participation in the CRS; for floodplain managers in non-CRS communities, we asked them whether they are aware of the CRS program, whether their communities participate in any flood-related programs, and what factors will increase their chances of participating in the CRS.

To administer the questionnaire to 100 floodplain managers in CRS communities and 100 floodplain managers in non-CRS communities, we worked with a university-based social science research institute in the United States that has experience conducting phone interviews. Administering the questionnaires via phone is appropriate given that we are seeking to collect both quantitative and qualitative data with individuals across the United States. We first provided this research institute with lists of floodplain managers that we identified by contacting state mitigation officers and by perusing local government websites. Then, we instructed the research institute to pre-tested two questionnaires with floodplain managers in both CRS and non-CRS communities to ascertain if any changes were warranted. The pre-test did not reveal any issues with the questionnaires. The research institute administered the questionnaires to floodplain managers between October 2018 and August 2019.

Variable Measurement

This study employs three dependent variables, which include floodplain managers' perceptions of their community's ability to (1) mitigate, (2), prepare, and (3) respond to floods. All three of these items captured quantitative and qualitative data on floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods. Two of the authors coded the qualitative responses individually; these two individuals then met to review each code and come to an agreement on any codes that were labeled differently. Both of these authors employed inductive coding techniques, which involves analyzing the raw text and identifying themes from this text rather than from previously identified codes (Ravitch & Mittenfelner Carl, 2016). The independent variables include the following: flood concern, flood problem, tenure, full-time employees, and CRS participation. This study also included two individual characteristics—education and gender—and seven community characteristics—population, median household income, employment rate, poverty rate, median age, percent of individuals who are white, and percent of individuals with a disability as control variables. These control variables were included as previous studies (e.g., Brody et al., 2010; Sadiq & Noonan, 2015) have shown these variables can impact flood mitigation, preparedness, and response. Table 1 shows the measurement and source for all the variables.

Table 1. Variables' measurement and source

Variables	Measurement	Source
<i>Dependent Variables</i>		
Perception of Flood Mitigation	Please rate your community's mitigation for flooding on a scale of 1 (very poor) to 5 (excellent). Explain your answer briefly.	Survey
Perception of Flood Preparedness	Please rate your community's preparedness for flooding on a scale of 1 (not at all prepared) to 5 (very prepared). Explain your answer briefly.	Survey
Perception of Flood Response	Please rate your community's ability to respond during a flood disaster on a scale of 1 (very poor) to 5 (excellent). Explain your answer briefly.	Survey
<i>Independent Variables</i>		
Flood Concern	Please, rate your community's concern for floods on a scale of 1 (not at all concerned) to 5 (extremely concerned).	Survey
Flood Problem	Please, rate the extent to which flooding is a problem in your	Survey

	community on a scale of 1 (not a problem) to 5 (a major problem).	
Tenure	How long have you been in this position?	Survey
Full-Time Employees	How many full-time employees does your department have?	Survey
CRS Participation	Coded by authors (0=Non-CRS community, 1=CRS community).	Survey
<i>Control Variables</i>		
Education	What is the highest level of education you have completed?	Survey
Gender	What is your gender?	Survey
Population	All people living in a given geographic area.	U.S. Census- 2018 American Community Survey 5-year estimates
Median Household Income	The midpoint income for all individuals 15 years old and over in the household, where one-half of the cases falling below the median income and one-half above the median.	U.S. Census- 2018 American Community Survey 5-year estimates
Employment Rate	Percent of individuals in the labor force with paid employment, based on the week before responding to the census questionnaire.	U.S. Census- 2018 American Community Survey 5-year estimates
Poverty Rate	Percent of individuals living in poverty, based on income in the past 12 months.	U.S. Census- 2018 American Community Survey 5-year estimates
Median Age	The age at the midpoint of the population, where half of the population is older than the median and half is younger.	U.S. Census- 2018 American Community Survey 5-year estimates
Percent of Individuals who are White	The percent of the population with origins in any of the original peoples of Europe, the Middle East, or North Africa, including people who indicate their race as “White” or report entries such as Irish, German, Italian, Lebanese, Arab, Moroccan, or Caucasian.	U.S. Census- 2018 American Community Survey 5-year estimates

Percent of individuals with a disability	Percent of the population with serious difficulty with hearing, vision, cognition, and ambulation.	U.S. Census- 2018 American Community Survey 5-year estimates
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Results

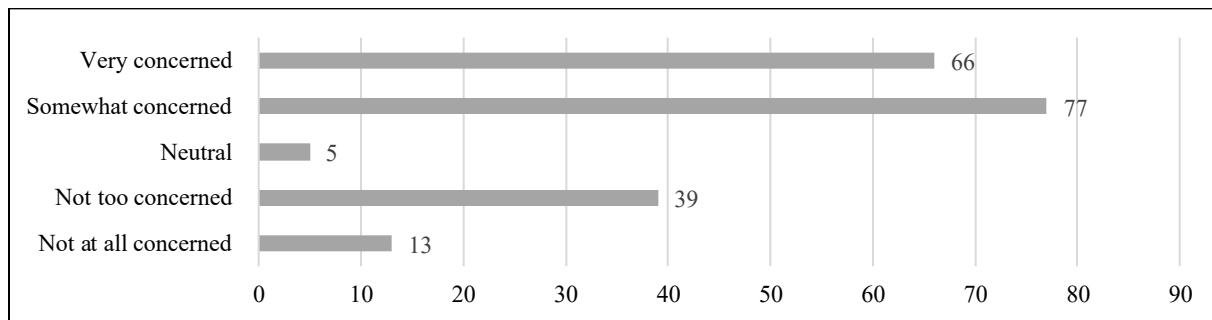
Table 2 shows the sample statistics for 200 floodplain managers that participated in this study. Please, note the N is not 200 in some instances because respondents did not answer the question. The majority of the floodplain managers were both male (72.5%), over the age of 44 (66.5%), and had a bachelor's (46%) or graduate degree (33%). In addition, most respondents have been in their position for approximately 3 to 8 years (38%).

Table 2. Sample statistics

Variables		Floodplain Managers (%)
Gender	Male	145 (72.5)
	Female	55 (27.5)
Age	27-44	58 (29.0)
	45-59	86 (43.0)
	60+	47(23.5)
	No response	8 (0.4)
Education	High school	6 (3.0)
	Some college or technical school	19 (9.5)
	2-Year college degree	17 (8.5)
	Bachelor's degree	92 (46.0)
	Graduate degree	66 (33.0)
Tenure	Less than 3 years	39 (19.5)
	3-8 years	76 (38.0)
	9-14 years	42 (21.0)
	15-20 years	14 (7.0)
	Over 20 years	25 (12.5)

Figure 1 shows floodplain managers' perceptions of their community's concern for floods. The majority of respondents reported their community were very (66, 33%) or somewhat concerned (77, 39%). Only 13 respondents (7%) reported their community was not at all concerned about floods.

Figure 1. Floodplain managers' perceptions of their community's concern for floods



Figures 2 through 4 provide information on floodplain managers' perceptions of their ability to mitigate, prepare, and respond to floods. In regard to mitigation, the majority of floodplain managers perceived their community's flood mitigation to be good (104 respondents, 54%), and only one respondent reported their community's flood mitigation to be poor. For preparedness, the majority of floodplain managers perceived their community to be somewhat prepared (110 respondents, 56%). Finally, in terms of flood response, most of the floodplain managers reported their community's ability to respond to floods as good (104 respondents, 54%).

Figure 2. Floodplain managers' perceptions of their community's ability to mitigate floods

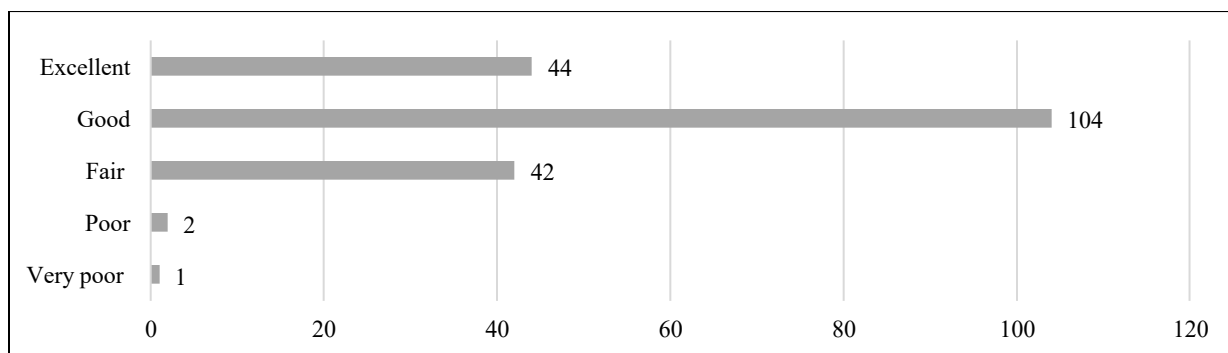


Figure 3. Floodplain managers' perceptions of their community's ability to prepare for floods

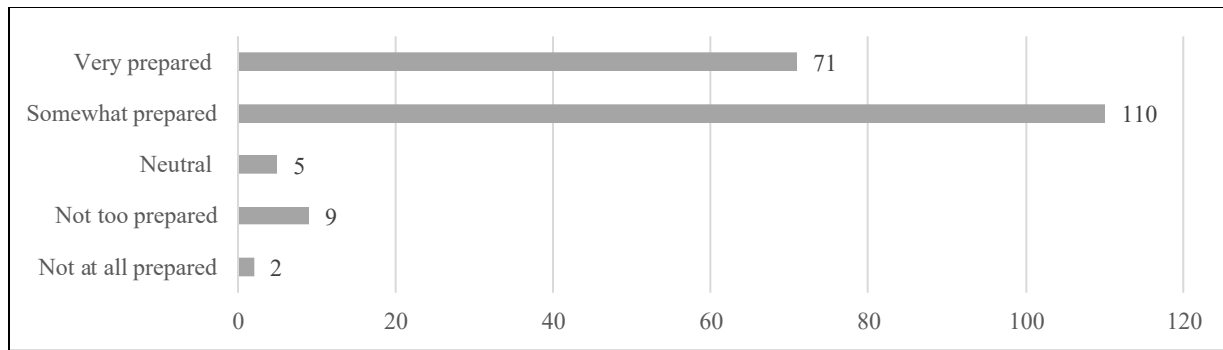


Figure 4. Floodplain managers' perceptions of their community's ability to respond to floods

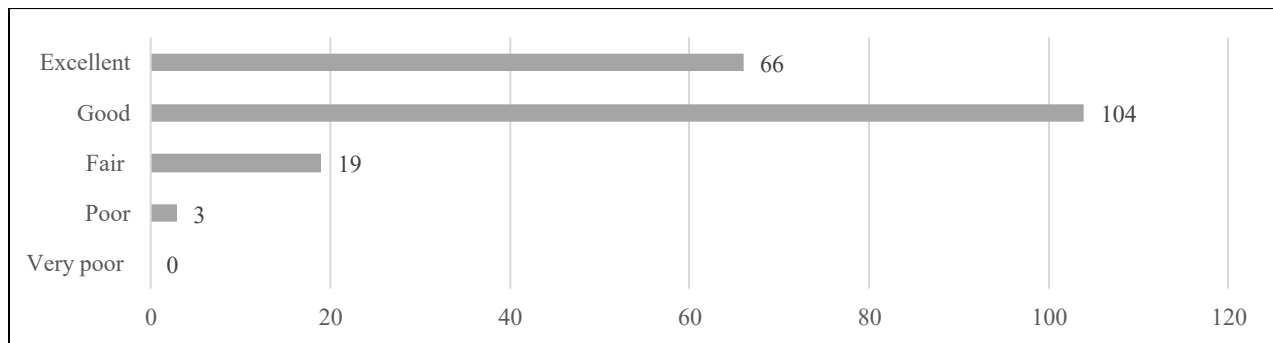


Table 3 shows the summary statistics for all of the dependent, independent, and control variables employed in this study. The mean for the three dependent variables are all relatively high (out of 5). The mean floodplain managers' perceptions of their community's flood mitigation, preparedness, and response are 4.0, 4.2, and 4.2, respectively.

Table 3. Summary statistics of all variables

Variables	Obs.	Mean	Std. Dev.	Min	Max
<i>Dependent Variables</i>					
Perception of Flood Mitigation	193	4.0	0.7	1	5
Perception of Flood Preparedness	197	4.2	0.8	1	5
Perception of Flood Response	192	4.2	0.7	1	5
<i>Independent Variables</i>					
Flood Problem	192	2.6	0.8	1	5
Flood Concern	200	3.7	1.3	1	5
Tenure	200	9.4	8.3	0.10	40
Full-Time Employees	194	35.8	89.9	1	700
CRS Participation	200	0.5	0.5	0	1
<i>Control Variables</i>					
Education	200	4.0	1.0	1	5

Female	200	0.3	0.5	0	1
Population Size	200	118,354.5	199,596.3	479	1,203,166
Median Household Income	200	60,327.1	21,773.5	20,179	209,825
Poverty Rate	200	14.3	7.3	2.1	42.2
Employment Rate	200	56.8	9.6	19.2	78.5
Median Age	200	40.1	8.81	23.1	75.4
Percent of Individuals who are White	200	76.8	18.0	14.6	100
Percent of Individuals with a Disability	200	13.5	4.4	2.7	33.3

To determine the factors supporting and undermining floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods, we used ordered logit regression on each of the three dependent variables (see Table 4). This model is appropriate as the dependent variables have varying categories, ranging from 1 to 5. The only variable that is statistically significant across all three models is CRS participation. For example, for a one unit increase in CRS participation, we expect a 0.8 increase in the log odds of being in a better level of flood mitigation, holding all other variables constant. The floodplain manager's educational level is statistically significant across two of the models—flood mitigation and flood preparedness. That is, for a one unit increase in the floodplain manager's educational level, we expect a 0.3 and 0.4 decrease in the log odds of being in a better flood mitigation and preparedness level, respectively. Flood concern is significant in only the mitigation model.

Table 4. Ordered logit regression results for mitigation, preparedness, and response

Variable	Mitigation	Preparedness	Response
	Coeff. (SE)	Coeff. (SE)	Coeff. (SE)
Flood Problem	-0.3 (0.2)	0.1 (0.2)	0.1 (0.2)
Flood Concern	0.0* (0.14)	0.2 (0.2)	0.1 (0.1)
Tenure	0.0 (0.0)	-0.0 (0.0)	0.0 (0.0)
Full-Time Employees	0.0 (0.0)	0.0 (0.0)	-0.0 (0.0)
CRS Participation	0.8*** (0.3)	0.6* (0.3)	0.6* (0.3)
Education	-0.3* (0.1)	-0.4*** (0.2)	-0.1 (0.1)
Female	0.5 (0.3)	0.5 (0.4)	0.6 (0.3)
Population Size	2.6e-08 (7.8e07)	1.0e-07 (8.8e-07)	7.7e-07 (8.1e-07)
Median Household Income	-8.3e-06 (0.0)	-0.0 (0.0)	-8.4e06 (0.0)

Poverty Rate	-0.0 (0.0)	-0.0 (0.0)	0.0 (0.0)
Employment Rate	-0.0 (0.0)	-0.0 (0.0)	0.0 (0.0)
Median Age	0.0 (0.0)	-0.0 (0.0)	0.0 (0.0)
Percent of Individuals who are White	-0.0 (0.0)	0.0 (0.0)	-0.0 (0.0)
Percent of Individuals with a Disability	-0.0 (0.1)	-0.0 (0.0)	-0.1 (0.0)
N	186	190	186
LR Chi ²	21.4	32.3	18.5
Prob>Chi ²	0.1	0.0	0.2
Pseudo R ²	0.1	0.1	0.1

Qualitative responses provide greater insight into the factors supporting and undermining floodplain managers' perceptions of their community's concern for floods as well as their ability to mitigate, prepare, and respond to floods. Below are summaries of why floodplain managers rated their community's ability to mitigate, prepare, and respond to floods the way they did.

Floodplain Managers' Perceptions of their Community's Concern for Floods

Not at All Concerned

Four respondents indicated a lack of floods as the reason why they are not at all concerned about floods. The remaining ten responses belong to the "other" category and included reasons like lack of awareness about flooding, absence of rivers or lakes, and the drought condition of the community.

Not Too Concerned

Among the respondents that said they were not too concerned about flooding in their communities, 12 of them mentioned a lack of or limited flooding, nine cited a lack of floodplains and/or bodies of water, and seven said flooding is not a major issue in their communities. In addition, respondents were not too concerned about flood because of their investments in flood protection measures, standards, and/or regulations (N=6), low flood risk (N=5), their concerns vary depending on the level of water or where the respondents are located (N=4), and presence of floodplains and/or bodies of water (N=3). There are seven reasons that did not fall into any of the previous groupings. These were put in the "other" category, and contained reasons, such as concern is about flash floods and debris, the feeling of safety in the community, and the fact that residents forget about past flood events.

Somewhat Concerned

Twenty-three respondents reported being somewhat concerned about flooding in their communities because of the presence of floodplains and/or bodies of water, while 16 respondents indicated prior flood experience as the reason why they are somewhat concerned about flood.

Furthermore, 14 respondents are somewhat concerned about flooding because their concern varies by the location within the community (e.g., inland versus coastal), time of the year, the type of rain, age of structures, and direction of the storm. Other reasons why respondents are somewhat concerned about flooding include the following: flooding is not a major issue (N=9); investment in flood protection measures, standards, and/or regulations (N=7); community features, such as presence of farms, large proportion of senior citizens, poverty level, and topography (N=6); high flood risk (N=4); and recent flood scare (e.g., dam failure scare) (N=3). In the “other” category (N=26), respondents said they are somewhat concerned about flood because the community is not located on the coast, the community manages the floodplain well, there was minimal flood damage from past events, community participates in NFIP, the community is more concerned about storm surges/ground water flooding/flash flooding/storm water flooding, and the community is prone to hurricanes, among other reasons.

Very Concerned

Twenty-five respondents indicated the reason for being very concerned about floods in their community is due to the presence of floodplains and/or bodies of water. Also, 24 respondents reported prior flood experience as the reason, while ten respondents cited high flood risk. In addition, respondents are very concerned about floods because of community features—presence of senior citizens, downtown nature of community, the age of community roads, and presence of a large number of repetitive loss properties (N=7), costs (e.g., cost of flood insurance) (N=5), and investment in flood protection measures, standards, and/or regulations (N=5). The “other” category (N=10) includes reasons, such as the enormous amount of rain and the inability of the ground to absorb water, location of the community, community’s large population, road flooding is an issue, previous flood warnings, etc.

Floodplain Managers’ Perceptions of Their Community’s Ability to Mitigate Floods

Flood Mitigation is Excellent

Fifteen respondents reported their flood mitigation is excellent because of the investment their community made in flood protection measures while ten respondents reported the same rating because their community has flood ordinances, standards, and/or regulations. In addition, seven respondents indicated their flood mitigation as excellent because their community limits development in flood-prone areas, and for another seven respondents, it is because of their community’s preparedness, training, and planning. Respondents in the “other” category (N=16) gave several reasons for reporting excellent flood mitigation. The reasons include, but are not limited to, good flood maps, knowledge about floodplain location, continuous improvement in mitigation, FEMA guidelines, absence of flood issues, good maintenance, good funding, and good drainage systems.

Flood Mitigation is Good

Twenty-eight respondents indicated their flood mitigation is good because of the investment their community made in mitigation and flood protection measures while 15 respondents reported the same rating because their community has flood ordinances, standards,

and/or regulations. Furthermore, 14 respondents said their flood mitigation is good because their mitigation is undergoing or in need of improvements. In addition, respondents gave other reasons why they think their flood mitigation is good. These reasons include limited resources (N=9), community limits development in flood-prone areas (N=6), knowledge and/or education about floods (N=4), community does what it can (N=3), community has plans (N=3), the presence of bodies of water (N=3), community is proactive (N=3), public outreach (N=3), and community is conducting a research study on flood-related issues (N=3). The “other” category (N=29) contains additional reasons why respondents indicated their flood mitigation is good. Some of the reasons are community’s past history, community’s ability to communicate with other communities, community is not located in a flood-prone area, community is a farming community, not much flooding takes place in the community, community has excellent storm water management practices, flooding is outside the community’s control, and community’s first responders respond quickly to events.

Flood Mitigation is Fair

Among respondents that indicated their flood mitigation is fair, six of them said it was because of funding constraints, five said it was due to the improvements their community is making, and another five reported it was because of resource constraints (e.g., staff). Other reasons why respondents indicated their community’s flood mitigation is fair include mitigation projects are inadequate (N=4), enforcement of floodplain ordinance (N=3), and flood risk (N=3). The “other” category contains additional reasons why respondents (N=23) rated their communities’ flood mitigation as fair. These reasons include the following: community is experiencing more flooding than previously, flood mitigation is not a priority in the community, no flood event in the community, slow response to flood events, community is not proactive on mitigation, cost of mitigation, not much awareness about flood mitigation in the community, developers still want to develop in the floodplain, etc.

Flood Mitigation is Poor

Two responses were reported, and first reason why the respondents indicated their communities’ flood mitigation to be poor is due to lack of or limited funding for flood mitigation. The other reason is that the community does not engage in flood mitigation.

Floodplain Managers’ Perceptions of their Community’s Ability to Prepare for Floods

Very Prepared

Thirteen respondents said their communities are very prepared for floods because of the availability and/or quality of personnel. The same number of respondents indicated that their communities’ are very prepared for floods due to their policies, plan, and/or procedures, while 11 respondents attributed this level of preparedness in their communities to coordination and/or collaboration. In addition, respondents listed other reasons for this level of community preparedness. They include state of readiness (N=11), prior flood experience (N=10), investment in flood protection measures, standards, and/or programs (N=7), engage in training and/or exercises (N=6), availability of resources (N=6), and community updates their planning (N=6).

Other reasons given are knowledge of when and/or where flooding occurs (N=3), lessons learned and making improvements (N=3), and community is proactive (N=3). In the “other” category, there are 14 respondents, and their justifications for indicating that their communities are very prepared for floods include the following: good communication among departments; it is a whole community effort; community stays above flood requirements; good response to flooding, etc.

Somewhat Prepared

Eighteen respondents reported their communities are somewhat prepared for flood because their communities established policies, plans, programs, and/or procedures, 16 respondents attributed their reasons to a lack of flood experience, while 13 said their community is somewhat prepared because of the awareness and/or knowledge of when/where flooding occurs within their communities. Further, respondents indicated their communities are somewhat prepared for floods for the following reasons: can, need to, and/or are making improvements (N=11), communities’ state of readiness (N=11), availability and/or quality of personnel (N=10), flooding is not a major issue in the community (N=8). Others include a lack of resources (N=8), coordination and/or collaboration (N=7), prior flood experience (N=6), presence of floodplain or body of water (N=5), reliance on others (N=4), uneducated/unaware/unprepared residents (N=4), a lack of and/or insufficient policies, plans, and/or procedures (N=3), and warning and/or monitoring systems (N=3). In addition, the “other” category (N=34) contains additional reasons for selecting somewhat prepared. Some of these reasons include, but are not limited to, the absence of a levee system, location of community in a hurricane zone, community responds well to flood issues, community is able to close off flooded roads, availability of resources, community has not conducted drills for floods, outdated flood maps, high level of resilience, community is located on a barrier island, etc.

Not too Prepared

Four respondents indicated flood is not a major issue, while three respondents indicated a lack of floods for the reason why their communities are not too prepared for floods. In the “other” category (N=6), reasons for selecting not too prepared include a lack of flood insurance for a majority of residents, the community is located on a steep topography, presence of small creek that runs through the community, etc.

Not at All Prepared

There were only two responses for this category, and the reasons for indicating their communities were not at all prepared for floods is because a flood had not happened in one of the communities in 43 years and the other reason is that the community has not experienced a lot of flood events.

Floodplain Managers’ Perceptions of their Community’s Ability to Respond to Floods

Flood Response is Excellent

Among the respondents reporting excellent response to floods, 24 said availability and/or quality of personnel is the reason for this rating, 11 cited established policies, plans, and/or procedures, and ten said they gave this rating because of experience and practice. Respondents also cited other reasons for indicating their flood response is excellent—coordination and/or collaboration (N=9), responsive (N=7), engage in training and/or exercises (N=5), proactive (N=5), state of readiness (N=5), awareness and/or knowledge of when/where flooding occurs (N=4). Other reasons include availability of resources (N=4), preparedness (N=4), have warning systems (N=3), and helpful and/or engaged community (N=3). There are 13 reasons that did not fall into any of the previous groupings. These were put in the “other” category. Reasons for indicating excellent response to floods include, but are not limited to, community just updated its hazard mitigation, the community is small, community issues road closure prior to flood events, community has no flood issues, community has a robust Geographic Information System (GIS), etc.

Flood Response is Good

Thirty-Three respondents cited availability and/or quality of personnel is the reason why they reported their communities’ flood response is good. The reason why 13 respondents reported the same rating is because of the response experience of their communities. In addition, 12 respondents cited developing and/or have policy, plan, and/or procedure as the reason for reporting good response to floods. Other reasons mentioned for reporting good flood response include resources and equipment (N=11), lack of flood experience and/or no major flood (N=11), knowledge of when/where flooding occurs (N=10), coordination and/or collaboration (N=8), responsive (N=7), small community (N=7). Other reasons include can, need to, and/or are making improvements (N=5), engaged in training and/or exercises (N=5), preparedness (N=5), and limited resources (N=4). Furthermore, the “other” category (N=34) contains additional justification for reporting good flood response. They include the following: flash flooding is the problem; coastal community; flooding still occurs; good communication; conducts evaluation after a storm; downed trees are a bigger problem than flooding; lots of people do not have flood insurance; few fatalities during floods; dams and levees are inspected; community does not have the infrastructure to handle floods, etc.

Flood Response is Fair

Among respondents reporting fair flood response, eight respondents cited lack of flood experience and/or issues, four mentioned respond adequately, and three cited a lack of resources. The “other” category contains additional reasons why respondents reported fair flood response. They include small city, slow response time, emergency plan exists but has never been implemented, community now has better stream gauge data, etc.

Discussion

The purpose of this study was to uncover floodplain managers’ perceptions of their community’s concern for floods as well as their ability to mitigate, prepare, and respond to floods. Using both quantitative and qualitative data gathered from interviews with 200 floodplain managers in the United State, we found that floodplain managers perceived their community to

be concerned about floods, with the majority of respondents reporting their community were very or somewhat concerned about floods. Qualitative responses indicated that the reason for being concerned about floods is due to the presence of floodplains and/or bodies of water as well as prior flood experience. This aligns with previous research that have found proximity or distance from a risk plays a role in shaping perceptions of flood risk and concern (Lindell & Hwang, 2008; Maderthaner et al., 1978).

Floodplain managers' perceptions of their community's ability to mitigate floods were generally viewed positively. The primary reasons for such positive reviews were due to their community's investments in flood protection measures as well as their flood ordinances, standards and regulations. This somewhat indirectly aligns with previous studies that have shown communities who had previous experience with flooding are more likely to be concerned and act to reduce the severity of future flood events (Lara et al., 2010; Miceli et al., 2008; Sadiq, 2017; Terpstra, 2011).

In regard to preparedness, floodplain managers generally reported their communities were somewhat prepared for floods. The main reasons for being somewhat prepared were having established policies, plans, programs, and/or procedures as well as having limited flood experience. In the latter case, respondents seemed to suggest that their preparedness efforts contributed to the limited flooding experience. In terms of response, the majority of respondents reported their community's flood response is good, primarily because of the availability and quality of their personnel. Finally, in regard to the factors supporting and undermining floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods, we found that CRS participation is the only variable that is statistically significant across all three models. This suggests participation in the CRS might improve communities ability to mitigate, prepare, and respond to flood disasters. This finding is not surprising as the 19 CRS creditable activities include mitigation, preparedness, and response measures.

Conclusion

The results of this study provide an initial understanding of floodplain managers' perceptions of their community's concern for floods as well as their ability to mitigate, prepare, and respond to floods. Specifically, the results indicate that floodplain managers perceived their community to be very concerned about floods, most of them rated their community's ability to mitigate floods as good, most of them said their communities were somewhat prepared for floods, and most floodplain managers rated their community's flood response as good. In terms of the factors supporting and undermining floodplain managers' perceptions of their community's ability to mitigate, prepare, and respond to floods, CRS participation is the only variable that is positive and statistically significant.

Our study provides important information about floodplain managers' concern about flooding and what they are doing to mitigate, prepare, and respond. This information, which is not publicly available, can help federal, state, and local emergency management agencies get a sense of what is going on regarding flooding and be able to develop flood management strategies to further help communities deal with flooding. There is a body of literature that demonstrated that concern about disaster impacts leads to the adoption of mitigation and preparedness measures (e.g., Sadiq, 2009; Tyler, forthcoming). Our study shows that communities are concerned about flooding, which suggests that they will be apt to implement flood management strategies.

Before these results are fully accepted, future research is needed to address some of the limitations of this study. For example, this study relies solely on perceptions. Studies have shown that emergency management professionals tend to inflate their mitigation, preparedness, and response capabilities (Sadiq, 2009). Future studies should supplement these perceptions with more objective measures. Future studies should also aim to include other objective measures in their models to determine the factors impacting these perceptions, such as prior flood history and flood risk. Also, we did not control for the personal experiences of floodplain managers with flooding. Hence, we recommend that researchers should include floodplain managers' flood experience as an important factor that could impact flood perceptions in future research. These limitations notwithstanding, this study is a crucial step in understanding floodplain managers' views on their communities' concern for and their ability to mitigate, prepare, and respond to the ever-growing threat posed by floods.

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