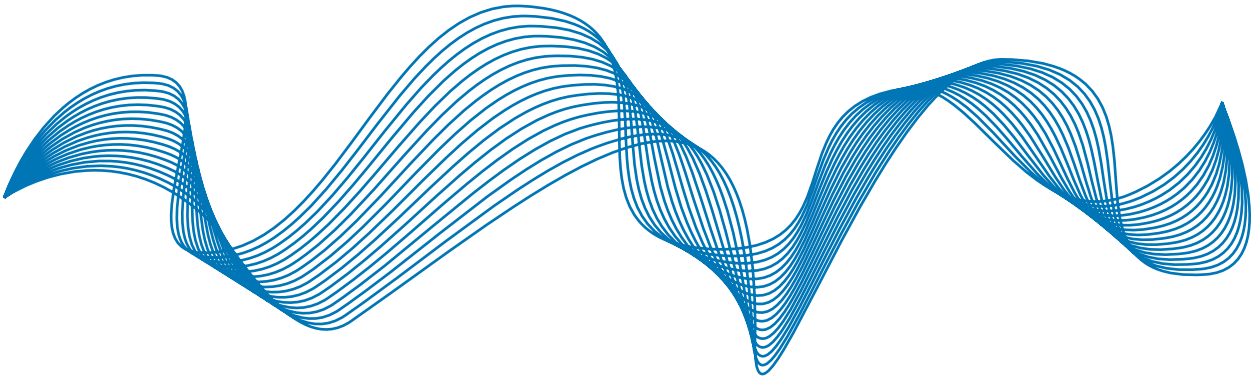
A Landscape Study of Social Equity Data Needs and its Access and Availability to Support the Disaster Resilience of Marginalized Communities:

Year 2 Findings



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Executive Summary

Federal agencies have noted the increase in hazards related to climate change, particularly wildfires, hurricanes, and flooding. One of the most enduring findings in disaster and climate change research is that socially marginalized communities are disproportionally more at risk from environmental hazards and less likely to recover fully and quickly. A community plan aimed at resilience, with equity as its foundation, could allow nonprofit and government agencies to proactively identify support for mitigation based on community needs. However, existing data sources may be inadequate for measuring, monitoring, and determining progress in the degree to which recovery plans and programs advance equitable and resilient outcomes.

One of the most enduring findings in disaster and climate change research is that socially marginalized communities are disproportionally more at risk from environmental hazards and less likely to recover fully and quickly.

A research team from the Coastal Resilience Center at the University of North Carolina at Chapel Hill has received funding from November 2021 to June 2024 to identify a framework that would improve equitable support to marginalized groups as they prepare for the next hazardous event. This report represents the findings collected from July 2022 to June 2023, which is deemed as Year 2 in the remainder of the report.

The purpose of this report is to provide evidence as to how local and federal agencies can improve measurement of outcomes for marginalized groups to help guide resilience and disaster recovery planning. This research aims to provide insight on how to transform the hazard mitigation and disaster risk management community through embedded equitable practices that support all groups, including the most marginalized. To achieve this, the research team worked to assess the use of metrics for measuring, assessing, and meeting the needs of marginalized populations in hazard mitigation and post-disaster recovery phases. Specifically, the team collected data from government disaster recovery and hazard mitigation records, public sector personnel and community members, and hazard mitigation and comprehensive plans. Ultimately, this report can help facilitate a conversation around the creation of a nation-wide monitoring system to improve outcomes for federal organizations such as the U.S. Department of Homeland Security (DHS), the National Oceanic Atmospheric Administration (NOAA), and others.

The team used the following overarching research question to guide our analysis: "How can local and federal agencies improve the measurement of outcomes for marginalized groups to help guide disaster recovery plans?" To answer this pressing question, we focused on these research topics:

1. Identify how hazard mitigation and disaster recovery resources are distributed with respect to household and community characteristics, such as income, rural vs. urban, and race.
2. Explore how public sector personnel and community members describe useful planning strategies to support recovery.
3. Examine local plans to identify gaps and opportunities to improve coordination in measuring and monitoring the resilience of marginalized populations.

Methods

The research team applied a mixed methods case study design that used quantitative and qualitative methods to build a new approach for local, state, and federal policymakers in applying equitable measures. This approach works to highlight indicators that reflect progress to advance equitable and resilient outcomes for marginalized communities. We used our equity framework for the disaster risk management community to guide our data collection and analysis, which focused on three critical dimensions: (1) social vulnerability metrics, (2) community voice, and (3) plan-based indicators. To achieve this, we divided our research process into two phases and collected data concurrently. In Phase One, we focused on data collection and analysis from four sites in one state (i.e., North Carolina). We analyzed data on hazard mitigation and disaster recovery funding, conducted 49 interviews with public sector personnel and community members, and finalized our plan evaluation for equity protocol. In Phase Two, we expanded data collection to 12 sites in an additional three states (i.e., California, Iowa, and Louisiana) and applied the updated plan evaluation protocol to planning documents in all four states and 16 sites.

Summary of Findings

Our findings from Phases One and Two focused on the three critical dimensions: (1) social vulnerability metrics, (2) community voice, and (3) plan-based indicators.

Phase One

Social vulnerability metrics

- In North Carolina, many of the neighborhoods that have received hazard mitigation funding are low-income relative to the state overall.
- For NC applicants for FEMA assistance after Hurricane Matthew and Hurricane Florence, the likelihood of being denied assistance was not substantially different across income brackets or housing types.
- However, low-income applicants made up the majority of households denied due to procedural and conditional reasons, such as lack of paperwork or insufficient damage. Applicants from mobile homes were similarly over-represented in those two categories.
- Wealthier applicants and those from single-family houses and duplexes were over-represented among those denied due to having insurance, voluntarily withdrawing, or applying for a non-primary residence.

Community voice

- Across our four case study communities, there is little formalized attention to or tracking of the ways that demographic and socioeconomic factors affect residents' abilities to prepare for, respond to, and recover from disaster.
- To the extent social vulnerability is currently considered and factored into local hazard mitigation or disaster recovery efforts, the focus is primarily on populations with access and functional needs, with relatively little attention given to other groups disproportionately impacted by disaster (e.g., communities of color, renters, and people with lower educational attainment).
- Interview data suggests that differences in hazard mitigation or disaster outcomes between various population groups in our four case study sites are not currently being tracked or evaluated.

There is little formalized attention to or tracking of the ways that demographic and socioeconomic factors affect residents' abilities to prepare for, respond to, and recover from disaster.

- There are some common practices that local governments across the four communities utilize to increase disaster communication and support to socially vulnerable populations. These include translation of hazards information and alerts into other languages, utilization of multiple modes of communication, partnerships with trusted community groups and faith-based organizations, and targeted outreach and support for specific vulnerable populations or vulnerable population locations.

Phase Two

Plan-based indicators

- Hazard mitigation plans are less likely than comprehensive plans to integrate equity as a core value or to include equity-supporting goals.
- Hazard mitigation plans address more hazards and provide more detailed and mapped information on exposure and risk than comprehensive plans. In contrast, comprehensive plans include more indicators that could be used to assess equity than do mitigation plans. The gaps between the two plan types raise problems if not addressed—there are missed opportunities to integrate and leverage relevant data across plans.
- All hazard mitigation plans we reviewed included data on past disaster damages and impacts, but rarely were these indicators mapped to distinguish differences across the planning area, and in no instances were differences tracked across socio-economic groups.
- Very few hazard mitigation or comprehensive plans acknowledged legacies of historic discrimination (e.g., forced land removal, redlining, racialized zoning, under-investment in infrastructure). Suppression of this information in planning has long-term impacts on marginalized communities' health and well-being, making them more susceptible to hazards and loss after a disaster and depriving them of equal access to the resources needed to adapt and recover.

Very few hazard mitigation or comprehensive plans acknowledged legacies of historic discrimination.

- The inclusion of indicators that could be used to assess equity in resilience varies more by urbanicity among comprehensive plans than it does among mitigation plans. The minimal variation for hazard mitigation plans suggests that federal standards for mitigation plans create a common standard for plan content that minimizes differences that might otherwise stem from disparities in community planning capacity.

Policy and Research Recommendations

Based on our review of social vulnerability metrics, interviews with public sector personnel and community members, and review of plan-based indicators, we developed the following recommendations for advancing equitable and resilient outcomes for marginalized populations. As with the summary of findings listed above, our recommendations are organized by phases and critical dimensions.

Phase One

Social vulnerability metrics

- Data on the distribution of flood mitigation funding are not fully consistent across sources. Efforts to standardize and improve the quality of records could support future research on this topic.
- While initial results suggest lower-income neighborhoods are accessing hazard mitigation funds, continued research on the distributional equity of federal and state funding is needed to provide stronger evidence and substantiation.
- Reforms to FEMA assistance policies are needed to improve access for those with the greatest needs. Changes were implemented after Hurricane Florence, and continued evaluation is needed to measure the benefits of those changes.

Reforms to FEMA assistance policies are needed to improve access for those with the greatest needs.

Community voice

- Equity training and education should be required for hazard management professionals. Understanding the systemic ways that historic marginalization and socioeconomic factors affect vulnerability to hazards and the ability to recover after a hazard event is critical to being able to address these vulnerabilities and equitably support the resilience of the entire community.
- Social vulnerability analysis and targeted support efforts should be expanded beyond the current focus on populations with access and functional needs. These efforts should incorporate other groups that experience disproportionate disaster outcomes, such as low-income communities, communities of color, renters, and individuals with lower educational attainment.
- Differences in hazard mitigation and disaster recovery outcomes across groups should be tracked. Collecting and evaluating data on hazard mitigation and disaster outcomes across groups is crucial to pinpointing current inequities and measuring progress in efforts to address those inequities.

- Federal funding should be increased to support resilience planning in limited-resource communities. Greater availability and access to technical and grant-writing assistance, data, and decision-support tools could enhance local hazard management capabilities for lower-resourced, rural communities and improve their ability to access and manage funds.

Phase Two

Plan-based indicators

- Local government agencies should be encouraged to share data that can be used to assess—and measure progress toward—equity in resilience. Future research should explore how inter-organizational coordination strategies and data sharing between hazard mitigation and comprehensive planning processes can be improved.

Local government agencies should be encouraged to share data that can be used to assess—and measure progress toward—equity in resilience.

- FEMA guidelines for developing local hazard mitigation plans have recently been updated to address equity. Future research should examine FEMA's newly updated Local Hazard Mitigation Planning Handbook (2023) and programs such as the Community Rating System to assess how and to what extent they support the resilience of marginalized communities and to identify opportunities for greater integration of equity in federal guidance for local resilience plans and policies.
- Social equity indicators included in local planning programs should be validated from the perspective of marginalized populations. Future research should examine how local residents can use current tools and self-assessment strategies to validate equity measures and plan policy interventions.
- Future research should explore the availability of data on legacies of historic discrimination and injustice (e.g., redlining, exclusionary zoning) and examples of communities that are successfully integrating this data into local resilience planning.
- Special attention should be given to developing the capacity of rural areas to use equity indicators in local plans. Future research should explore the effectiveness of federal and state initiatives to enhance rural planning capacity and how they might be applied to strengthen equitable hazard mitigation and climate adaptation planning in rural areas.

Limitations

Caution should be used in interpreting these findings since this is a preliminary analysis. Generalizability of results is limited due to the limited sample size and an in-depth focus on North Carolina. Research and analysis for the social vulnerability metrics and community voice dimensions of our study focused exclusively on data and perspectives from North Carolina communities. For the plan review dimension of our research, the team expanded the sample to include 12 case study sites from California, Iowa, and Louisiana, in addition to the 4 sites in North Carolina. We suggest continuing to expand the sample of local jurisdictions to additional sites and states to improve the external validity of findings.

Respondents interviewed for the community voice dimension of the study represented only four North Carolina case study sites, limiting the perspectives of residents living in other locations in and outside the state. Also, over the past decade, only two of our North Carolina sites have experienced a federally declared major disaster where FEMA Individual Assistance funds were available to residents (excluding Covid-19), thus limiting our ability to collect perspectives from community members with direct experience of the FEMA aid application process.

Future Direction

In Year 3, we will build on the work by continuing our mixed-methods study in two phases. In the first phase, we will continue our deep dive into North Carolina case study sites by analyzing interview data collected from Year 2 and conducting additional interviews upon further review of the quantitative analysis. We will also continue to expand our analysis to consider how to measure vulnerability and recovery through quantitative and qualitative measures. In the second phase, we will add two sites to our sample and conduct a cross-state comparison of the planning documents.

Introduction

Federal agencies have noted the increase in hazards related to climate change, particularly wildfires, hurricanes, and flooding (DHS, 2012; FEMA, 2021; NOAA, 2021; NASA, 2021; EPA, 2021). One of the most enduring findings in disaster and climate change research is that socially marginalized communities are disproportionally more at risk from environmental hazards and less likely to recover fully and quickly (Davis et al., 2021). A community plan aimed at resilience, with equity as its foundation, could allow agencies to proactively identify support for mitigation based on community needs. However, existing data sources may be inadequate for measuring, monitoring, and determining progress in the degree to which recovery plans and programs advance equitable and resilient outcomes.

Recent federal programs such as Building Resilient Infrastructure and Communities (BRIC) and Justice40 that increase availability of equity funding are motivating communities to give greater attention to creating plans that incorporate an equity lens. An equity lens provides a framework to prompt acknowledgment of equity considerations during public engagement and decision-making processes, develop strategies that support equitable outcomes, and institute accountability to track progress toward such outcomes.

A major feature of accountability is integration of equity indicators in local, state, and federal hazard planning, mitigation, and recovery efforts. Equity indicators can help communities develop a stronger fact base for local planning efforts, measure baseline conditions of marginalized populations, monitor the performance of local government plans in reducing inequalities, and assess impacts of aid delivery programs by FEMA, the Department of Housing and Urban Development (HUD), and others.

Quantitative indicators are often used by planners and emergency managers to identify groups that are especially vulnerable to a disaster. Vulnerability arises from a combination of social, economic, and political processes (Tate et al., 2021). Due to its inherent multidimensionality, many different indicators are relevant to vulnerability, including age, income, race, and language. There have been several efforts to collapse these many relevant indicators into simpler metrics. Most well-known among them include the Centers for Disease Control's Social Vulnerability Index (SVI) and the University of South Carolina's Social Vulnerability Index (SoVI ®). These composite metrics have been used in a wide range of applications, including numerous state and local hazard mitigation plans, scientific publications, and government tools (Centers for Disease Control and Prevention, 2022; University of South Carolina Hazards & Vulnerability Research Institute, 2022).

While the simplicity of a composite indicator, such as the SVI, is attractive for end-users, questions remain about their validity (Rufat et al., 2019; Spielman et al., 2020). The processes that collapse many indicators into one can make it difficult to identify which variables are driving the results. In addition, the single combined indicator may show vastly different results than other individual indicators, and those differences may be meaningful to local agencies. The data sources can also differ, even for a variable that is on the surface the same across indices (e.g., percent of households in poverty). Finally, vulnerability is context-specific; some factors will be more influential in some communities than others, and uniform indices do not reflect that variation.

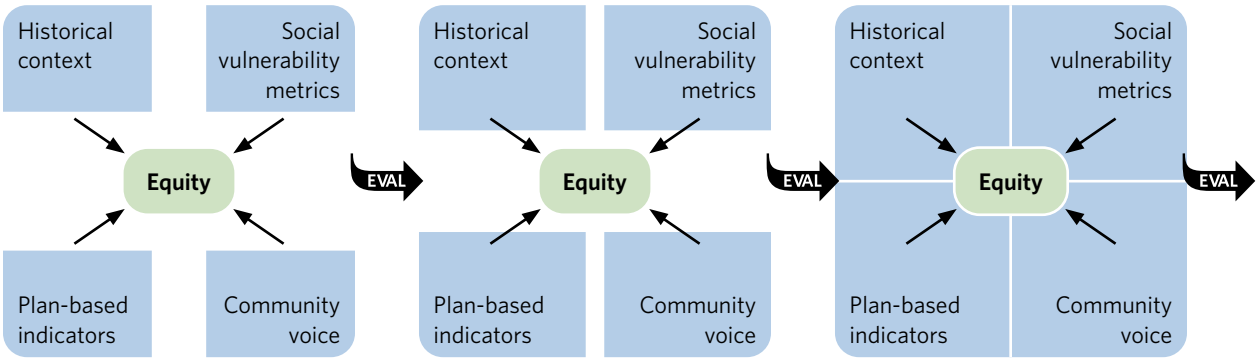
Our research aims to provide insight on how to transform the disaster risk management community so that equity is an embedded practice that encapsulates the needs of all, including the most marginalized. Supporting the resilience and recovery of marginalized communities requires identifying who is overlooked in plans and programs, devising strategies that include and support those populations, and measuring the effectiveness of those strategies by tracking resilience and post-disaster recovery outcomes. While there are many definitions of resilience, we adopt a broad interpretation that incorporates pre- and post-event activities. We conceive of community resilience as the capacity to anticipate, plan for, and adapt to adversity, and transform during recovery into healthier, less vulnerable, and more equitable communities (Community & Regional Resilience Institute, 2013; United Kingdom Department for International Development, 2011). Accordingly, this research project aims to integrate quantitative and qualitative data to strengthen local, state, and federal efforts and guide investments that lead to more equitable and resilient outcomes when developing plans and programs relevant to climate and disaster risk.

Conceptual Framework

In Year One, the research team conducted a literature review on social equity frameworks across disciplines to construct an equity framework for the disaster risk management community (Figure 1). The mission of this framework is to advance equitable and resilient outcomes for marginalized groups. Current metrics are likely outdated, and we argue that relying on one database, indicator, or data source alone will not achieve equitable outcomes. Instead, a combined effort of collecting, mining and understanding multiple sources is required. We offer a holistic approach that requires collecting multiple types of data to assess for and inform more equitable outcomes. The equity framework presented in Figure 1 provides a guide for how decision makers can rethink how to integrate and support marginalized groups, using equity as a foundation.

Figure 1. Equity framework for the disaster risk management community

Mission: Measure, monitor, and determine progress to advance equitable and resilient outcomes for marginalized populations

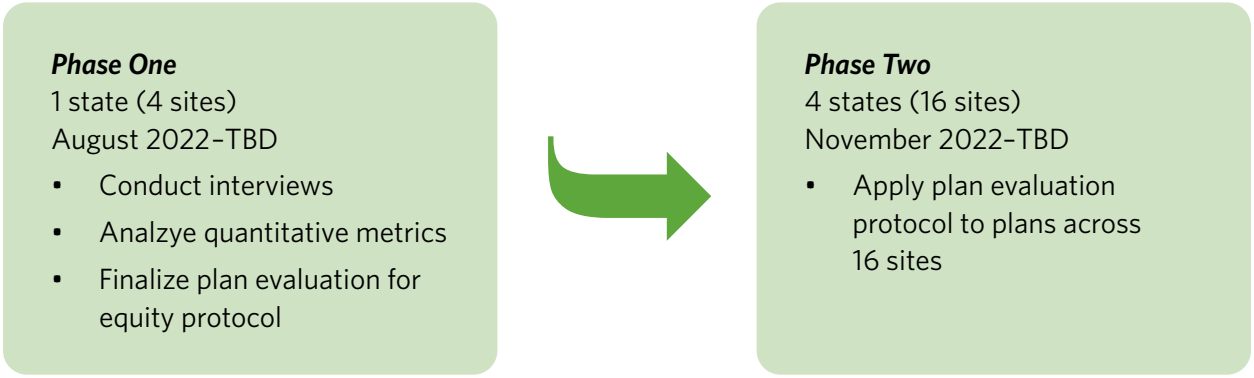


1. Identifying Inconsistencies
2. Identifying consistencies and building metrics
3. Reaching an equitable approach

Research Procedure

This research aims to provide insight on how to transform the hazard mitigation and disaster risk management community through embedded equitable practices that support all groups, including the most marginalized. In Year 2, we continued our mixed-methods study in two phases (Figure 2). In the first phase, we continued our deep dive into North Carolina case study sites by analyzing hazard mitigation and disaster recovery funding, conducting interviews with public sector personnel and community members, and finalizing a plan evaluation for equity protocol. In the second phase, we expanded our case study sites to include 12 additional sites across three states (i.e., California, Iowa, and Louisiana). We applied the updated plan evaluation protocol to plans from all 16 sites to assess for the presence of equity in local hazard mitigation and comprehensive planning documents. Appendix A provides a description of the research topics by phase, the activities that align to each question, and their alignment to the equity framework's critical dimensions.

Figure 2. Description of Phases One and Two for Year 2



Layout of Report

The Findings section of the report is organized by these critical dimensions: (1) social vulnerability metrics, (2) community voice, (3) plan-based indicators. Each section includes the methods and results for data collected within the dimensions. Following the results, the report offers conclusions and recommendations for next steps by dimension.

Findings

Phase One: Social Vulnerability Metrics

Methods

There were two main components of quantitative data analysis undertaken in Year 2. The first focused on hazard mitigation funding at the property level, such as home elevation and voluntary buyout projects. The second evaluated post-disaster recovery funding through FEMA's Individuals and Households Program.

Hazard mitigation funding

This component of the analysis aimed to evaluate the distribution of hazard mitigation funding across various types of neighborhoods and communities. We worked with two primary datasets: address-level records of mitigated properties shared by the state government and OpenFEMA data on Hazard Mitigation Assistance (FEMA, 2023). Both datasets include multiple Hazard Mitigation Assistance programs (i.e., Hazard Mitigation Grants Program, Repetitive Flood Claims Program, Severe Repetitive Loss Program, and Pre-Disaster Mitigation Program). The FEMA records are reported at city or county level.

We began by conducting an extensive data cleaning process for the state government records. The main challenges involved the quality of the address and location data, as we needed to geocode the addresses in order to assign the mitigated properties to neighborhoods, cities, and counties. Many of the addresses needed to be modified to be geocoded; for example, some addresses contained the names of mobile home parks with no other identifying information, while others named an intersection but no street number. If enough information was provided to assign the location to a present-day, geocodable address, then the addresses were modified. This review was conducted manually. Once the state government records were geocoded to a set of coordinates, each location was mapped to a census block group, census tract, city, and county.

We then cross-walked the state data with OpenFEMA records to ensure that the two datasets are broadly consistent (and so that our results do not shift significantly based on which dataset we use). We conducted this comparison at the county level.

Finally, we merged information on community characteristics from the American Community Survey to the block group, census tract, or city/county of the mitigated properties to analyze what types of neighborhoods and communities have been receiving hazard mitigation funding. Specifically, we compared the median household income of block groups that received funding to the county median household income, as well as the share of people of color in the population of the block group vs. the county overall.

Post-disaster recovery funding

Our primary dataset is FEMA's "Individuals and Households Program - Valid Registrations" dataset, extracted from OpenFEMA's API in January 2022. The dataset contains applicant-level information from FEMA's National Emergency Management Information System describing the applicant and household characteristics, such as income, owner/renter status, insurance coverage, household composition, and level of damage to the residence. It also includes data on the outcome of the application, both for Housing Assistance (HA) and for Other Needs Assistance (ONA). We focus in particular on HA eligibility and reasons for ineligibility, described in the column *haStatus* – "the most recent Housing Assistance decision."

We extracted the data for North Carolina applicants after Hurricane Matthew (disaster number 4285) and Hurricane Florence (disaster number 4393). Of these, 1,362 were identified as duplicate applications (specifically, the haStatus column included IDUPA: Duplicate Application, ILDOBR: Linked for Duplicate Review, and IAW: Same Address). Duplicate records were removed from the dataset before the analysis was conducted. The final dataset is 217,837 total records, where 37% are associated with Hurricane Matthew and 63% with Hurricane Florence.

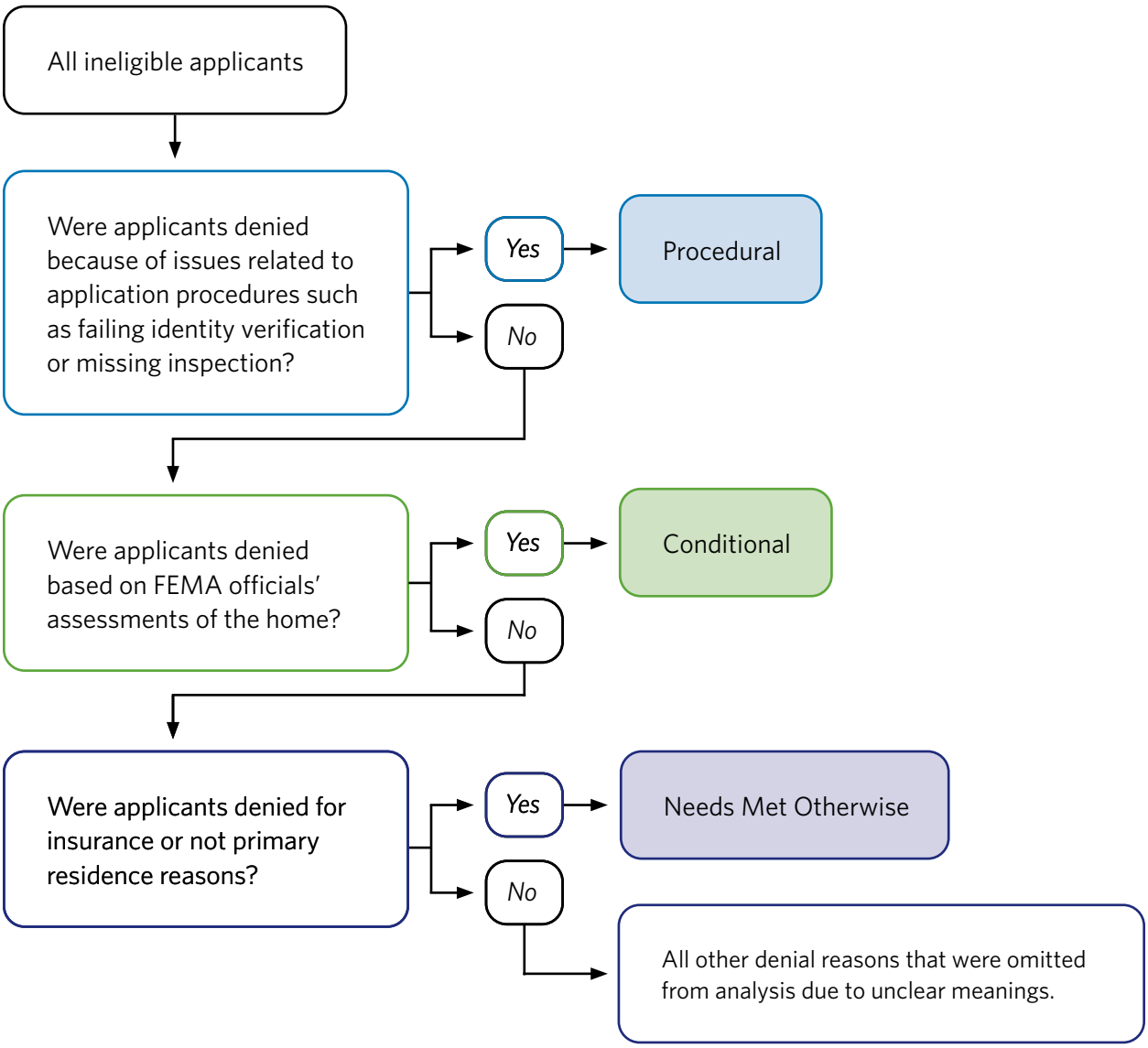
We used the *ihpEligible* column (true or false) to calculate overall rates of eligibility within the applicant pool. Then we analyzed specific reasons for ineligibility using the haStatus column, which contains codes associated with reasons for denial. There are more than 30 different codes, and the column can contain multiple codes for a single applicant. There were 238 unique combinations of denial codes. We assigned each code to one of three categories:

- *Procedural (UNP):* This category represents applicants who were denied due to FEMA's policies and procedural requirements. Lack of paperwork to verify identity, ownership, or occupancy is a common denial reason in this category. Other codes include missed inspection, non-compliance with flood insurance requirement, and the residence being located in a Coastal Barrier Resources Act or Other Protected Area zone.
- *Conditional (UNC):* This category includes applicants who were denied due to inspector judgments about the damage to their residence. The codes in this category are insufficient damage and damages not disaster related.
- *Needs Met Otherwise (NMO):* This category represents applicants who were denied because they had other sources of assistance, including home insurance and flood insurance. Applicants for non-primary residences or who withdrew voluntarily are also included in this category.

While each application can be associated with multiple denial codes, we sorted each application into a single category based on the order of priority shown in Figure 3. Thus, if any of the codes met the Procedural category, an application was sorted into that category and omitted from Conditional and Needs Met Otherwise, even if they had other codes indicating those conditions. A total of 97,686 applications were sorted into one of three categories, leaving 57,873 unsorted. The unsorted denial codes do not have straightforward explanations for denial such as INO: Ineligible Other, TSA: Transitional Shelter Assistance, and IOVR: Over Program Maximum. The lack of information available for the meaning of these codes prevented them from being categorized. Thus, only codes that have clear meanings for denial were included in sorted categories.

We further examined the prevalence of each ineligibility category by the characteristics of applicants. When individuals apply for assistance, they answer questions about household composition, housing type, income, and insurance coverage. We used the housing type and income information to assess how eligibility rates and ineligibility reasons vary by applicant type. Income is reported categorically: $0, <$15,000, $15,000–$30,000, $30,001–$60,000, $60,001–$120,000, $120,001–$175,000, and >$175,000. There are 13 housing types reported in the dataset, and we considered three primary categories: single-family house/duplex, mobile home, and an aggregation of the remaining 11 housing types into other housing. Other housing includes apartment, travel trailer, condo, townhouse, military housing, assisted living facility, college dorm, boat, correctional facility, unknown, and other. Because ineligibility reasons vary widely—from having insurance coverage to having an inspector deem damage not disaster-related—such an analysis is critical for identifying if particular obstacles exist for households that face the highest needs.

Figure 3. Procedure for assigning denial codes to categories

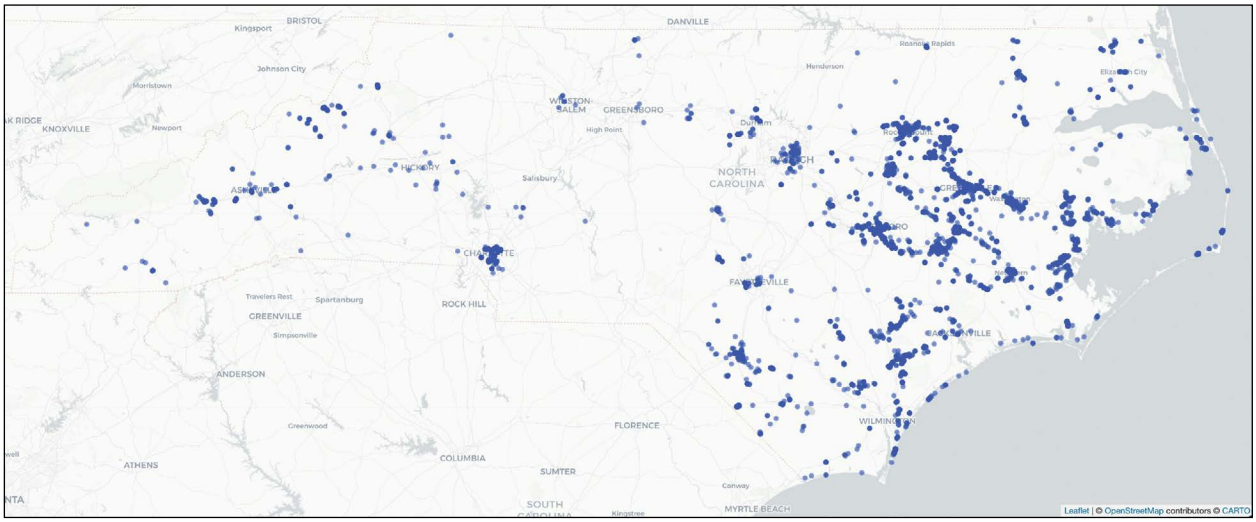


Results

Hazard mitigation funding

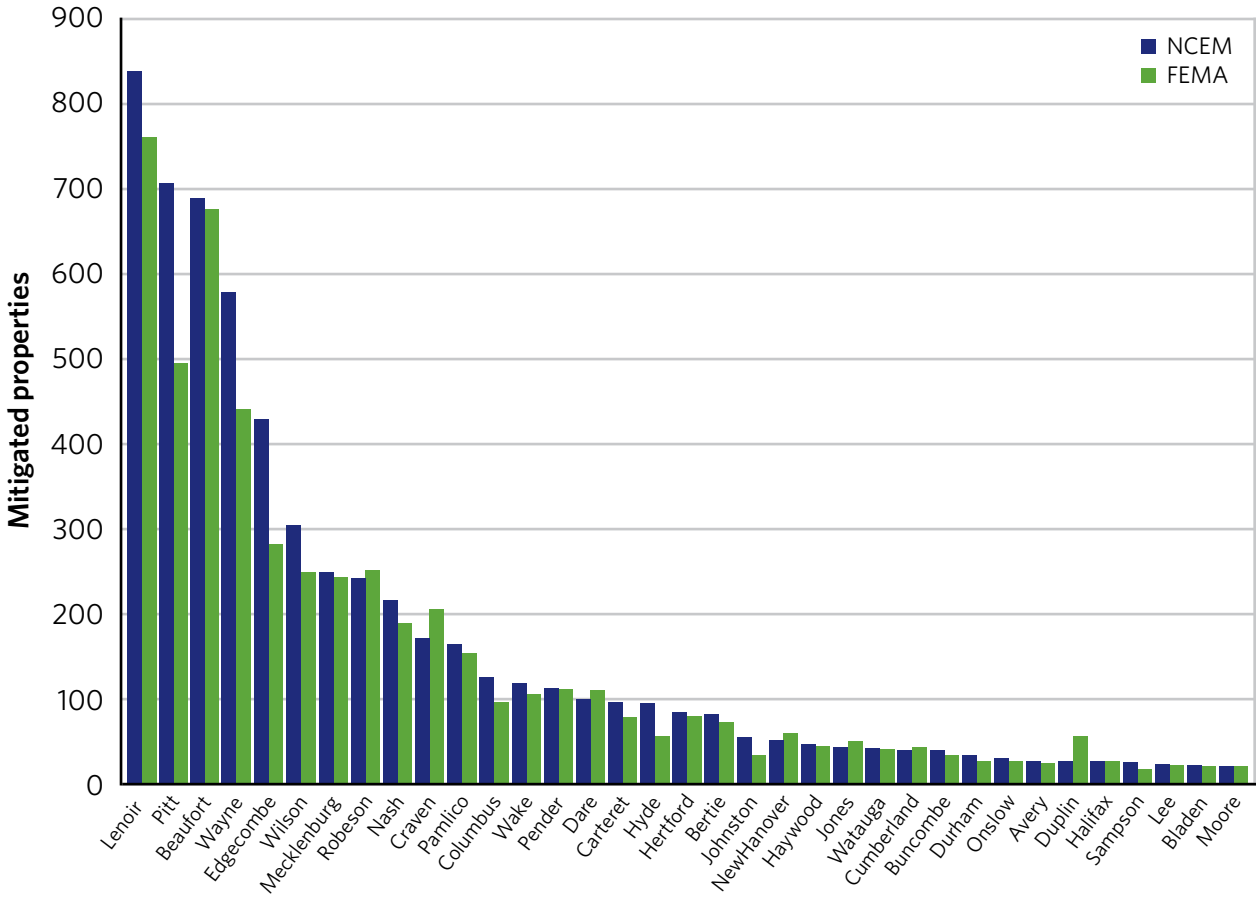
We began with 12,309 records from the state on mitigated properties. After manual cleaning and review, 11,519 were geocoded to a street address. The remainder either geocoded to a coarse unit (e.g., a city centroid or point of interest) or did not return any location. The distribution of the 11,519 records successfully geocoded to street address locations can be seen in Figure 4. As expected, the mitigations are concentrated in the eastern portion of the state, and especially in riverine areas in the coastal plain.

Figure 4. Mitigated properties across North Carolina



Checking the state data against FEMA records required several additional processing steps to resolve discrepancies. The state data (11,519 records) contain many more addresses than the OpenFEMA data (5,328 properties). Each of the FEMA records is associated with a unique project identifier—either a disaster declaration or a project associated with programs other than the Hazard Mitigation Grant Program. While many of the state records contain corresponding project identifiers, a number of them have no information at all for the project identifier. These may be associated with state funding and thus do not have an identifier that matches FEMA records. There are also two project identifiers in state records that do not exist in FEMA records. Once properties that do not have a matching project identifier in FEMA records were removed, the total number of state entries for comparison decreased to 6,049, compared to 5,328 in FEMA records. The project-level discrepancies are small.

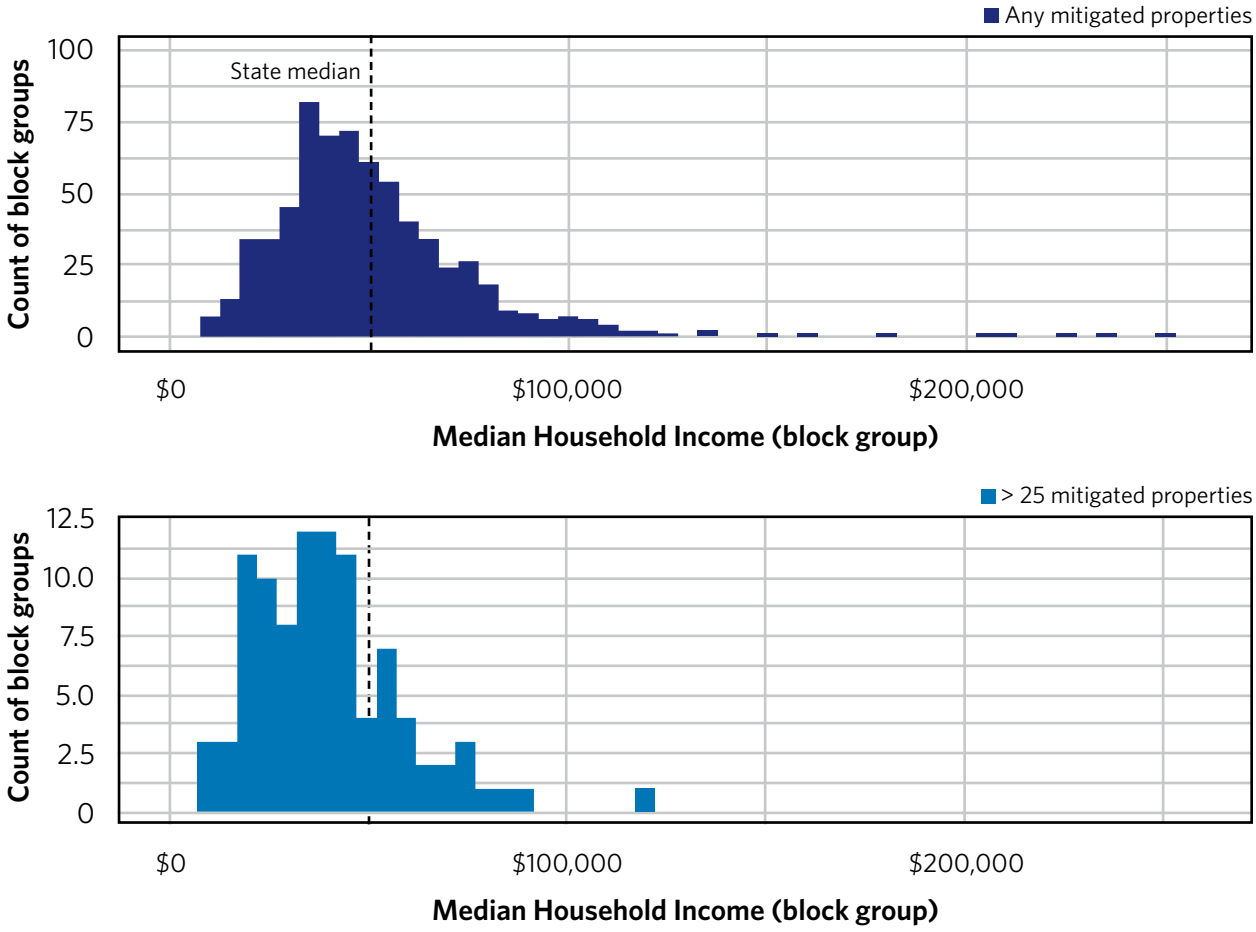
Figure 5. County-level comparison of state (NCEM) records and FEMA records of properties mitigated



A county-level comparison of the filtered state records with FEMA's records shows that the two datasets largely agree on the distribution of mitigated properties throughout the state. Figure 5 shows the count of mitigated properties in each county with at least 20 mitigated properties in state records. Both datasets show Lenoir County with the most mitigated properties. The state data shows Pitt County second, followed by Beaufort County and Wayne County. FEMA records have Beaufort County second, followed by Pitt County and Wayne County. These remaining discrepancies could be due to a variety of reasons, such as more properties starting the process than being completed or administrative errors.

Finally, returning to the complete state dataset of more than 11,000 records, we evaluated the characteristics of communities that have received funding for flood mitigation. The initial results indicate that block groups with flood mitigation funding tend to have lower household incomes than the state median (Figure 6, top panel). When examining only the block groups with many mitigated properties (i.e., more than 25), the distribution shifts further left and the wealthier block groups (i.e., incomes of $150k or higher) largely disappear (Figure 6, bottom panel). However, it is important to note that the income data are at block group scale, not household scale. Therefore, these findings are not necessarily true for the actual recipients of the mitigation funding; the mitigated household may have an income significantly less than or greater than the block group median.

Figure 6. Households receiving mitigation funding

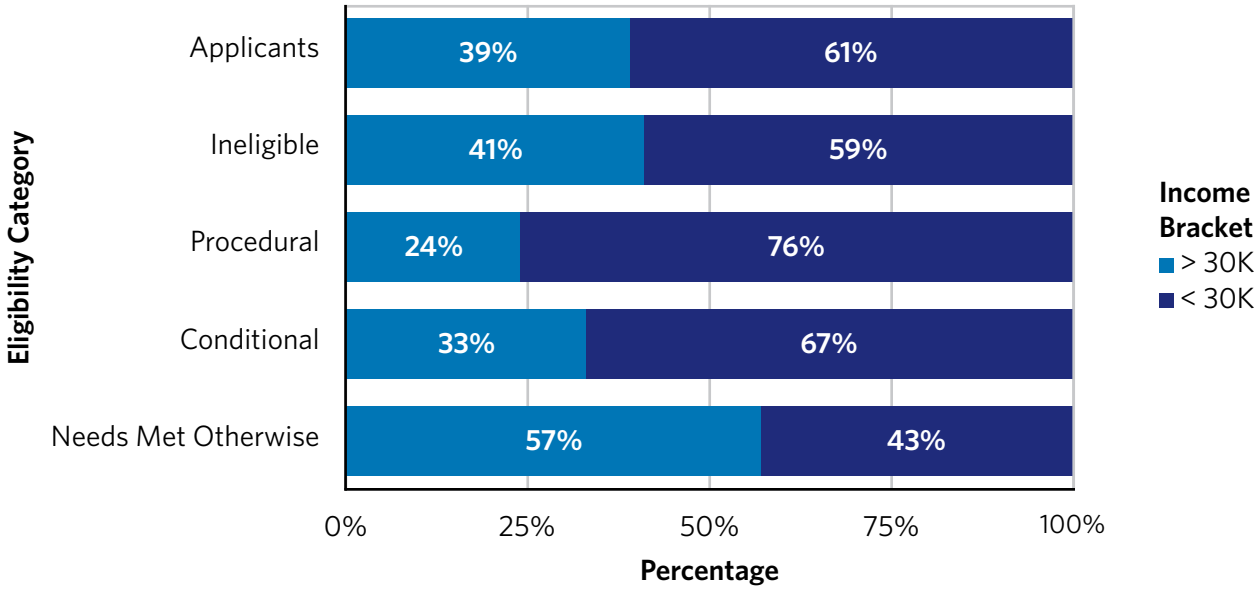


Post-disaster recovery funding

Across both disasters, only one-third of applications (63,640 of 217,837) were ultimately deemed eligible for housing assistance. Overall eligibility rates did not vary substantially by applicant income (when broken down into two categories as shown in Figure 7) or housing type. Roughly, 61% of the applicant pool reported an annual income under $30k. Of those deemed ineligible, 59% had an income under $30k, illustrating that applicants with incomes below $30k and applicants with incomes above $30k were denied at approximately the same rates.

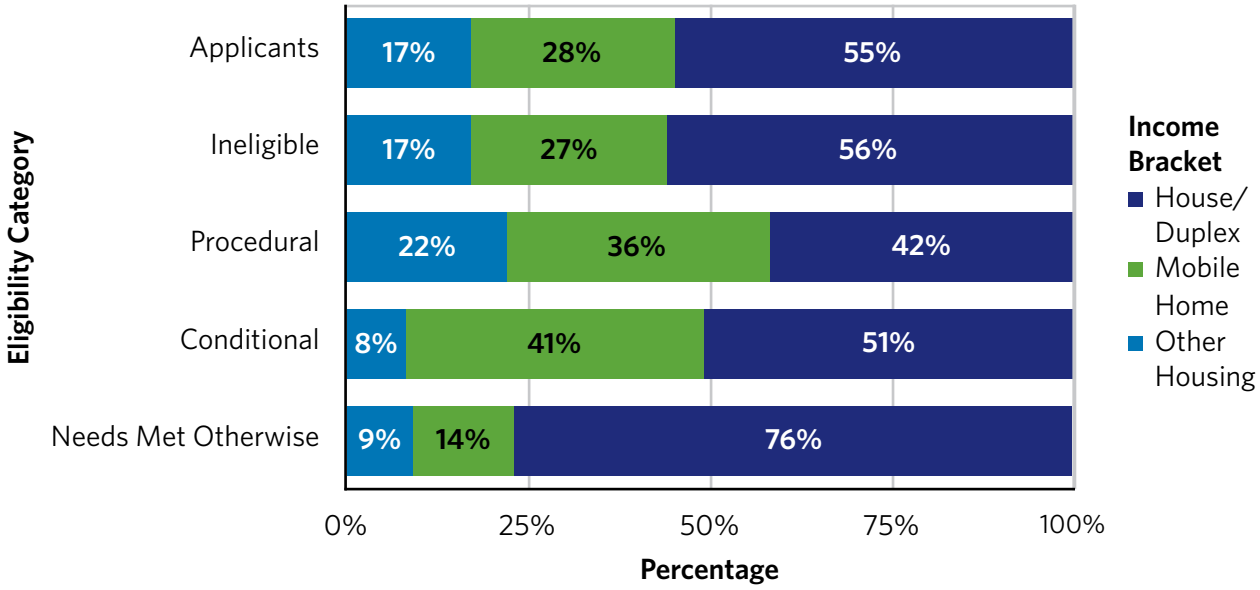
There were significant differences in denial reasons across income categories. About 57% of the applicants denied for Needs Met Otherwise (NMO) reasons (i.e., insurance or applying for a non-primary residence) had household incomes above $30k. In contrast, only 24% of the applicants denied for Procedural reasons, such as lacking paperwork or missing an inspection, had incomes above that threshold. Households with incomes below $30k were over-represented in both the Procedural and Conditional categories.

Figure 7. Housing assistance by eligibility and income



For housing type, 55% of the applicant pool lived in a single-family home or duplex, compared to 56% of the ineligible applicants, as shown in Figure 8. Roughly 28% of applicants and 27% of ineligible applicants lived in a mobile home, with the remainder reporting another housing type, including apartment, travel trailer, condo, townhouse, military housing, assisted living facility, college dorm, boat, correctional facility, unknown, and other. Both mobile homes and other housing types are over-represented among applicants denied for Procedural reasons. Applicants from mobile homes make up 41% of applicants denied for Conditional reasons—inspectors deeming the damage to be insufficient or not related to the disaster. In contrast, mobile homes and other housing types were under-represented among applicants denied due to Needs Met Otherwise (NMO) reasons.

Figure 8. Housing assistance by eligibility and housing type



Phase One: Community Voice

Methods

The interview component of our study was designed to extend our analysis of equity in disaster resilience by collecting and evaluating critical perspectives from community members and people involved in hazard management across four case study communities in North Carolina. Through these interviews, we sought to answer the following questions: how, if at all, does the disaster risk management community plan for equity and what opportunities exist to better incorporate equity and support the resilience of marginalized communities? We also sought to uncover to what extent marginalized communities are organizing or relying on informal planning or support in the face of local hazards, in place of or in addition to formalized planning and support from the public sector.

Interviews were conducted with a total of 49 respondents from Buncombe, Burke, Edgecombe, and Mecklenburg counties. Table 1 provides a breakdown of the number and type of respondents interviewed in each county.

Table 1. Number of interview respondents by county

County	Public Sector Respondents	Community Respondents	Total Respondents
Buncombe	9	6	15
Burke	6	5	11
Edgecombe	7	3	10
Mecklenburg	9	4	13
Total	31	18	49

We used a semi-structured interview protocol that was developed based on literature review as well as themes and questions that arose from the research team's content analysis of equity in local planning documents and quantitative analysis of social vulnerability metrics and federal recovery and mitigation spending. Our interview respondents included two cohorts: public sector respondents and community respondents. For the purpose of this report, we defined public sector respondents as local planners; floodplain managers; stormwater management, emergency management, public health and social services personnel; and elected officials. We selected individuals based on their involvement in various aspects of local hazard management and recruited them using contact information from local government or other public-facing websites. The second interview cohort, which we refer to as community respondents, is composed of current and former residents of our four cases study sites and represents a range of lived experiences with local hazards. Community respondents were recruited via personal connections or through recruitment e-mails and phone calls.

The research team developed two versions of our interview protocol: one for public sector respondents and the other for community respondents. General background and disaster impact questions were identical across both versions of the protocol. All respondents were asked to speak to disaster support, planning, and engagement between local government and the community, but specific questions varied between the two protocols. Questions for public sector respondents were tailored to expand our understanding of how local government agencies work to equitably support community members before, during, and after hazard events. Questions for community members were designed to probe their experiences and observations of local planning and support—both formal and informal—including any experiences they had trying to access assistance from FEMA.

Interviews were conducted via phone, video call, or in person depending on the preference of the respondent and were recorded and transcribed with the respondents' consent. Most interviews were conducted one-on-one, but three public sector interviews (inclusive of six respondents in total) were conducted jointly—with two colleagues from the same government agency participating in a joint interview session. Research team members completed a Qualtrics survey following each interview to reflect on and record major themes. These Qualtrics summaries, in addition to interview notes, formed the basis for the interview findings presented in this report. Future analysis will dive deeper into the interview transcripts to draw out additional details and recommendations.

Our preliminary findings are summarized by case study site in the following section. We begin with an overall summary of findings from the combined North Carolina sites. Following that, we provide a deeper summary of each site's findings, including a brief synthesis of how respondents characterized their community and then reporting on the following:

- *Local hazards:* most significant local hazards as identified by respondents
- *Impact and vulnerability:* respondents' descriptions of marginalized groups within the community and populations most vulnerable to and/or impacted by local hazards
- *Experiences of support:* inclusive of perspectives on both formal and informal forms of support available to community members before, during, and after a hazard event, with a focus on the extent to which that support is targeted at or accessible to marginalized communities
- *Experiences accessing FEMA aid:* perspectives on the process of applying for and accessing FEMA assistance, inclusive of Individual Assistance, Public Assistance, and Hazard Mitigation Grants

Results

Our preliminary results show that the most common hazards identified by respondents across our four case study sites were flooding, tropical storms, and winter storms. The people identified as the most vulnerable to hazards within these communities included people in low-income households, residents of color, individuals living in flood-prone areas, and residents of mobile home parks. After a storm, residents turn to various sources for support, including friends, family, neighbors, church groups, food pantries, and community organizations. Local governments communicate information on hazards and recovery resources through multiple channels, including hotlines, radio ads, flyers, town hall meetings, social media, word of mouth, and in-person presentations. Most hazards experienced by the four case study sites were not big enough in scope or impact to trigger FEMA response or funding—putting the onus of response and recovery on local and state governments and networks of faith, nonprofit, and community-based organizations. Of our case study sites, only Edgecombe and Buncombe have experienced major disasters within the past decade (excluding Covid-19) that have triggered Individual Assistance funding from FEMA. Residents in Edgecombe County noted a strong FEMA presence following Hurricane Matthew in 2016, but also noted that this support was not sustained beyond the immediate aftermath of the storm, despite ongoing displacement. The process of obtaining FEMA funding in cases where it was available was described as slow and complex due to unclear eligibility criteria, confusion regarding different program requirements, and delays in the application process. Appendix B provides a brief summary of the overall themes collected from interview respondents by case study site.

Buncombe County

The research team interviewed a total of 15 people in Buncombe County, including nine public sector respondents and six community respondents. Interview respondents in Buncombe County spoke positively of their community, but also commented on a rapid rate of change and development in recent years, noting that the area has become a destination for retirees, remote workers, second-home owners, and "climate refugees." They voiced worries that this growth is driving up home values, leading to gentrification, a lack of adequate affordable housing, and increased disparities. One community member described these changes as a barrier to resilience, due to the negative impact on community connectedness and the loss of community knowledge and memory that occurs as older residents are pushed out.

Local hazards: Flooding, winter storms, and remnants of tropical storms were named as the most significant hazards impacting the area. Many respondents noted seeing an increase in heavy precipitation, which they attributed to climate change. Recent hazard events included Tropical Storm Fred in 2021—a federally declared disaster resulting in damage to private residences in the area, as well as private drives, bridges, and culverts—and a hard freeze in December 2022 that resulted in extended water shut-offs for a large portion of the community.

Impact and vulnerability: Half of our respondents cited a predominance of low-income households and mobile home parks in the lower-lying, more flood-prone areas of the county and identified these communities as among the most impacted due to greater exposure and having fewer resources for recovery. Two respondents mentioned a recent shift in this pattern, with new tourists and transplants increasingly interested in the scenic value of riverfront properties. It was noted, however, that these higher-income floodplain residents are more likely to live in newer, more flood-resilient houses (built after floodplain regulations were adopted) and have more resources to recover if hit.

When asked about data sources they use to identify the most marginalized populations, public sector respondents mentioned a new Community Index map developed by Buncombe County's Equity and Inclusion Workgroup in collaboration with County GIS staff. This tool is still being rolled out, but the intention is that it will be used by departments throughout the county to better target investments, infrastructure, and services toward places with a higher concentration of need as seen through an equity lens. One public sector respondent from a small town in Buncombe noted that an advantage of being in a smaller, more rural community is that local planners and emergency management personnel are more likely to have direct knowledge of where the most marginalized residents are located: "I don't have a heat map [...]; I just know where they are."

Experiences of support: Public sector respondents listed hazard mitigation and comprehensive planning, adoption of stricter land use and development ordinances, purchase of conservation easements in flood prone areas, and education, outreach, and mass alerts as the primary ways they work to mitigate local hazard risks. In the wake of hazard events, local government personnel conduct damage assessments and help connect residents to available local, state, and federal recovery resources. Support efforts specifically targeted toward socially vulnerable or historically marginalized groups included translation of communications into Spanish and Ukrainian to reach non-English speaking

populations; targeted outreach to homeless encampments and low-income mobile home parks in flood-prone areas, to warn of anticipated flood events and to facilitate evacuation or rescues if necessary; and targeted support to group living facilities during recent weather induced water-shutoffs to make sure they had adequate temporary water supplies. Despite translation of preparedness and recovery information, multiple respondents raised the concern that non-English speakers may not receive adequate support due to language barriers as well as distrust toward local government. Lack of trust for local government was cited as a barrier to effective engagement more broadly as well. Local government agencies have tried to overcome this barrier by partnering with trusted community organizations and churches to communicate preparedness and recovery information to community members, noting that pastors and faith-based organizations "have a captive audience that's hard for us [in local government] to reach." Respondents said they primarily rely on neighbors, church groups, food pantries, or other community organizations when seeking support before or after a hazard event.

> To overcome language barriers and mistrust of government, local government agencies have translated outreach materials into multiple languages and forged partnerships with churches and trusted community organizations.

Experiences accessing FEMA aid: No one interviewed in Buncombe County had personal experience applying for FEMA Individual Assistance, but public sector respondents who had supported local residents applying for aid spoke to residents' frustrations with how long the process takes, how many different damage assessments have to happen before they receive assistance, and confusion around eligibility. One respondent noted that the length of the process has the unintended impact of weeding out anyone who doesn't have the resources or supports available to help them get by while they wait the process out. Another observed that local community organizations and faith-based groups are more nimble and timely in their response, due to less bureaucracy, but also because of greater connections to and knowledge of the community. A frequently cited problem in Buncombe County was that FEMA funds cannot be used to repair damage to private driveways, bridges, or culverts—private infrastructure that is critical for access, particularly in more isolated, rural parts of the community, but is not eligible for funding under existing FEMA recovery programs.

When asked about their experiences accessing FEMA mitigation grants, public sector respondents spoke to the amount of time and resources required to apply for and report on these grant funds and the challenge this posed in the context of limited staff capacity. Multiple respondents also commented on how competitive these federal grant programs are and felt that the relative lack of presidentially declared disasters or repetitive loss in their area makes it harder for them to access federal funds that are by design weighted toward places with greater historic occurrences or impact.

Burke County

The research team interviewed 11 people in Burke County, including six public sector respondents and five community respondents. People interviewed spoke about their community with pride and care, but also noted that the county struggles with high poverty rates and increasing homelessness. Respondents raised concerns about inadequate access to healthcare, social services, and affordable housing; lack of economic opportunity; and aging or inadequate infrastructure, with some noting that their small tax base and lack of funding makes it hard to address these issues. Respondents described the community as predominantly White, but also mentioned the Hmong, Hispanic, and Black communities that live there, and noted the presence of the North Carolina School for the Deaf.

Local hazards: Respondents identified winter storms, tropical storms, severe weather (e.g., thunderstorm winds, hail), and flooding as the most significant hazards faced by the county, with occasional, more localized impact from wildfire and tornadoes. Burke County was hit hard by back-to-back storms, Frances and Ivan, in 2004. The county also experienced severe winter storms and flooding in 2010 and severe storms, flooding, and landslides in 2013, but have not had any federally declared disasters in the years since then.

Impact and vulnerability: Community respondents highlighted lower-income and homeless individuals as those most impacted by local hazards, due to greater exposure and vulnerability and less access to financial resources that facilitate recovery. Public sector respondents tended to focus more on location of hazards as a determinant of who is most impacted, but socioeconomic aspects of vulnerability and impact came up as well. One respondent noted that although flooding occurs throughout the county, the impacts tend to be worse in the eastern part, which is home to more low- and middle-income residents as well as to many of the county's Hispanic and Hmong residents. In contrast, on the western side—home to more well-off residents—greater investment has gone into flood mitigation over the past 30 years, which the respondent said has helped "tremendously" in lessening impacts for those residents. Another public sector respondent said they do not track differences in impact across groups, but that he thought lower-income groups struggle more. Asked whether that knowledge affected how they target response and recovery resources, he said: "Well, our first priority is saving lives, so if we know we have folks that are vulnerable, [those are] the first places we try to reach to when any type of event happens."

> Speaking to how they targeted resources for hazard mitigation, public sector respondents in Burke County said their efforts were guided largely by indicators of damage or repetitive loss—not socioeconomic considerations.

Experiences of support: Community respondents shared that the local government communicates hazards information and warnings through traditional and social media, a local weather notification and preparedness app (i.e., Foothills Weather Network), and direct phone calls or home visits to residents in at-risk areas. Public sector respondents mentioned that specific efforts are made to reach the Hispanic and Hmong populations as well as deaf and hard-of-hearing residents in the county, via translation and partnering with organizations that have connections to these communities.

When asked where they turned for support in disaster, two community respondents said they would rely first on insurance before seeking out additional support; the other three mentioned relying primarily on neighbors, friends, and family. Three respondents shared instances where they relied on their insurance to pay for disaster damages in the past; one mentioned having access to another home to stay in while they rebuilt. In contrast, one respondent noted seeing people walk away from properties with flood damage because they did not have the resources to repair them.

Speaking to how they targeted resources for hazard mitigation, public sector respondents said their efforts were guided largely by indicators of damage or repetitive loss—not socioeconomic considerations. Overall, our interview responses indicated that socioeconomic factors and the specific needs of marginalized communities are considered little, if at all, in how decisions are made and that the current guiding ethos in disaster risk management is one of equal protection, but not necessarily equitable protection.

Experiences accessing FEMA aid: None of our respondents in Burke County had experience applying for Individual Assistance from FEMA. Outside of COVID-19 response, this type of aid has not been available in the area since 2004, in the wake of hurricanes Frances and Ivan. One public sector respondent commented that residents do "suffer a lot of damage that FEMA doesn't cover, like their driveway is washed out, or private roads."

When it came to accessing Public Assistance to reimburse public disaster-related expenditures, one public sector respondent shared that he had almost 100% success in accessing grant funds. He attributed his high level of success to detailed, accurate real-time records of expenses incurred, as well as to a high level of familiarity with FEMA and with disaster recovery logistics and funding, acquired through his work with the National Guard. He reflected that he was probably better versed than most and noted that communities without enough staff capacity or with less knowledge and familiarity of the federal and state recovery system are likely at a disadvantage when it comes to accessing these funds.

Edgecombe County

The research team interviewed a total of nine people in Edgecombe County, including six public sector respondents and three community respondents. Public sector respondents expressed love and admiration for their community and described it as diverse and friendly, while also acknowledging challenges posed by limited resources, high unemployment, low educational attainment, and limited economic and educational opportunities.

Two community respondents were from Princeville, the oldest town founded by freed Blacks in the U.S. and a community that has been hard hit by flooding. These respondents expressed mixed feelings about Princeville. One voiced frustration with the repeated flood events, stating they would leave if they were flooded again. The other expressed a deep connection to the community and commitment to staying there despite repeated flooding, due to their personal history and property ownership. Both highlighted the historical significance of Princeville and the resilience of its predominantly Black population.

Public sector respondents in Edgecombe County mentioned using Census data to identify marginalized or socially vulnerable populations and shared that they also work closely with Social Services to identify people who may need additional help.

Local hazards: The community's main weather-related disasters include flooding, hurricanes, fires, and heavy rain events. Riverine flooding from the Tar River, as well as flooding in low-lying areas and smaller tributaries throughout the county, are common in heavy rain events. Flash flooding is also a concern, even outside of floodplains, due to development. Flooding is the major concern for the Town of Princeville due to its proximity to the Tar River and inadequate protection from the existing levee system. Hurricanes Floyd in 1999 and Matthew in 2016 were major disasters that impacted the entire community.

Impact and vulnerability: Since flooding is the county's most significant hazard, public sector respondents identified people living in low-lying areas as those most impacted by hazardous events. It was noted, however, that the lowest-lying parts of the county tend to be predominantly Black. Community members mentioned renters and people living in mobile home parks as among those most impacted. Both groups conveyed a sense that, in this flood-prone area, everyone is affected by disasters, but that the impact is greatest for low-income people.

Public sector respondents mentioned using Census data to identify marginalized or socially vulnerable populations and shared that they also work closely with Social Services to identify people who may need additional help. Respondents felt that with additional personnel they would be able to obtain and utilize more data in local hazard resilience planning.

Experiences of support: When asked about engagement between the community and local government, a public sector respondent stated that the local government takes an "aggressive approach" to support community members recovering from disaster: providing information about aid programs, assisting with application processes, and even offering personal support such as helping individuals obtain copies of receipts necessary for their application paperwork. They strive to educate and alert residents through various channels, such as social media, annual mailings, and the Code Red System, to ensure they are well-informed and prepared for storms. After disaster events, they get word out about recovery efforts and resources through phone hotlines, radio ads, flyers, town hall meetings, social media, word of mouth, and in-person presentations to groups that may have limited access to technology, such as elderly residents. Efforts are being made to provide information in Spanish to accommodate the growing Hispanic/Latinx population. Barriers to engagement include the loss of a daily newspaper and limited access to local TV channels and social media platforms. To overcome these challenges, officials collaborate with churches, neighborhood recreation centers, and schools to reach a wider audience.

> According to public sector respondents, Edgecombe County's smaller tax base and limited staff capacity—combined with the competitiveness of FEMA mitigation grant programs—present barriers to accessing adequate mitigation funding.

According to public sector respondents, Edgecombe County actively utilizes hazard mitigation grant funds and various programs to address the impacts of disasters. They pursue buyouts and elevation projects to move residents out of flood-prone areas and mitigate risks to critical infrastructure. The Town of Princeville is reconstructing areas and planting rain gardens and trees in high-risk areas to aid in managing and absorbing water. Upgrading town resources (i.e., roads, sewers, storm water infrastructure) was identified as critical in minimizing damage and expediting recovery. While the county has made progress in reconstruction and infrastructure updates, one respondent noted there is also a need for expanded mental health and counseling services for residents affected by past disasters.

Among community respondents, perceptions of local government support and communication varied. One individual expressed negative views overall, stating that the government was not doing anything and that residents were largely taking care of themselves. However, when specifically discussing the mayor and commissioners, this respondent acknowledged efforts made by local officials to warn residents about imminent storms and facilitate evacuation. Another community respondent praised the county's response to past events and their preparation for future hazards. A third respondent

expressed dissatisfaction with the level of transparency and accountability in rebuilding efforts, urging the government to vet contractors more thoroughly and provide greater transparency to prevent prolonged displacement.

Despite receiving government funds and acknowledging government initiatives such as buyouts and elevations, there was still a perception that the government was not doing enough. A public sector respondent reflected: "There are people who don't get as much as they wanted, but that is kind of hard to remedy because, if you just had your entire property—everything you own—destroyed by a flood, it's hard to imagine any response, any recovery initiative that could come in and make you whole again."

Experiences accessing FEMA aid: One community respondent obtained FEMA funds to purchase a new house after their trailer was damaged in Hurricane Floyd. It took approximately two years to receive the funding and move into their new home. During that time, they stayed with family and in FEMA trailers. Their new home was damaged in Hurricane Matthew, at which point they were temporarily housed in a local motel using FEMA funds and received assistance to repair the damage to their house. Another respondent acknowledged FEMA's fast response and presence in the immediate aftermath of disaster, but noted that FEMA's presence diminished after the event, despite ongoing displacement in the community.

Challenges that residents face in gaining access to FEMA aid include unclear eligibility criteria and confusion around varying eligibility requirements for different programs, as well as delays in the application process. One respondent mentioned that a lack of understanding and awareness has led to some community members running into issues with accidental duplication of funds, resulting in having to pay money back to the government, placing those residents in an even more stressful position. Another noted that residents who have resources and alternative housing options to fall back on until federal dollars arrived were more likely to access aid. Denials of aid were observed to be most often due to exceeding the income requirements or having excessive liens or mortgages.

According to public sector respondents, the county faces challenges in accessing FEMA mitigation aid due to its limited tax base and having to compete with larger counties that often have more resources such as additional personnel. Respondents have faced obstacles in securing sufficient grant funding for buyouts, elevations, and critical infrastructure projects.

Mecklenburg County

The research team interviewed a total of 13 people in Mecklenburg County, including nine public sector respondents and four community respondents. People we spoke with praised the community's diversity, which encompasses a variety of cultures, ethnicities, income levels, races, and age groups. They described residents as a mix of blue-collar workers, professionals, young people, families, retirees, and people without homes. Respondents also mentioned the challenges of resource and wealth disparity, growing traffic, high crime rates, gentrification, and the need to improve public transportation and infrastructure to cater to the fast-growing population. Despite these challenges, respondents spoke highly of their community and its resilience in coming together to address local issues.

> Community respondents mentioned primarily relying on family, friends, neighbors, and local organizations for assistance during or after a disaster, rather than looking to state or federal resources.

Local Hazards: Hazards that have affected the community in recent memory include hurricanes, tornadoes, tropical storms, ice storms, winter storms, extreme heat events, and flash flooding. Mecklenburg has not had a major disaster declaration (excluding the Covid-19 pandemic) since Hurricane Fran in 2004, but the county experiences regular localized flooding and flash flooding events. The most recent significant flood event mentioned by respondents was in 2019 along the Catawba River and it caused significant damage to properties and businesses.

Impact and vulnerability: When asked who in the community was most impacted by hazard events, most respondents highlighted those living in flood-prone, low-lying areas as well as low-income people. Two community respondents also mentioned emergency workers, renters, and those who are food insecure as among the most impacted. Three public sector respondents identified Black and Brown communities, people without homes, undocumented immigrants, and people with access or functional needs (e.g., transit-dependent, medically dependent, deaf or hard of hearing, seniors, and disabled people) as among the most impacted by hazard events.

Public sector respondents utilized various data sources to identify marginalized or socially vulnerable populations, including flood insurance claims, socioeconomic data from the Census and city surveys, and information on disabilities, language barriers, and other access and functional needs obtained from the state. However, they noted a need for increased capacity to actively address gaps in the data and delays in data availability. One respondent mentioned they reach out to community partners to help fill gaps in the data, including an organization that conducts outreach and gathers data on unhoused people in the community. According to this respondent, the organization is trusted within the community and thus can gain access to data that the local government is not privy to.

Experiences of support: There were mixed perspectives on local government effectiveness in engaging and supporting the community around hazards. One respondent had a close relationship with city and county officials and mentioned a city councilman coming to her house to help clean up after every hazard. Another respondent commended the local government's successful efforts in alerting residents about extreme weather and flooding risks through email notifications and social media outlets. Two community respondents expressed less satisfaction with the government's involvement and support. One individual felt that they were systematically not well supported by insurance and the government after a disaster but acknowledged it could be due to not knowing whom in local government to talk to or ask for assistance. Another suggested involving smaller community organizations in hazard planning and communication, because they are closely connected to the community, including marginalized populations. Community respondents mentioned primarily relying on family, friends, neighbors, and local organizations for assistance during or after a disaster, rather than looking to state or federal resources.

Public sector respondents spoke about several key strategies they employ to mitigate hazard risks. These strategies include fostering partnerships and collaborations with various agencies and organizations to ensure coordinated disaster response and support. They said data plays a crucial role in their approach. They educate the community about local hazards through social media, radio campaigns, and outreach programs. When asked how local government engages the community and addresses barriers to equitable outreach, public sector respondents said they distribute information in multiple mediums and venues, translate outreach materials into Spanish, have a presence at local community events, and go door-to-door in rural areas. However, they noted it can be challenging to capture people's attention in between hazard events, and they highlighted a lack of trust in the government as an additional obstacle to engagement.

One of the ways Mecklenburg works to mitigate local flood hazards is through locally funded floodplain buy-outs and retrofits, which can be administered with greater speed and less red-tape than federally funded mitigation projects. This program targets properties in the floodplain, either acquiring them outright to support residents in moving out of harm's way or providing financial assistance for elevations and other flood-risk mitigating retrofits. However, residents must pay for retrofit costs up-front and receive reimbursement from the county afterward, which effectively acts as a barrier to participation for many low-income community members who cannot afford the upfront cost. Recognizing this limitation, Mecklenburg County is partnering with Habitat for Humanity to begin targeting specific lower-income neighborhoods for retrofits.

Experiences accessing FEMA aid: No respondent from Mecklenburg County had applied for FEMA Individual Assistance. Mecklenburg County has, however, successfully applied for and received Hazard Mitigation Assistance to fund floodplain buyouts. Public sector respondents described the process of obtaining FEMA mitigation funding as slow, bureaucratic, and complex in ways that can compromise the success of a mitigation project, even in cases where funding is ultimately obtained. They shared that FEMA funding can take months or even years to materialize. One respondent gave the example of a mitigation grant to buy out 15 houses in one particularly flood-prone neighborhood. When they started the application process, they had buy-in from all 15 property owners, but by the time the funding was finally approved—three years later—only five property owners were still interested. Respondents from Mecklenburg also emphasized that the FEMA grant application process could be daunting and complicated, especially for communities unfamiliar with it.

Phase Two: Plan-based Indicators

Methods

Within this section, we explore the extent social equity framing and indicators were integrated in hazard mitigation plans and comprehensive plans in 16 communities across four states. The team used the following research questions to guide this exploration:

- To what extent do hazard mitigation and comprehensive plans include equity as a core value to organize the content and format of plans?
- To what extent do hazard mitigation and comprehensive plans include indicators that could be used to document, measure, and monitor equity in disaster resilience?
- Do hazard mitigation and comprehensive plans vary in inclusion and mapping of equity indicators by urbanicity (i.e., urban, suburban, rural) or state planning context?

Answers to these questions will provide insight into how social equity indicators can be used to support equitable and just resilience.

Selection of States and Local Jurisdictions

Our sample consisted of four states, with four local jurisdictions in each state. California, Iowa, Louisiana, and North Carolina were selected based on geography and state planning laws. Sampled states represent four of the ten FEMA national planning regions. We intentionally oversampled for coastal states (California, Louisiana, North Carolina), given that coastal areas are especially prone to hazards (NOAA, 2022).

Local jurisdictions were selected within each state based on disaster experience, urbanicity, geography, and population characteristics. The sites selected for each state include one high-density or urban county, one mid-density or suburban county, and two low-density or rural counties and represent a diverse mix of geographic regions, hazards, racial/ethnic composition, and socioeconomic characteristics (see Table 2). For the three states added in Year 2 of our study (California, Iowa, and Louisiana), we limited our sample selection to counties that experienced at least one federal disaster declaration between 2012 and 2022 (excluding the Covid-19 disaster declaration) that triggered both Public Assistance and Individual Assistance grants.

Table 2. County characteristics used for site selection (2020)

Site	Geographic region	Total Population	Urbanicity	White, Non-Hispanic (%)	Median Household Income	Poverty Rate (%)	Median House Value
California							
Mendocino	Northern	87,110	Rural	64.1	$52,915	12.1	$388,500
Tulare	Central	463,955	Suburban	27.8	$52,534	18.4	$223,600
Ventura	South Coast	845,599	Urban	44.9	$89,295	6.1	$609,200
Yuba	North Central	77,524	Rural	54.0	$59,424	11.5	$273,600
Iowa							
Polk	Central	485,418	Urban	77.0	$69,747	7.3	$190,400
Scott	East	172,938	Suburban	79.2	$63,876	8.3	$167,900
Tama	Central	16,962	Rural	79.9	$54,749	8.3	$114,400
Woodbury	Northwest	102,687	Rural	71.8	$60,768	9.4	$131,300
Louisiana							
Caddo	Northwest	243,243	Suburban	44.3	$42,003	18.1	$150,200
Calcasieu	Southwest	202,858	Rural	71.8	$52,866	13.0	$160,800
East Baton Rouge	Capital Area	443,158	Urban	44.3	$56,076	11.9	$201,100
Madison	Northeast	11,137	Rural	33.6	$32,585	31.6	$77,600
North Carolina							
Buncombe	Mountains	259,576	Suburban	83.3	$55,032	6.5	$250,600
Burke	Mountains	90,148	Rural	81.4	$43,915	12.6	$120,600
Edgecombe	Coastal	52,069	Rural	35.9	$40,489	18.3	$88,500
Mecklenburg	Piedmont	1,095,170	Urban	46.3	$69,240	7.8	$253,500

Data sources: All demographic and housing data is from American Community Survey 5-year estimates (2016–2020). Urbanicity was classified using state specific delineations for NC (NC Rural Center) and CA (California State Association of Counties). No state specific classifications with a "suburban" tier could be found for IA or LA, so counties in those states were classified using population density criteria from the NC Rural Center (average density for urban counties exceeds 750 people per square mile; for suburban, 250–750 people per square mile; for rural, 250 people or fewer per square mile).

Selection of Plans

We collected 16 hazard mitigation plans and 14 comprehensive plans between August 2022 and March 2023. Plans were collected from county and municipal government websites or websites of planning consultants that helped draft the plans. All hazard mitigation plans were multi-jurisdictional. Four mitigation plans spanned two or more counties and incorporated municipalities within those counties. The remainder were county-level plans, with participating jurisdictions including the county, municipalities, and special purpose districts. All hazard mitigation plans we reviewed were officially adopted.

For comprehensive plans, we evaluated county-level plans where available. In local counties lacking a county-level comprehensive plan, we reviewed the comprehensive plan of the county's largest municipality (e.g., Charlotte in Mecklenburg County, NC and Asheville in Buncombe County, NC). Two counties in our study (Madison Parish, LA and Tama County, IA) had no officially adopted plans regulating land use at either the county or municipal level. Despite the absence of comprehensive plans, we chose to include these sites in our study because we sought for our sample to broadly represent communities across the U.S., including rural communities with limited local planning capacity such as these. In cases where no comprehensive plan was present, we reviewed only the local hazard mitigation plan. Appendix C provides a list of the plans reviewed by state.

Coding protocol

A plan evaluation protocol was developed to conduct a content analysis of hazard mitigation and comprehensive plans following standard content analysis procedures (Stevens et al. 2014). The protocol evaluates five major elements of the planning document (i.e., framing, public participation, fact base, policies and implementation strategies, output and outcome metrics). Our Year 8 analysis focuses on the presence or absence of an equity framing and the inclusion of fact base indicators that could be used to assess equity in relation to hazard resilience.

To examine for the presence or absence of an equity framing, our protocol reviewed the following items: whether and how the plan defined equity, presence of goals that support equity, identification of historically marginalized or disadvantaged groups within the planning area, and frequency with which the term "equity" appears in the plan. Through additional qualitative notes taken by researchers coding the plans, we also identified those plans that explicitly named equity as a core value or guiding principle of the plan.

In evaluating the plan fact base, we assessed how many and which hazards were addressed in the plan and coded for the presence of five types of equity indicators: (1) disaster damage and recovery, (2) social vulnerability, (3) access to infrastructure and opportunities, (4) health and environment, and (5) historical injustices. In developing our categories and list of indicators, we first developed a universe of coding items using the resilience and equity indicators literature (e.g., APA, 2021; Meerow et al., 2019; NAACP, 2015; CEQ, 2022). Next, through multiple rounds of pre-testing on local plans, we revised the universal list of indicators to capture the range of indicators used in the plans. Table 3 provides a description of the indicator categories and a list of indicators included in the protocol.

Table 3. Hazards and equity indicators reviewed for in analysis of plan fact base

Category	Description	#	Metrics
Hazards	Events or phenomena caused by atmospheric, climatic, or tectonic processes that threaten people, property, or the environment	16	Flood, hurricane/tropical storm, severe weather, severe winter weather, extreme heat, earthquake, wildfire, dam and levee failure, drought, tornado, landslide, sinkhole, erosion, infectious disease, compound hazards, other
Disaster Damage and Recovery	Measures of disaster damage and recovery that, if spatially represented or disaggregated by population group, could be used to assess disparities in disaster impact and rates of recovery	9	Deaths, injuries, crop damage, property damage, acres burned, homes or structures damaged, homes or structures destroyed, homes or structures protected, other
Social Vulnerability	Demographic and socioeconomic variables often correlated with susceptibility to hazards and a community's ability to prepare for, respond to, and recover from disaster	22	Population density, population change, age, race/ethnicity, English language proficiency, educational attainment, vehicle access, population insured, disabled population, single-parent households, housing tenure, housing cost-burden, crowding, homelessness, housing unit type, age of housing stock, unemployment rate, income, poverty rate, SNAP participation, social vulnerability index, other
Access to Infrastructure and Opportunity	Community infrastructure, resources, and opportunities that influence overall community resilience and the capacity of communities to prepare for, respond to, and recover from disaster	30	***Infrastructure and facilities:*** sewer and water, parks and greenways, roads, transit, broadband service, higher education, schools, childcare, libraries, fire stations and EMT, police stations, recreation or community centers, senior centers and senior housing, hospitals and clinics, grocery stores and food pantries, evacuation routes, emergency shelter sites, other ***Economic opportunities:*** job density, job proximity, labor force participation, % employed by occupation or industry, financial institutions, other ***Safe and affordable housing:*** housing units, vacancy rate, home value, rental costs, foreclosure rates, other
Health and Environment	Public health and environmental characteristics that have the potential to exacerbate (or, in the case of tree canopy, mitigate) the impacts of local hazards within a community	10	Asthma levels, diabetes levels, heart disease levels, low life expectancy, energy burden, air quality, water quality, tree canopy, impervious surface, other
Historic Injustices	Historic policies and practices that have systematically deprived marginalized groups of basic resources and opportunities and that contribute to present-day disparities in hazard exposure and vulnerability and in the distribution of resources needed to mitigate or recover from disaster	11	Indigenous genocide, land removal from marginalized groups, slavery, segregation, redlining, deed restrictions or restrictive covenants, inequity in the provision of infrastructure, inequity in the permitting of locally undesirable land uses (LULUs), highway construction and urban renewal, exclusionary zoning, other

Coders used these indicators to conduct two types of evaluation for each plan. First, each indicator was coded as present or absent (1 = indicator present; 0 = indicator not present). Second, if present, each item was coded as spatial via mapping or aspatial with no geographic association (1 = indicator spatial; 0 = indicator aspatial). Historic injustices were rarely presented spatially (with the exception of a redlining map in one plan), so for this category of indicators we coded instead for whether or not the present-day impacts of the historic injustice were described.

Data Analysis

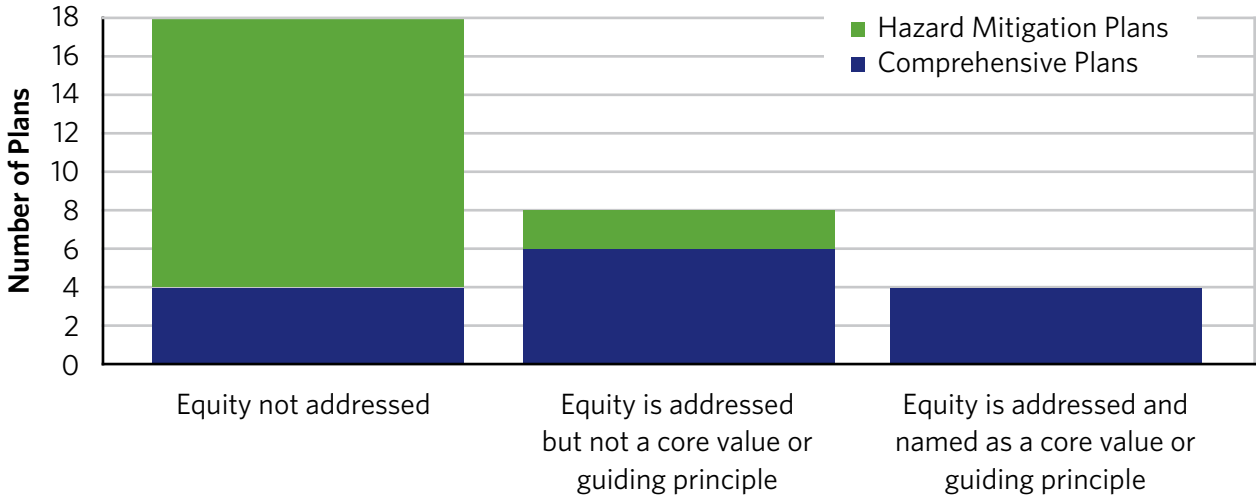
We used descriptive statistics to determine the frequencies, percentages, and means. We compare findings between comprehensive and mitigation plans, including the number of plans that name equity as a core value or guiding principle, the mean number of indicators used in each of the equity categories, the percent of indicators mapped (or, in the case of historic injustices, the percent where present-day impacts are described), and the mean number of indicators by urbanicity (urban, suburban, rural). Our analysis also considered qualitative notes taken by plan evaluators to further elaborate on the extent plans incorporate equity within various plan elements.

Results

Equity framing

Figure 9 shows the level of attention to equity within our sample of comprehensive plans and mitigation plans—distinguishing among plans that do not address equity; those that do address equity, but don't name it as a core value or guiding principle; and those that address equity and explicitly name it as a core value or guiding principle of the plan. Of the 16 mitigation plans, 14 do not address equity; two address equity, but not as a core value (Yuba County and Mendecino County, CA). None of the mitigation plans reviewed named equity as a core value or guiding principle. In contrast, four of the 14 comprehensive plans do not address equity; six address equity, but do not name it as a core value; and four address equity and explicitly name it as a core value or guiding principle of the plan (Ventura County, CA, Charlotte, NC, Asheville, NC, East Baton Rouge, LA).

Figure 9. Extent to which equity is addressed in sampled plans



We determined the frequency that the term "equity," or its derivatives, appeared in a plan as another indicator of the presence and strength of equity framing. Ventura County's mitigation plan, which integrated equity more than any other mitigation plan we reviewed, made only nine mentions of equity in its thousand-plus pages. In contrast, equity was mentioned 239 times in Charlotte's comprehensive plan, 175 in Asheville's comprehensive plan, 69 times in Ventura County's comprehensive plan, and 43 in the East Baton Rouge comprehensive plan (the four plans in our sample that named equity as a core value or guiding principle).

Equity goals. Ten out of 14 comprehensive plans included goals that support equity, compared to only four out of 16 hazard mitigation plans. Table 4 provides selected examples of equity-supporting goals from the sampled plans. Some goals that support equity in the comprehensive plans specifically target marginalized or disadvantaged communities and/or explicitly name social equity within the goal language. Others are less explicit in their equity focus or prioritization of the needs of marginalized communities, but support equity through addressing issues of access to housing, transit, green space, and other community amenities. Equity-supporting goals found in hazard mitigation plans largely promoted equity through a focus on protecting vulnerable populations or vulnerable population locations.

Table 4. Select examples of equity-supporting goals

Plan	Goal
Ventura County General Plan	"Promote meaningful dialogue and collaboration between members of designated disadvantaged communities and decision-makers to advance social and economic equity."
Scott County Comprehensive Plan	"Coordinate, develop, and maintain an accessible transportation system that promotes mobility for a variety of citizens, particularly those with special needs such as the elderly, disabled, and low-income persons."
Edgecombe County Hazard Mitigation Plan	"Protect the most vulnerable populations, buildings, and critical facilities through the implementation of cost-effective and technically feasible mitigation actions."
Calcasieu Parish Hazard Mitigation Plan	"Reduce or prevent future damage to special facilities, including schools, nursing homes, health care facilities, prisons, and historical and cultural resources."

Definitions of equity. Five comprehensive plans defined equity, compared with only one hazard mitigation plan. The definitions varied across plans, but common concepts included access, fairness, justice, and opportunity (Table 5). The Ventura County Hazard Mitigation Plan was the only mitigation plan we reviewed that included a definition of equity.

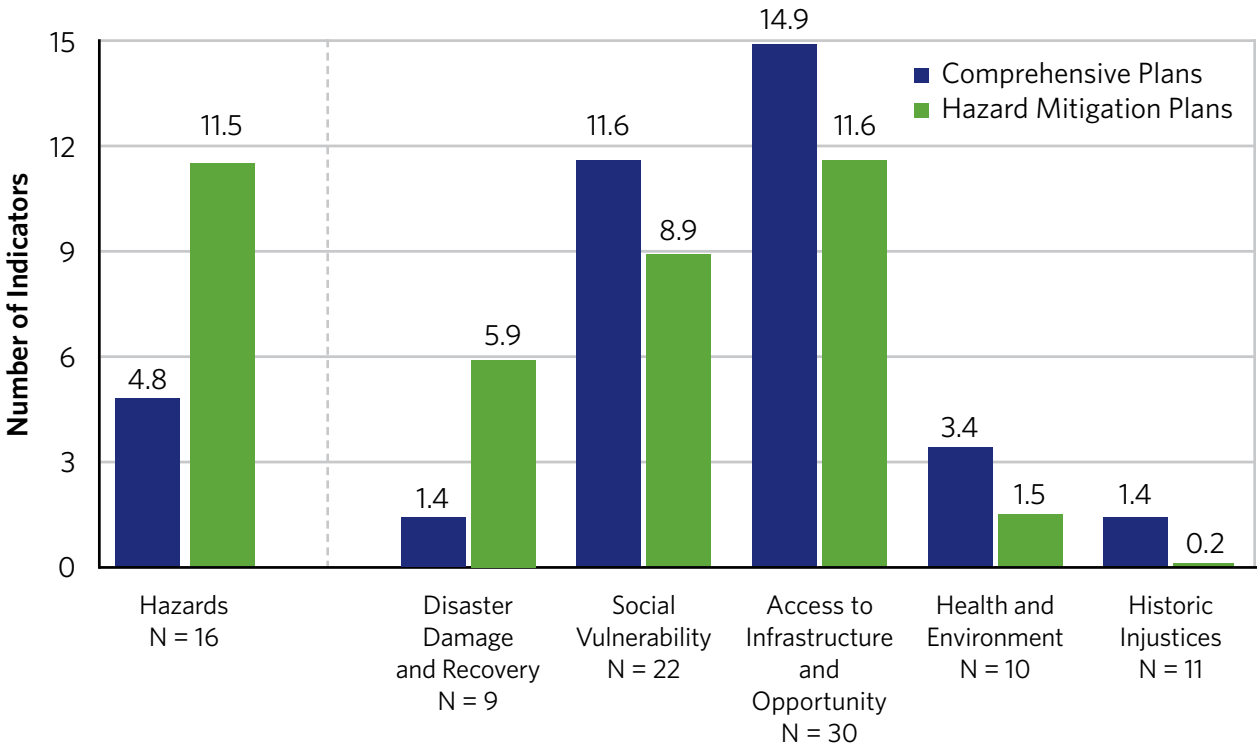
Table 5. Select definitions of equity in sampled plans

Plan	Definition of Equity
City of Charlotte Comprehensive Plan	"Equity provides people with the opportunities necessary to meet their specific needs. [...] Equity makes things accessible for everyone. A city that develops equitably is *fair* about how public investments are made and *just* in doing something about existing unfairness."
East Baton Rouge Comprehensive Plan	"All residents have access to a good education, public services, housing and job opportunities."
Ventura County Hazard Mitigation Plan	"The absence of avoidable or remediable differences among groups or people, whether those groups are defined socially, economically, demographically, racially, or geographically."

Inclusion of fact base indicators by category and plan type

Advancing equity in resilience requires not just equity-oriented goals and values, but also a fact base that can inform an understanding of existing inequities. A local government plan dealing with resilience typically includes a fact base that provides the empirical foundation for identifying baseline conditions, measuring the future impacts of policies and actions, and monitoring outcomes and progress in achieving goals. We evaluated each plan for the number of hazards addressed and for five categories of equity indicators: (1) disaster damage and recovery, (2) social vulnerability, (3) access to infrastructure and opportunity, (4) environmental and health conditions, and (5) historic injustices. In reviewing for indicators included, we counted both those that were explicitly used for equity analysis purposes within the plan and those that were not used for equity purposes but have the potential for such use. Figure 10 illustrates the mean, or average, number of indicators included for each of these fact base categories across our 30 sampled plans.

Figure 10. Equity Fact Base: Mean number of indicators that could be used to assess equity in comprehensive plans and hazard mitigation plans by category



N = total number of indicators reviewed for each category

We determined the average number of hazards (e.g., flood, wildfire, heat) identified in hazard mitigation and comprehensive plans. Unsurprisingly, mitigation plans addressed more hazards than comprehensive plans—providing detailed and mapped information on exposure, physical vulnerability, and likelihood of hazards that could impact the planning area. The mean, or average, number of hazards addressed in comprehensive plans was 4.8, compared to a mean of 11.5 addressed in hazard mitigation plans. Notably, comprehensive plans we reviewed from California addressed significantly more hazards and included a higher level of detail on hazard exposure and risk than comprehensive plans from the other three states. The mean number of hazards addressed in California comprehensive plans was 10.5, compared to a mean of 2.5 for comprehensive plans from other states. This distinction is largely due to California law requiring that comprehensive plans include a safety element addressing local hazard risks, climate change impacts, and resilience measures.

Comprehensive plans also included less data on disaster damage and recovery than hazard mitigation plans did. The mean number of disaster damage and recovery indicators included in comprehensive plans was 1.4, compared to 5.9 for mitigation plans. In fact, only half—seven out of 14—of the comprehensive plans reviewed included disaster damage and recovery indicators (four of those seven were plans from California). In contrast, all hazard mitigation plans included indicators of damage and recovery. However, most of these indicators were reported only at the county

or municipality level, and very few were mapped—making it impossible to assess distributional differences in the level of damages or mitigation and recovery across socioeconomic groups or different parts of the planning area.

While they included less information on hazards and on disaster damage and recovery, the comprehensive plans on average contained more indicators of social vulnerability (mean = 11.6 for comprehensive plans, mean = 8.9 for mitigation plans), access to infrastructure and opportunity (mean = 14.9 comprehensive plans; mean = 11.6 mitigation plans), environmental and health conditions (mean = 3.4 comprehensive plans; mean = 1.5 mitigation plans), and historic injustices (mean = 1.4 comprehensive plans; mean = 0.3 mitigation plans). As these numbers indicate, while most comprehensive plans paid relatively little attention to hazards, they tended to include more of the types of indicators that could be used to assess equity in hazard resilience (except disaster damage and recovery indicators).

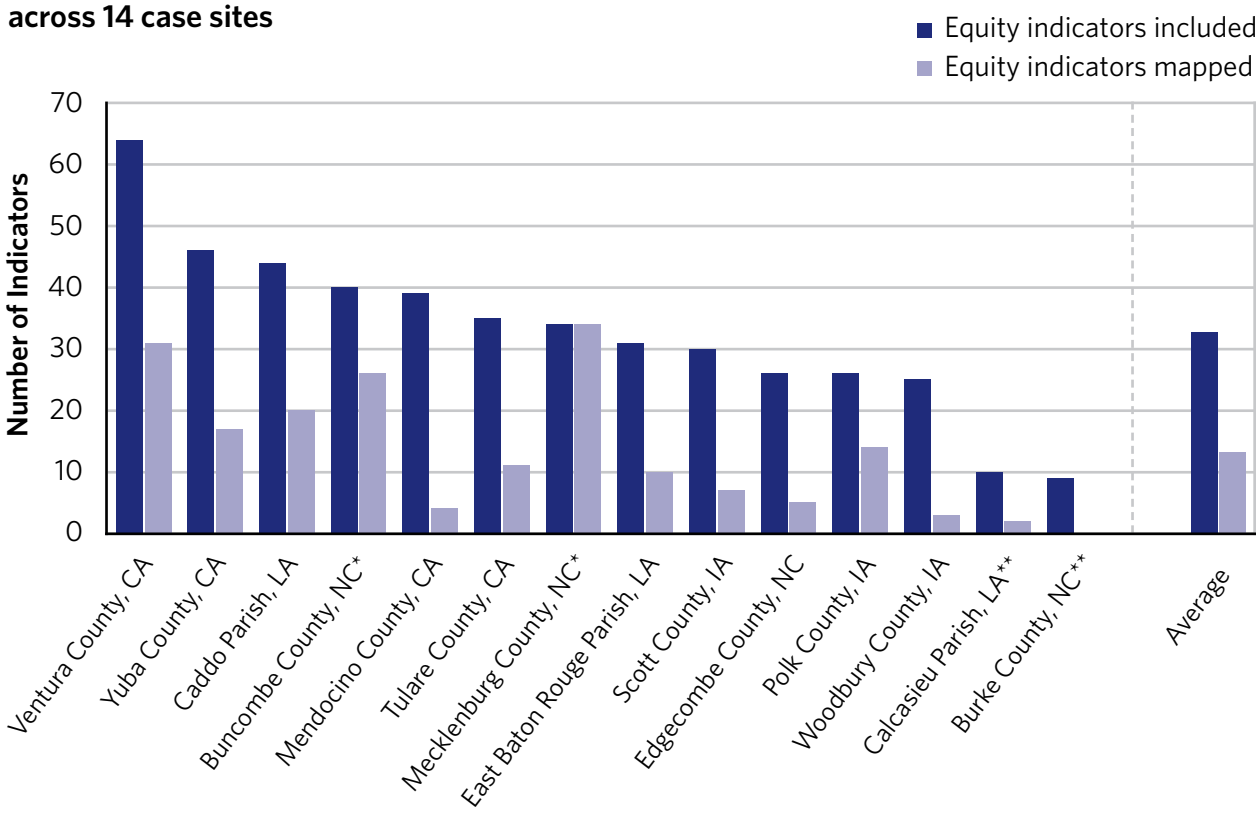
For example, Charlotte's comprehensive plan is explicit in addressing the local impacts of historic injustices. It also contains a set of Equity Metric maps that illustrate the geography of access to critical infrastructure and services, housing, and employment opportunities, as well as environmental conditions that affect health and well-being. Yet it directly addresses only one local hazard (flooding) and does not include disaster damage and recovery data. In contrast, the Mecklenburg County mitigation plan, which covers Charlotte and other incorporated and unincorporated parts of the county, includes detailed information on local exposure and risk for 12 different natural hazards, but includes very few indicators of access to infrastructure and opportunity, only two health and environment indicators, and zero acknowledgment of the historic injustices that shape the present-day distribution of risk.

Health and environment and historic injustices were the least represented indicator categories across all the plans, but particularly among hazard mitigation plans. The limited use of health and environmental data in mitigation plans is striking, given how environmental and health conditions influence hazard vulnerability and disaster resilience. While comprehensive plans acknowledged a slightly higher mean number of legacies of unjust discrimination (e.g., redlining and disinvestment in infrastructure), the majority of plans we reviewed—both mitigation and comprehensive—gave no attention to these histories of injustice. Despite their impact on current conditions, only four of 14 comprehensive plans and one of 16 hazard mitigation plans included information on such legacies. Suppression of this information in planning inhibits active redress of these injustices and has long-term impacts on marginalized communities' health and well-being, making them more susceptible to hazards and loss after a disaster and depriving them of equal access to the resources needed to adapt and recover.

Total equity indicators included and mapped

Figure 11 shows the total number of indicators that could be used to assess equity that were included in each of the 14 comprehensive plans. This total is the sum of the five equity indicator categories. The lighter purple bar shows the total number of equity indicators included within the plan that were mapped (or, in the case of historic injustices, where the present-day impacts were described). Ventura County's Comprehensive Plan, with 64 indicators—nearly half of which were mapped—included the highest number of indicators that could be used to assess equity. Notably, four of the six plans with the highest number of equity indicators included are plans from California, which has more stringent and detailed planning mandates than the other three states where we reviewed plans, including multiple mandates to identify disadvantaged communities, assess their needs, and develop policies and strategies to address those needs. In contrast, the land use plan for Burke County, a rural county in North Carolina, had the lowest total, with only nine indicators that could be used to assess equity, none of which are mapped.

Figure 11. Total number of equity indicators included and mapped in comprehensive plans across 14 case sites



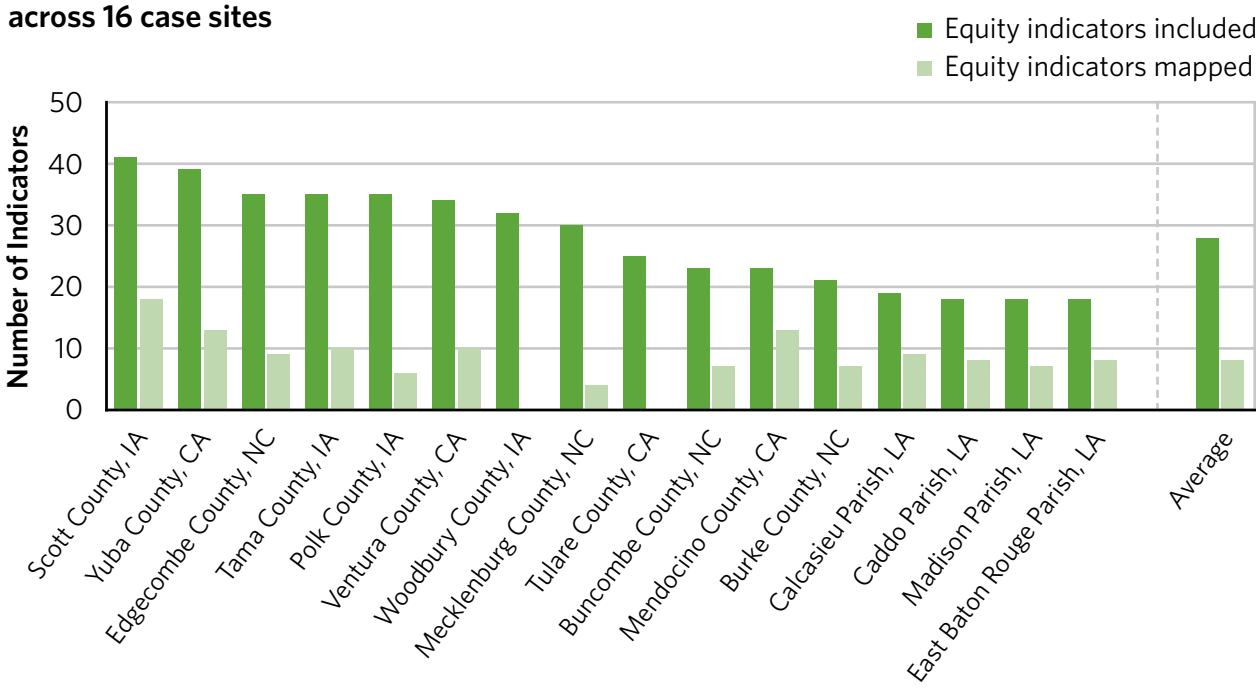
** Buncombe and Mecklenburg lacked updated county-level comprehensive plans, so the plan for the largest municipality in each county (Asheville and Charlotte, respectively) were reviewed in place of a county-level plan.*

***Calcasieu Parish and Burke County lacked comprehensive plans. In place of a comprehensive plan, we reviewed other local plans that satisfy similar land use and development regulating functions (i.e., the Calcasieu Parish Coastal Zone Plan and the Burke County Land Use Plan). Madison Parish, LA, and Tama County, IA, lacked formally adopted land use plans of any sort, so they were excluded from this part of the analysis.*

One plan that stands out despite including fewer equity indicators than some of the others is the comprehensive plan for the City of Charlotte (in Mecklenburg County, NC). The total number of equity indicators included (34) was only slightly above the average for comprehensive plans (33), but 100% were mapped and every indicator was used specifically for the purposes of equity analysis. Though all of the plans we reviewed included indicators that could be used to assess equity, in many cases the data was used more broadly—as part of a general planning area profile—rather than for equity assessment. Charlotte's comprehensive plan was the only plan where every indicator included was explicitly used for equity analysis and also the only plan in our sample where all of the indicators included were mapped.

Compared to comprehensive plans (Figure 11), mitigation plans included a lower mean number of indicators that could be used to assess equity (Figure 12), and a smaller percentage of the indicators were mapped. Though mitigation plans include extensive mapped data on hazard exposure, risk, and past occurrences, demographic and socioeconomic data were usually presented in tables or figures rather than maps. On average, only 29% of the equity indicators included in the mitigation plans we reviewed were mapped (compared to 40% of those included in comprehensive plans). Almost all the mapped indicators in mitigation plans were mapped for the purpose of assessing physical risk and potential losses (e.g., location of critical infrastructure and facilities at risk), not for the purpose of assessing equity in hazard resilience.

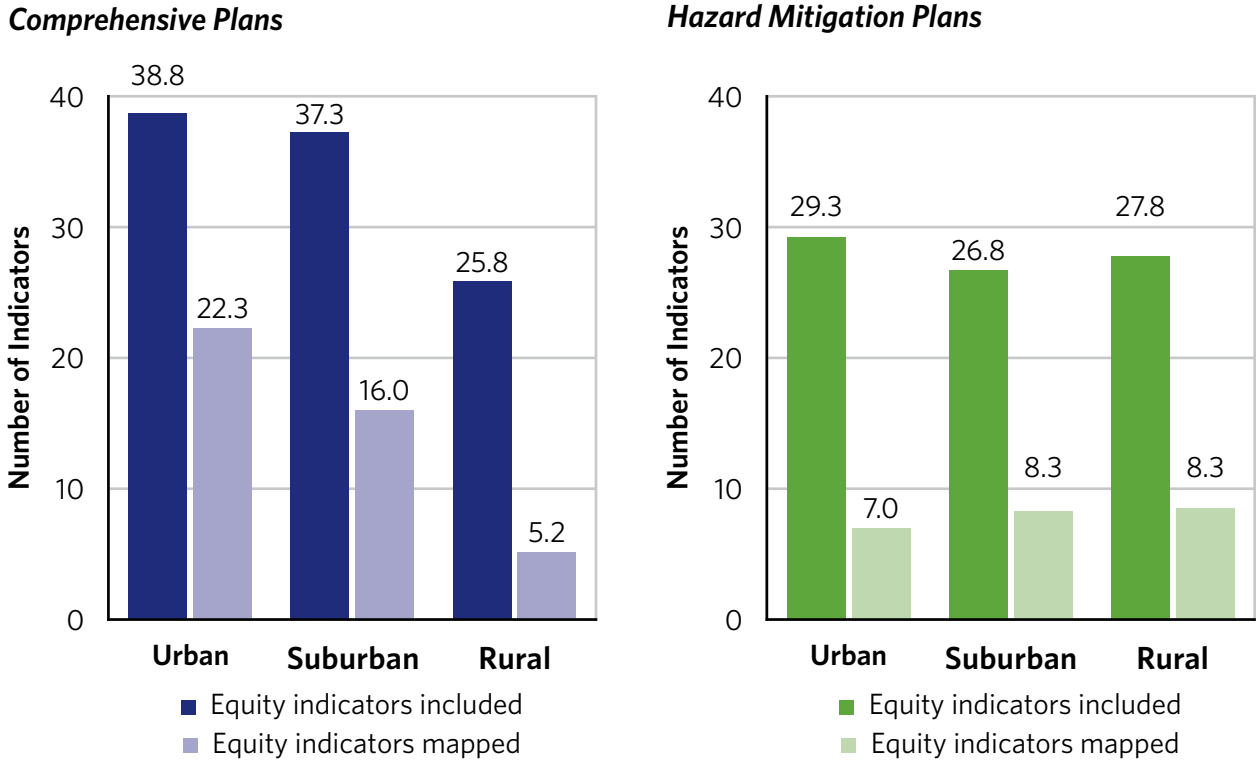
Figure 12. Total number of equity indicators included and mapped in hazard mitigation plans across 16 case sites



Equity indicators included by urbanicity of case sites

Figure 13 shows the mean number of indicators included in comprehensive and mitigation plans by urbanicity. Comprehensive plans vary more among the city, suburban, and rural jurisdictions than mitigation plans. Comprehensive plans from rural districts had a lower mean number of equity indicators than those from urban or suburban ones, which is unsurprising given greater planning capacity and data access in urban and suburban communities compared to less-resourced, rural communities.

Figure 13. Mean number of indicators that could be used to assess equity in comprehensive plans and hazard mitigation plans by urbanicity



The mean number of equity indicators included in mitigation plans was nearly equivalent across urban, suburban, and rural sites. The minimum variation for hazard mitigation plans suggests that federal standards for mitigation plans and the availability of mitigation planning grants to help fund these efforts create a common standard for plan content and help to minimize differences that might otherwise stem from disparities in community planning capacity. It should be noted, however, that the mean number of equity indicators included in mitigation plans across urban, suburban, and rural sites is closest to the mean for comprehensive plans from rural sites, and considerably lower than the mean for comprehensive plans from urban or suburban communities. Mitigation plans, regardless of urbanicity, also mapped far fewer equity indicators than comprehensive plans from urban and suburban sites.

Summary of Findings

This section provides a summary of the overall findings from social vulnerability metrics, interviews with public sector personnel and community members, and plan-based indicators. Overall, the research team sought to determine how federal agencies can improve the measurement of outcomes for marginalized groups to help guide equitable hazard mitigation and disaster recovery efforts. Our research aims to provide insight on how to transform the disaster risk management community so that equity is an embedded practice that encapsulates the needs of all, including the most marginalized. The following conclusions are preliminary and are separated by research phase and critical dimension. Our findings may change as we further reflect on our results and conduct additional analysis.

Phase One

Social-vulnerability metrics

After an extensive data cleaning and validation process, our initial analysis of hazard mitigation funding suggests that many of the neighborhoods receiving funding are low income relative to the state overall. Subsequent analysis of the hazard mitigation data will focus on other neighborhood characteristics, such as housing tenure and racial composition. Regarding post-disaster recovery assistance, we find that the likelihood of being denied for assistance is not substantially different across income brackets or housing types. However, the reasons for denial do vary across applicant types. Low-income applicants make up most households denied due to procedural and conditional reasons, such as lack of paperwork or insufficient damage. Applicants from mobile homes are similarly over-represented in those two categories. Wealthier applicants and those from single-family houses and duplexes are over-represented among those denied due to having insurance, voluntarily withdrawing, or applying for a non-primary residence.

Community Voice

Across our four case study communities, interview responses indicated that there is anecdotal awareness of, but relatively little formalized attention to or tracking of, the ways that demographic and socioeconomic factors affect residents' abilities to prepare for, respond to, and recover from disaster. When asked who in their community was most impacted by local hazards, respondents spoke broadly of people who live in hazard-prone areas but also named specific socially vulnerable groups, including low-income households, unhoused populations, renters, mobile home residents, Black residents, and non-English speakers. When public sector respondents described the data used to inform local hazard related planning, response, and recovery, however, the metrics cited were primarily ones denoting physical risk and geographic extent of impact or exposure, not socioeconomic or demographic indicators.

To the extent social vulnerability is currently considered and factored into local hazard mitigation or disaster recovery efforts, our interviews suggest that the focus is primarily on populations with access and functional needs (e.g., elderly residents, medically dependent populations, and

non-English speakers), with relatively little attention given to other groups disproportionately impacted by disaster and underserved by current approaches to recovery, such as communities of color, renters, and people with lower educational attainment. Some public sector respondents shared that they felt low-income groups were the most impacted by hazards (and mentioned specific efforts to reach out to and support these populations), while others insisted that there was no disproportionate impact along socioeconomic lines within their community. But when public sector respondents were asked whether they formally tracked or evaluated differences in hazard mitigation efforts or disaster outcomes between population groups, the answer was almost universally "no."

Despite revealing an overall lack of formalized attention to equity issues, our interviews did point to some common practices that local governments across the four communities engage in to increase disaster communication and support to socially vulnerable populations. These included the following:

- Translation of hazards information, alerts, and recovery resources into other languages to increase access for non-English speakers
- Utilization of multiple modes of communication, including traditional media, social media, utility bill inserts, and phone calls or home visits to people in risk-prone areas
- Partnerships with trusted community groups and faith-based organizations to overcome engagement barriers and reach a broader segment of the population
- Identification and targeted outreach and support for specific vulnerable populations or vulnerable population locations, including medically dependent or elderly residents, group living facilities, and mobile home parks

Phase Two

Plan-based indicators

Hazard mitigation plans are less likely to integrate equity as a core value than comprehensive plans. Among plans reviewed for this study, four comprehensive plans identified equity as a core value or guiding principle, but not one of the mitigation plans did. Only four of 16 mitigation plans included an equity-supporting goal or goals, compared to seven of 14 comprehensive plans.

Hazard mitigation plans address more hazards and provide more detailed and mapped information on exposure and risk than do comprehensive plans. In contrast, comprehensive plans include more indicators that could be used to assess equity than do mitigation plans. The gaps between the two plan types raise problems if not addressed—there are missed opportunities to integrate and leverage relevant data across plans. These missed opportunities translate to inefficient and inequitable allocation of resources and potentially increased risk from hazards and climate change.

All hazard mitigation plans included data on past disaster damages and impacts, but rarely were these indicators mapped to distinguish differences across the planning area, and in no instance

were differences tracked across socio-economic groups. Though some mitigation plans included data on "mitigated structures," none of the plans included data on recovery rates or outcomes, much less on differences in recovery rates across groups.

Very few mitigation and comprehensive plans acknowledged legacies of historic discrimination (e.g., forced land removal, redlining, racialized zoning, under-investment in infrastructure). Suppression of this information in planning has long-term impacts on marginalized communities' health and well-being, making them more susceptible to hazards and loss after a disaster and depriving them of equal access to the resources needed to adapt and recover.

The inclusion of indicators that could be used to assess equity in resilience varies more by urbanicity among comprehensive plans than it does among mitigation plans. The minimal variation for hazard mitigation plans suggests that federal standards for mitigation plans create a common standard for plan content that helps to minimize differences that might otherwise stem from disparities in community planning capacity.

Policy and Research Recommendations

Based on our analysis of social vulnerability metrics, interviews with public sector and community respondents, and assessment of hazard mitigation and comprehensive plans, we have created the following recommendations for advancing equitable and resilient outcomes for marginalized populations. These recommendations are organized by phase and critical dimension.

Phase One

Social-vulnerability metrics

- Standardize and improve the quality of flood mitigation funding records. Current data on the distribution of these funds are not fully consistent across sources. Efforts to improve and standardize recordkeeping across relevant government agencies could support future research on this topic.
- Conduct continued research on the distributional equity of federal and state funding for hazard mitigation. While initial results suggest lower-income neighborhoods are accessing hazard mitigation funds, additional research is needed to provide stronger evidence and substantiation.
- Reform FEMA assistance policies to improve access for those with the greatest needs. As there have already been changes implemented since Hurricane Florence, continued evaluation is needed to measure the benefits of those changes and identify further opportunities for improvement.

Community voice

- Require equity training and education for hazard management professionals. Our interview data suggest that many people working in the disaster risk management field may not have been trained to consider how socio-economic difference and marginalization affect disaster risk and outcomes. A lack of formalized training in and institutionalized attention to the ways that socio-economic difference and marginalization affect disaster risk and outcomes puts the onus on individuals to do this work themselves. It also increases opportunities for personal biases to factor into how professionals perceive and respond to need in the community. Understanding the systemic ways that historic marginalization and socioeconomic factors affect vulnerability to hazards and the ability to recover after a hazard event is critical to being able to address these vulnerabilities and equitably support the resilience of the entire community.
- Expand social vulnerability analysis and targeted support efforts beyond the current focus on populations with access and functional needs. Local government efforts to support specific socially vulnerable populations across our four case study communities focused almost exclusively on communication and outreach to people with access and functional needs (e.g., seniors, medically dependent individuals, non-English speakers). Social vulnerability analysis and targeted support efforts should be expanded to incorporate other groups that experience disproportionate disaster outcomes, such as low-income communities, communities of color, renters, and individuals with lower educational attainment.

- Track differences in hazard mitigation and disaster recovery outcomes across groups. While some public sector respondents spoke about tracking indicators such as the number of structures mitigated or the dollar value of prevented loss or destruction resulting from these mitigation projects, no one we interviewed was tracking differences in mitigation or disaster outcomes across socioeconomic groups within the community. Collecting and evaluating data on hazard mitigation and disaster outcomes across groups is crucial to pinpointing current inequities and measuring progress in efforts to address those inequities.
- Increase federal funding to support resilience planning in limited-resource communities. Respondents we spoke to in rural communities suggested that low staff capacity, lack of resources, and limited data capabilities can be a barrier to applying for and reporting on grants, as well as engaging in more involved planning and mitigation efforts. Greater availability and access to technical and grant writing assistance, data, and decision-support tools could help to enhance local hazard management capabilities for lower-resourced, rural communities and could improve their ability access and manage funds.

Phase Two

Plan-based indicators

- Encourage local government agencies to share data that can be used to assess—and measure progress toward—equity in resilience. Future research should explore how inter-organizational coordination strategies and data sharing between hazard mitigation and comprehensive planning processes can be improved.
- Conduct research to examine FEMA's newly updated Local Hazard Mitigation Planning Handbook (2023) and programs such as the Community Rating System to assess how and to what extent they support the resilience of marginalized communities and to identify opportunities for greater integration of equity in federal guidance for local resilience plans and policies.
- Validate social equity indicators included in local planning programs from the perspective of marginalized populations. Future research should examine how local people can use current tools and self-assessment strategies to validate equity measures and plan policy interventions.
- Conduct research to explore the availability of data on legacies of historic discrimination and injustice (e.g., redlining, exclusionary zoning) and examples of communities that are successfully integrating this data into local resilience planning.
- Give particular attention to developing the capacity of rural areas to use equity indicators in local plans. Future research should explore the effectiveness of federal and state initiatives to enhance rural planning capacity and how they might be applied to strengthen equitable hazard mitigation and climate adaptation planning in rural areas.

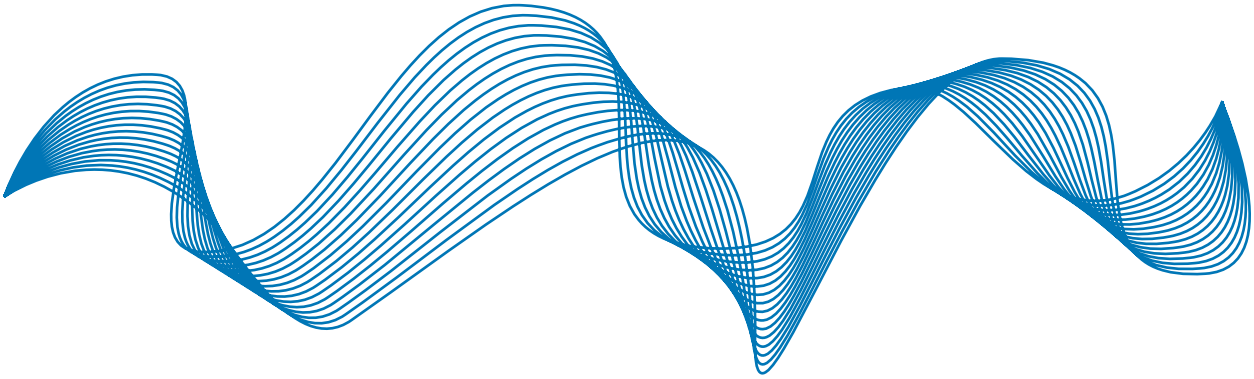
Limitations

Caution should be used in interpreting the findings since this is a preliminary analysis. Generalizability of results is limited due to the limited sample size and an in-depth focus on North Carolina. Research and analysis for the social vulnerability metrics and community voice dimensions of our study focused exclusively on data and perspectives from North Carolina communities. For the plan review dimension of our research, the team expanded the sample to include 12 case study sites in California, Iowa, and Louisiana, in addition to the four sites in North Carolina. We suggest continuing to expand the sample of local jurisdictions to more sites and additional states to improve the external validity of findings. An expanded sample should include states that represent a diversity of state planning contexts (e.g., states with strong local planning mandates and those with weak ones) and case study sites that represent a wide mix of geographic settings, hazards, population characteristics, and social and economic conditions.

Public sector and community respondents interviewed for the community voice dimension of the study represented only North Carolina case study sites, limiting the perspectives of residents living in other locations within and outside the state. Also, over the past decade, only two of our North Carolina sites have experienced a federally declared major disaster where FEMA Individual Assistance funds were available to residents (excluding Covid-19), thus limiting our ability to collect perspectives from community members with direct experience of the FEMA aid application process.

Next Steps for Research

In Year 3, we will continue to use our equity framework within a theory of change to assess how marginalized groups are effectively identified and supported in hazard mitigation and recovery. We will use this time to dive more deeply into the data by analyzing our quantitative and qualitative findings and determining areas of convergence across the various data sources. We will build on the work by continuing our mixed-methods study in two phases. In the first phase, we will continue our deep dive into North Carolina case study sites by analyzing interview data collected from Year 2 and conducting additional interviews upon further review of the quantitative analysis. We will also continue to expand our analysis to consider how to measure vulnerability and recovery through quantitative and qualitative measures. The team will also explore if and how quantitative metrics, plans, and community voices interact. In the second phase, the team will expand the sample with two additional sites to improve the comparability of the plans across the four selected states. We will conduct a cross-state comparison of the planning documents and analyze similarities and differences across plans from urban, suburban, and rural communities.



References

American Planning Association (APA). (2021, January 1). *Climate change policy guide.* https://planning-org-uploaded-media.s3.amazonaws.com/publication/download_pdf/Climate-Change-Policy-Guide.pdf.

Community and Regional Resilience Institute. (2013). *Definitions of Community Resilience: An Analysis.* Meridian Institute. https://www.merid.org/wp-content/uploads/2019/08/Definitions-of-community-resilience.pdf

Council on Environmental Quality (CEQ). (2022, November 22). *Climate and economic justice screening tool.* https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5

Davis, C.R., Berke, P., Holloman, D., Griffard, M., Haynes, S., Johnson, E., Warraich, Z, Crisostomo-Morales, L, Gbikpi-Benissan, D.G., Gillespy, C., Butterfield, W., & Rakes, E., (2021). Supporting strategies for socially marginalized neighborhoods likely impacted by Natural Hazards. Chapel Hill: Coastal Resilience Center.

Federal Emergency Management Agency (FEMA). (2021, February 24). *Climate change.* https://www.fema.gov/emergency-managers/national-preparedness/climate-change

Federal Emergency Management Agency (FEMA). (2023, June 29). *OpenFEMA data sets: Hazard mitigation.* https://www.fema.gov/about/openfema/data-sets#hazard

Meerow, S., Pajouhesh P., & Miller, T. R. (2019). Social equity in urban resilience planning. *Local Environment, 24*(9), 793-808 DOI: 10.1080/13549839.2019.1645103

National Aeronautics and Space Administration (NASA). (2021, April 29). *Climate change: How do we know?* https://climate.nasa.gov/evidence/

National Association for the Advancement of Colored People (NAACP). (2015). *Equity in climate adaptation planning resilience indicators.* https://climateaccess.org/system/files/NAACP_Equity%20in%20Resilience.pdf

National Oceanic and Atmospheric Administration (NOAA). (2021). *Climate change.* https://www.noaa.gov/categories/climate-change

National Oceanic and Atmospheric Administration (NOAA). (2022). *Global and regional sea level rise scenarios for the United States.* https://oceanservice.noaa.gov/hazards/sealevelrise/sealevelrise-tech-report-sections.html

Rufat, S., Tate, E., Emrich, C. T., & Antolini, F. (2019). How valid are social vulnerability models? *Annals of the American Association of Geographers, 109*(4), 1131–1153. https://doi.org/10.1080/24694452.2018.1535887

Spielman, S. E., Tuccillo, J., Folch, D. C., Schweikert, A., Davies, R., Wood, N., & Tate, E. (2020). Evaluating social vulnerability indicators: Criteria and their application to the social vulnerability index. *Natural Hazards, 100*(1), 417–436. https://doi.org/10.1007/s11069-019-03820-z

Stevens, M. R., Lyles, W., & Berke, P. R. (2014). Measuring and reporting intercoder reliability in plan quality evaluation research. *Journal of Planning Education and Research, 34* (1), 77–93. https://doi.org/10.1177/0739456X13513614.

Tate, E., Rahman, M. A., Emrich, C. T., & Sampson, C. C. (2021). Flood exposure and social vulnerability in the United States. *Natural Hazards, 106*(1), 435–457. https://doi.org/10.1007/s11069-020-04470-2

United Kingdom Department for International Development (DFID). (2011). *Defining disaster resilience: A DFID approach paper.* https://www.fsnnetwork.org/sites/default/files/dfid_defining_disaster_resilience.pdf

United States Environmental Protection Agency (EPA). (2021). *Climate change indicators: Weather and climate.* https://www.epa.gov/climate-indicators/weather-climate

United States Department of Homeland Security (DHS). (2012). *Climate change adaption roadmap.* https://www.dhs.gov/sites/default/files/publications/

Appendix A: Research Questions and Activities for Year 2

Phase	Research Topics	Research Activities	Conceptual Framework: Critical Dimension
Phase One **1 state (4 sites)**	1. Identify how hazard mitigation and disaster recovery resources are distributed with respect to household and community characteristics, such as income, rural vs. urban, and race 2. Explore how public sector respondents and community members describe useful planning strategies to support recovery	Evaluate the distribution of government assistance (pre- and post-disaster) within and across communities	Social-vulnerability metrics
		Explore the suitability of "new" datasets, such as cell phone-based mobility data, for understanding resilience and recovery trajectories	Social-vulnerability metrics
		Uncover how, if at all, marginalized communities are organizing informal non-governmental planning around a climate hazard and compare it with formal government planning	Community voice
		Finalize plan evaluation for equity protocol to assess equity within hazard mitigation and comprehensive plans	Plan-based indicators
Phase Two **4 states (16 sites)**	3. Examine local plans to identify gaps and opportunities to improve coordination in measuring and monitoring the resilience of marginalized populations	Identify 12 additional diverse communities in three states based on location, density, type of hazard, demographic characteristics, and availability of relevant data	Plan-based indicators
		Review plan content within each site to assess for the presence and extent of equity framing	Plan-based indicators
		Identify potentially effective strategies in community engagement and plan development for increasing representation of marginalized communities	Plan-based indicators
		Evaluate if and how communities are tracking progress concerning the resilience and recovery of marginalized communities	Plan-based indicators

Appendix B: Summary of Interview Findings by County

County (NC)	Hazards	Vulnerability and Impact	Experience of Support	Accessing FEMA Aid
Buncombe	Flooding, tropical storms, winter storms	• Predominance of low-income households and mobile home parks in flood-prone areas • County is rolling out new equity index mapping tool to identify areas of greatest need	• Residents look to neighbors, church groups, food pantries, or other community organizations when seeking support • Local government partners with trusted community organizations and churches to disseminate preparedness and recovery information to harder-to-reach populations	• Length of time and confusion around application process and eligibility requirements create barriers to successful participation, particularly for those without the resources to "wait it out" • County has seen extensive damage to private roads, bridges, and culverts, which are not covered by FEMA • Relative lack of federally declared disasters in the area makes it harder for county to access federal mitigation funds
Burke	Flooding, tropical storms, winter storms, severe weather	• Community respondents identify low-income and homeless residents as those most impacted • Public sector respondents focus more on location of hazard, less on socioeconomic factors when talking about impact	• Residents look to insurance or to neighbors, friends, and family as first line of support in disaster • Local fire departments key in facilitating communication and support • Specific efforts made to reach Hispanic, Hmong, and deaf communities	• Residents "suffer a lot of damage that FEMA doesn't cover" (e.g., private roads or driveways being washed out) • Higher level of familiarity with FEMA processes and staff capacity to maintain detailed, accurate, real-time records of disaster recovery expenses contribute to greater success in accessing funds, but not all communities have that

County (NC)	Hazards	Vulnerability and Impact	Experience of Support	Accessing FEMA Aid
Edgecombe	Flooding, hurricanes, fires, heavy rain	• Predominance of Black communities in low-lying, flood-prone areas • Black communities, low-income households, renters, and residents of mobile home parks identified as most impacted	• Local government mitigates risk through buyouts, elevations, floodplain regulations, and improvements to infrastructure • Information on hazards and recovery resources communicated through hotlines, radio, flyers, town hall meetings, social media, annual mailings, word of mouth, and in-person presentations • Specific efforts made to reach the elderly community and growing Hispanic/Latinx population	• Strong FEMA presence following disaster, but presence not sustained despite continued displacement • Unclear eligibility criteria, confusion around varying requirements for different programs, and delays in the application process create challenges for residents applying for individual aid • Call for more collaboration among local, state, and federal actors in program and policy creation; greater consistency needed in program guidelines and communication of those guidelines before disaster occurs to streamline recovery process
Mecklen-burg	Flash flooding, tropical storms, tornadoes, winter storms, extreme heat events	• People living in low-lying, flood-prone areas and low-income households identified as most impacted • Community respondents also highlight emergency workers, renters, and food-insecure people • Public sector respondents identify Black and Brown communities, homeless, undocumented immigrants, and people with access and functional needs	• Residents rely on friends, family, neighbors, and community organizations for support • Local government distributes hazards info in multiple mediums/ venues, translates materials into Spanish, has a presence at local community events, and goes door-to-door in rural areas to reach as much of the community as possible • Low-income homeowners face barriers to participation in local flood mitigation retrofit program; a new partnership with Habitat for Humanity could help address this barrier	• Multiple respondents impacted personally by flooding and storms, but none had applied for FEMA Individual Aid because it was not available • Process of obtaining FEMA mitigation funding described as slow, bureaucratic, and complex in ways that can compromise the success of the project being funded

Appendix C: Hazard Mitigation and Comprehensive Plans Reviewed

Site	Year	Title
California		
Mendocino	2020	Mendocino County Multi-Jurisdictional Hazard Mitigation Plan
Mendocino	2009	Mendocino County General Plan (2021 Housing and Safety Update)
Tulare	2018	Tulare County Multi-Jurisdictional Local Hazard Mitigation Plan
Tulare	2012	2030 Tulare General Plan (2015 Housing Update)
Ventura	2022	Ventura County Multi-Jurisdictional Hazard Mitigation Plan
Ventura	2020	Ventura County 2040 General Plan
Yuba	2021	Yuba County 2021 Local Hazard Mitigation Plan
Yuba	2011	Yuba County 2030 General Plan (2021 Housing and Safety Update)
Iowa		
Polk	2019	Polk County Multi-Jurisdictional Hazard Mitigation Plan
Polk	2022	Polk 2050 Comprehensive Plan
Scott	2018	Scott County Multi-Jurisdictional Hazard Mitigation Plan
Scott	2008	Scott County Comprehensive Plan
Tama	2021	Tama County Multi-Jurisdictional Hazard Mitigation Plan
Woodbury	2020	2020 Regional Hazard Mitigation Plan
Woodbury	2005	Planning for 2025: A General Development Plan for Woodbury County
Louisiana		
Caddo	2016	Caddo Parish Hazard Mitigation Update
Caddo	2010	Great Expectations: Shreveport-Caddo 2030 Master Plan
Calcasieu	2020	Calcasieu Parish Hazard Mitigation Plan Update
Calcasieu	2017	Coastal Zone Management Plan for Calcasieu Parish
East Baton Rouge	2016	East Baton Rouge Parish Hazard Mitigation Update
East Baton Rouge	2018	FutureBR: A Vision for East Baton Rouge Parish
Madison	2016	Madison Parish Hazard Mitigation Update
North Carolina		
Buncombe	2021	Buncombe Madison Hazard Mitigation Plan
Buncombe	2018	Living Asheville: A Comprehensive Plan for Our Future
Burke	2019	Unifour Regional Hazard Mitigation Plan
Burke	2016	Blueprint Burke: A Strategic Land Use Plan
Edgecombe	2020	Nash-Edgecombe-Wilson Regional Hazard Mitigation Plan
Edgecombe	2014	Edgecombe County Comprehensive Plan
Mecklenburg	2020	Mecklenburg Multi-Jurisdictional Hazard Mitigation Plan
Mecklenburg	2022	Charlotte Future: 2040 Comprehensive Plan