

Rural Resiliency Hubs: An Integrated, Community-Centered Approach to Addressing the Resiliency Divide through Rural Public Libraries

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Abstract

Resilience is often treated as a single-dimension system attribute, or various dimensions of resilience are studied separately without considering multi-dimensionality. Disproportionate effects of disasters on minorities, low-income, hard-to-reach, and vulnerable rural populations call for a community-oriented planning approach to address the “resilience divide.” Rural areas have many advantages, but low population density, coupled with dispersed infrastructures and community support networks, make these areas more affected by natural disasters. This paper will catalyze three key learnings from our current work in public librarians’ roles in disaster resiliency: rural communities are composed of diverse sub-communities, each which experiences and responds to traumatic events differently, depending on micro-geographic and demographic drivers. Rural citizens tend to be very self-reliant and are committed to strengthening and sustaining community resiliency with local human capital and resources. Public libraries are central to rural life, providing a range of informational, educational, social, and personal services, especially in remote areas that lack reliable access to community resources during disasters. Public libraries and their librarian leaders are often a “crown jewel” of rural areas’ community infrastructure. In this paper, we present a community-based design and assessment process for resiliency hubs located in and operated through rural public libraries. The research questions explored in the proposed paper are: 1) Who were the key beneficiaries and what did they need? 2) What was the process of designing a resiliency hub? 3) What did library resiliency hubs provide and how can they be sustained? This resiliency hub study will detail co-production of solutions and involves an inclusive collaboration among researchers, librarians, and community members to address the effects of cascading impacts of natural disasters. Our novel co-design process reflects an in-depth understanding of the complex interactions among libraries, residents, governments, and other agencies by collecting sociotechnical hurricane-related data for Calhoun County, Florida, USA, a region devastated by Hurricane Michael (2018) and hard-hit by Covid-19. We will analyze data from newly developed fusing algorithms and incorporating multiple communities and developed a framework and process to co-design resiliency hubs sited in public libraries. This research leverages a unique opportunity to library-centered policies and technologies to establish a new paradigm for developing disaster resiliency in rural settings. Public libraries serve a diverse population who will directly benefit from practical support tailored to their needs. The project will inform efficient plans to ensure that high-need groups are not isolated in disasters. The knowledge and insight gained from the resiliency hub design process will not only improve our understanding of emergency response operations, but also will contribute to the development of new disaster-related policies and plans for public libraries, with a broader application to rural communities in many settings.

Rural Resiliency Hubs: An Integrated, Community-Centered Approach to Addressing the Resiliency Divide through Rural Public Libraries

Resilience is often treated as a single-dimension system attribute, or various dimensions of resilience are studied separately without considering multi-dimensionality. The increasing frequency of catastrophic natural or man-made disasters affecting rural areas demands holistic assessments of community vulnerability and assessment. Disproportionate effects of disasters on minorities, low-income, hard-to-reach, and vulnerable populations demand a community-oriented planning approach to address the “resilience divide.” Rural areas, i.e., areas of at least 2,500 but less than 50,000 people (United States Census Bureau, 2018), have many advantages, but low population density, coupled with dispersed infrastructures and community support networks, make these areas more impacted by natural disasters.

Resiliency hubs are widely becoming an effective means for augmenting the resiliency of vulnerable populations and preventing the overload of local governments and healthcare systems. A resiliency hub provides a community with a path to address the shocks and stresses they face, empowering action to reduce vulnerability, improve adaptability, and respond effectively to hazards and changing conditions (Colorado Department of Local Affairs, 2019a). Resiliency hubs are enhanced community facilities that serve as gathering places for group activities; sites to access information; and centers for social support services. They can also provide specialized services such as job training and childcare, community programming, resource distribution, communications coordination, and general quality of life enhancement. Local public libraries are often a ‘crown jewel’ of rural areas’ community infrastructure; while these facilities offer a range of services in many communities, we posit that rural public libraries are ideal resiliency hubs.

We place these assets at the center a community-based design and assessment process for resiliency hubs located in and operated through rural public libraries. After we present an overview of resiliency challenges, we summarize our foundational work in Calhoun County, our participating community in the rural Northwest Florida Panhandle. Then, we detail our proposed community-based resiliency hub design process located in and operated through rural public libraries. This proposed process allows us to explore integrated socio-technical research questions including:

- RQ1. *Who are the key beneficiaries and what do they need?* What interactions between community actors, population needs, environment, information, and infrastructure foster disaster resilience in rural communities? How do rural county stakeholders and residents view public libraries?
- RQ2. *What is the process of designing a resiliency hub?* What is the process of co-constructing a resiliency hub design framework that integrates heterogeneous data to account for the interdependency and interconnectivity between social, spatial, environmental, and infrastructural factors in community resilience?
- RQ3. *What do library resiliency hubs provide and how can they be sustained?* How can we address and bridge the response gap and resiliency divide using existing rural libraries as resiliency hubs against natural disasters? What key supports will sustain these hubs?

Through citizen involvement, this knowledge, will frame the decision-making questions relating to the project’s impact and sustainability. Involving community stakeholders more appropriately

identifies measurement strategies and data sources at the community level, to ensure that community members feel heard, understood, and appreciated.

Rural Resiliency Challenges

Resiliency is a system’s ability to maintain or rapidly return to desired functions in the face of a disturbance, adapt to changes, and quickly transform sub-systems that limit current or future adaptive capacity (Meerow et al., 2016). Most of the recent work on resiliency is as a single-dimension system attribute without considering multidimensionality (Sriram et al., 2019; Ulak et al., 2021). The increasing frequency of catastrophic hurricanes has emphasized the need for holistic multidimensional assessments of community vulnerability. Addressing the disproportionate effects of disasters on vulnerable populations requires a community-engaged design. For example, many Florida Panhandle residents are nowhere close to recovering from 2018’s Hurricane Michael, with roofs still covered with tarps, jobs in short supply, and daily life in flux. This region has a long history of being impacted by adverse weather events and is likely to experience more natural disasters in the future, as Figure 1 indicates.

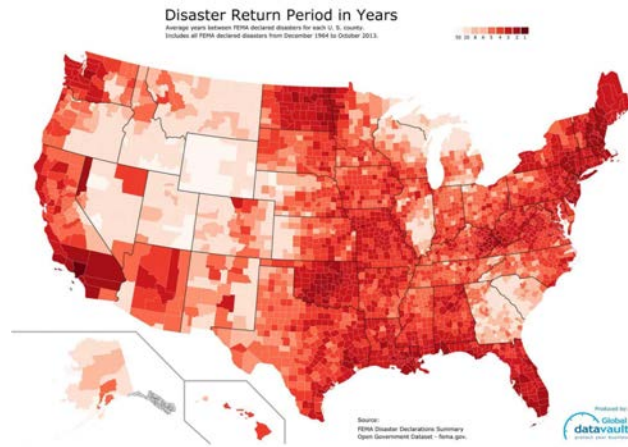


Figure 1. Frequency of U.S. Natural Disasters (FEMA 2018)

As Figure 1 indicates, Florida is hard hit by national disasters. Northwest Florida experiences a Federal Emergency Management Agency (FEMA)-declared disaster every one-two years, including hurricanes and other severe weather (FEMA, 2021). To complicate matters further, this region has been also been severely affected by the Covid-19 global pandemic (Elliott, 2021). These risks culminate in an almost exact overlay with social vulnerability, as Figure 2 shows.

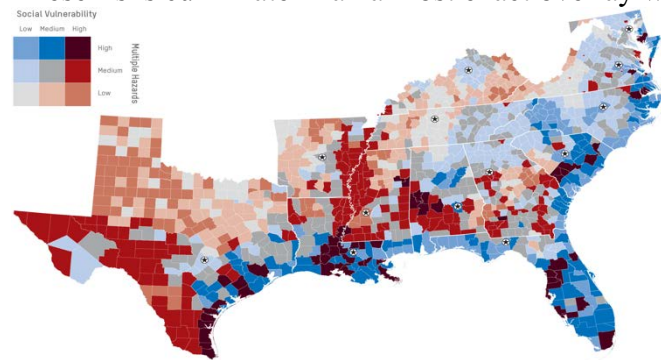


Figure 2. Areas of U.S. Social Vulnerability (Oxfam, 2019).

Social vulnerability measures reflect the potential negative effects on communities caused by external stresses such as natural or human-caused disasters, or disease outbreaks. As Figure 2 indicates, the social vulnerability index (SVI) registers the highest along the Panhandle coast, in the same areas repeatedly exposed to natural disasters. Rural areas account for over 70% of our nation's land (Elliott, 2021) and these areas hold a range of potential advantages, such as environmental amenities, substantial land availability, and affordable cost of living. However, the low rural density, coupled with dispersed infrastructure and community support networks, make them more vulnerable to ongoing disaster impacts.

Rural Communities Are Diverse

Rural American's demographic diversity has grown over the last decade. In 2020, over 24% of rural Americans were people of color (Elliott, 2021). At the community-level, this means that rural local leaders must embrace intentional strategies to nurture demographic diversity and dynamic local economies, including improving the built environment and quality-of-life improvements for vulnerable residents, strengthening social cohesion between neighbors, and nurturing new community-led structures to build capacity and advance community priorities (Elliott, 2021). In Florida, rural counties are composed of large, diverse districts, each of which experiences and responds to traumatic events differently, depending on geographic and demographic drivers, indicating that these improvements must be attuned to the many differences within diverse communities.

Rural Citizens Are Self-Reliant

Rural citizens tend to be very self-reliant and, because their small populations are often deprioritized in a disaster's aftermath, they are committed to strengthening and sustaining community resiliency with local human capital and resources. Covid-19 hit rural America hard for a variety of reasons, including the closure of rural hospitals in recent years; deep poverty; and state discretion for distributing direct economic aid (Ajilore & Willingham, 2020). However, this self-reliance can be self-defeating since, in traumatic situations, higher levels of self-reliance have been associated with significantly higher symptoms of depression and suicidal ideation compared to individuals reporting lower levels of self-reliance. Faced with situations in which rural residents do not have adequate access to resources and supports, self-reliance can actually prolong trauma (Keller & Owens, 2020).

Public Libraries Are Central to Rural Life

Public libraries are central to rural life, providing a range of informational, educational, social, and personal services, especially in remote areas that lack reliable roadway, power, and broadband access to community resources during disasters. A population's vulnerability can be determined by its members' ability to access social, economic, physical, and intellectual community affordances such as health care, information, transportation, food, and utilities. Geographic location can challenge access. Rural citizens in the southeast are particularly at risk, as Figure 2 showed.

In rural communities, public librarians have enabled marginalized users to build social capital through information access, thus widening their awareness and engagement (Johnson & Griffis,

2013). When rural residents make use of information communication technology (ICT) at their libraries, they improve their quality of life by linking to important social services and bridging the digital divide caused by a lack of home Internet connectivity (Hambly & Rajabiun, 2021). Public libraries and librarians work to serve vulnerable, rural populations through various initiatives, programming, services, and outreach efforts; they provide education, technological infrastructure, and tax help to small businesses in rural communities and these information professionals provide support that would otherwise have been inaccessible to community members (Mehra et al., 2017). While librarians in rural areas have faced myriad challenges when attempting to implement community engagement services, they are passionate about the efforts and demonstrated a dedication to serving their communities to the best of their abilities with often limited resources (Howard & Reid, 2016).

Public libraries have a pivotal role in all stages of disaster response and in meeting critical community needs during these times. For example, public libraries offer shelter and physical aid while public librarians work to connect communities with emergency information after storms, care for community members in need, collaborate with partner government and relief organizations, clean up damage, provide continuity of services, and reduce stress (Bishop & Veil, 2013). This support also includes basic activities such as assisting community members with successfully submitting claims to Federal Emergency Management Agency (FEMA), and more personal services such as lost relative location message boards or therapeutic story hours for children suffering post-event trauma (Mardis et al., 2021). However, these critical roles of libraries and librarians are not always well recognized in communities (Bayraktar & Dal Yilmaz, 2018) because the roles of public libraries and librarians in the aftermath of disasters are centered on improvised services and librarian initiative (Celedón et al., 2012). Brobst, Mandel, and McClure (2012) underscored eight major service roles public librarians in disaster situations: 1) institutional supporters, 2) collection managers, 3) information disseminators, 4) internal planners, 5) community supporters, 6) government supporters, 7) educators/trainers, and 8) information community builders. Unfortunately, these roles are rarely formalized, thus leading to uneven disaster response in serial disasters (Mardis et al., 2021).

Foundational Work

In 2020, we completed a one-year pilot for the resiliency hub design process outlined in this paper. We investigated the viability of a novel systems framework focused on the simultaneous interactions between regional infrastructure, the local environment, and communities in response to large scale disasters, such as hurricanes. Our central assumption was that, in the aftermath of a hurricane or other disaster, a rural county (including its infrastructure, local environment, and people) would dynamically converge and better cooperate through the real-time, localized flow of information and services. We identified that public libraries were an obvious hub for such information and services. To test this assumption, we gathered extensive mapping, secondary, and county leader interview data.

From these data, we learned that, although some curated digital geographical data beyond traditional sources (e.g., the U.S. Census) do exist for the region, those data are rarely used for emergency management design. For example, a clear data gap is knowledge of how the people in the region move and interact (e.g., evacuate to shelters, obtain food and water) during times of disasters. This information is critical, for example, to understanding potential infrastructure

demands and efficient resource distribution; developing multi-network resiliency metrics and multivariate risk maps; and identifying population resiliency needs in an overall resiliency hub design. We learned that Calhoun County has mapping software and a sense of the potential for analytical capability, but more training will be necessary to use it effectively, especially as their design capacity is improved by the proposed research.

From our secondary data analysis, which included county commission meeting recordings from before, during, and after Hurricane Michael; locally produced health and recovery reports; U.S. Census data; and state county profile data, we learned that the county's population is diffuse, with large sparsely populated areas, as Figure 5 indicates. We also reviewed county commission meeting transcripts from before, during, and the two months after Hurricane Michael (2018) and learned that commissioners faced challenges unique to each district, with debris removal, service distribution, financial constraints, economic impacts, and reaching vulnerable populations as major stressors. While the existing county disaster plan was not available for review, we were able to review the Community Health Improvement Plan (Calhoun County Department of Health & Liberty County Department of Health, 2020) and Calhoun County Long-term Recovery Plan (Calhoun County Board of County Commissioners, 2020, September) and found that health and mental health service accessibility, as well as making available more information and resources relating to community design, accessibility, housing, economic impacts, infrastructure, flood and debris management, and health and social services were consistent themes.

We interviewed the Calhoun County clerk, chief commissioner, public libraries director, emergency operations coordinator, and the mapping coordinator. The interviewees and meeting attendees spent considerable time discussing the knowledge needed to prepare for, cope with, and respond to a disaster, suggesting that information coordination was a high need. These participants also reported that more alignment between response units was needed to ensure that the county did not continue to experience unequal access to state and federal resources (a *response gap*) and uneven distribution of aid services and resources to vulnerable and hard-to-reach residents (a *resiliency divide*). Local stakeholders urged us to think of disaster resilience in terms of the five county districts, each with its own populations, challenges, and needs. Librarian interviews revealed that public libraries have important, yet often undocumented and not institutionalized, roles in providing health and social, community, infrastructure, natural resources, and housing services to citizens in and beyond the library walls. In prior research (Mardis et al., 2021), we reported that librarians' efforts, while successful, have been disjointed and not formally recognized in disaster response plans

Resiliency Hub Design Process

The proposed project brings together a multi-disciplinary research team with county leaders and librarians to co-design rural resiliency hub plans for public libraries in each Calhoun County district.

Design Framework

A resiliency hub design is not like a disaster response plan. Rather, designing a resiliency hub for a public library branch is a collaborative process to assess current risks, plans and practices, and build resiliency into policies, actions, and investments across multiple sectors. Limitations in

existing resiliency plans lead to response gaps and resiliency divides, but an inclusive co-design process provides an opportunity for many stakeholders to engage deeply to establish a collaborative, long-term roadmap for action. Key components of resiliency hub design include: common understanding of resilience and how it relates to community values; analysis of baseline existing conditions in the community and the shocks and stresses that the community faces; inclusive engagement process that informs the public about the importance of resilience and informs the academic and civic team as it develops hub design framework; vision for the community that is supported by forward-looking goals, actionable strategies, and projects for action; and a roadmap for ongoing multi-disciplinary coordination and action (Colorado Department of Local Affairs, 2019a), much like the Colorado Resiliency Framework (CRF) (Colorado Department of Local Affairs, 2019b). Figure 3 illustrates the CRF, adapted to learnings from our previous research and the resiliency hub co-design process we propose.



Figure 3. Adapted Colorado Resiliency Framework (2019)

Participating Community

Calhoun County, located in Florida’s Panhandle, has many lifelong residents due to its proximity to family, natural surroundings, and affordable living. Calhoun County encompasses approximately 574 square miles and is home to about 14,000. Almost 20% of the population is over the age of 65, with a similar percentage under 18. About one fifth of Calhoun County’s adults are in poverty and only 10% have more than a high school education. Typical of rural communities, Calhoun County is racially and ethnically diverse (25% residents identify as non-white), and much of the workforce is dependent on natural resources like timber for their livelihoods. (Calhoun County Board of County Commissioners, 2020, September). As Figure 2 suggested, Calhoun County’s region is socially vulnerable.

Calhoun county businesses, homes, libraries, and schools are still devastated and rebuilding from the debilitating effects of 2018’s Hurricane Michael. While the rest of Florida may have moved on this from disaster, Calhoun County’s residents are still very much in recovery. Citizens rely

on their public libraries for information and assistance; the libraries are even working through Covid-19. The next hurricane season will begin May 15, 2022 (two weeks earlier than the past) and portends new disasters for an embattled community.

Calhoun County’s conditions provide many opportunities to enhance community resilience, exclusive of disasters. However, the county is highly susceptible to hurricanes, tropical storms, high intensity rainfall, and storm surge winds. The area has experienced, on average, a tropical hurricane every 3.5 years, increasing the threat of damage from high winds. Calhoun County was also particularly hard hit by Covid-19. Since the beginning of the pandemic, at least 1 in 8 residents have been infected, a total of 1,686 reported cases as of late April 2021 (New York Times, 2021). This “layering” of disasters has profound implications for resiliency, especially in the wake of ongoing hurricane recovery.

Calhoun County Public Libraries. Despite challenges, Calhoun County has six public library branches, one per county district, with one district having two: this astounding number shows how this community values its libraries. Figure 4 illustrates Calhoun County’s population distribution and six public library locations, within the five county districts. Each of the five districts is represented by a county commissioner with one county commissioner serving as chief.

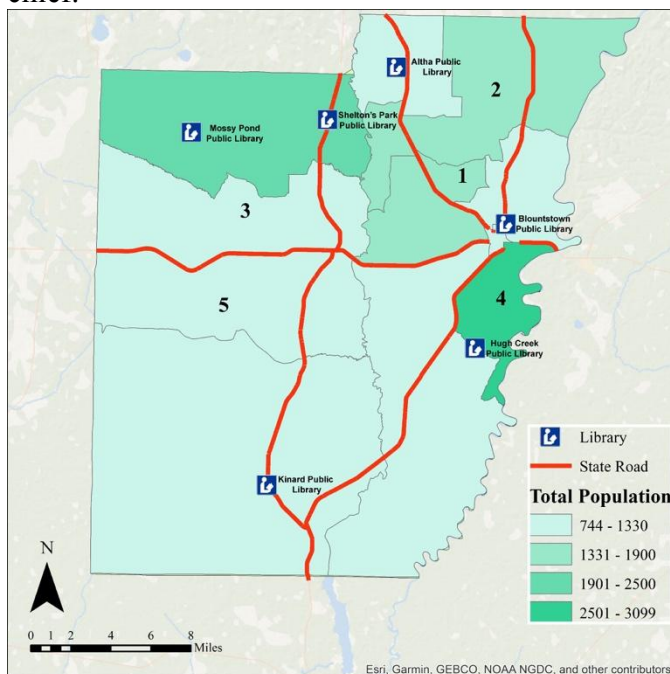


Figure 4. Calhoun County districts with public library branch locations.

As Figure 4 shows, this number of library branches yields a 1:2300 public library branch to resident ratio, which compares very favorably to the national 1:20,500 ratio (American Library Association, 2019, June 14; U.S. Census Bureau, 2016, December 28).

Due to decade-old cuts to rural social services, the libraries now house and staff social services sub-stations for food assistance, social security and disability, and other government assistance programs. All library staff are trained in CPR and first aid; many are bilingual in English and Spanish. In Hurricane Michael, Calhoun County Public Libraries assisted 4,148 residents

(FEMA, 2021). As an example of other ways Calhoun County’s public libraries support resiliency is the library branch built primarily as a shelter. The library building’s foundation extends 20 feet below ground; its windows are tinted shatterproof glass; and it has a commercial generator. The facility includes a second floor with sleeping accommodations; restrooms with showers; a full kitchen; a nurse’s office; and police and fire substations, all situated among the library collections and traditional furnishings. During Hurricane Michael, at this library branch, librarians sheltered and cooked three meals a day for 144 area adults and children. The State of Florida has designated public school buildings as primary shelter locations. However, most standard shelters are underutilized, but special needs shelters, which serve vulnerable and hard-to-reach communities are lacking (Florida Division of Emergency Management, 2017). While school buildings may be unreachable or unused by many Calhoun County residents, the number and location of public library buildings may offer a remedy to this shelter deficit.

Method

Consistent with real-world research designs outlined in the NSF *Common Guidelines for Educational Research* (Institute of Education Sciences [IES] & National Science Foundation [NSF], 2013, August; National Science Foundation & Institute of Education Sciences, 2018, November 28), we propose a mixed-methods, sequential explanatory approach within a multiple case study (Creamer, 2018; Creswell, 2006; Stake, 2006) to quantitatively document Calhoun County resiliency needs via survey, secondary data, mapping, and movement data and qualitatively elaborate on those findings with interviews, ethnography, and community participatory activities. Data will be collected and analyzed in each of Calhoun County’s five districts and integrated through comparative cross-case analysis. The project will be evaluated, and the results disseminated to achieve transferrable and scalable solutions for the entire region and assess multi-community transfer learning algorithms.

We elaborated the CRF (2019b) illustrated in Figure 4 to the resiliency hub design framework illustrated in Figure 5. As Figure 5 suggests, the project will begin with activities designed to integrate data to create maps and metrics that consider multi-network data, yielding spatial assessment and optimization data that will be reviewed through ethnographic fieldwork and other qualitative community activities. Throughout this process, civic and academic leads will conduct the steering committee (community leaders; responders, service providers; county government officials; librarians; health specialists) meetings and listening sessions for citizen feedback.

Work Plan

The proposed community-based participatory design process, piloted in five concurrent case studies in each of Calhoun County’s five districts, will be accomplished through several tasks. In our multiple case study design, the initial research unit is the county district. We will analyze data for each district “case,” then integrate case findings to surface overarching needs and themes, which will inform transferability. Tasks will yield greater insight on the study areas outlined in Figure 5.

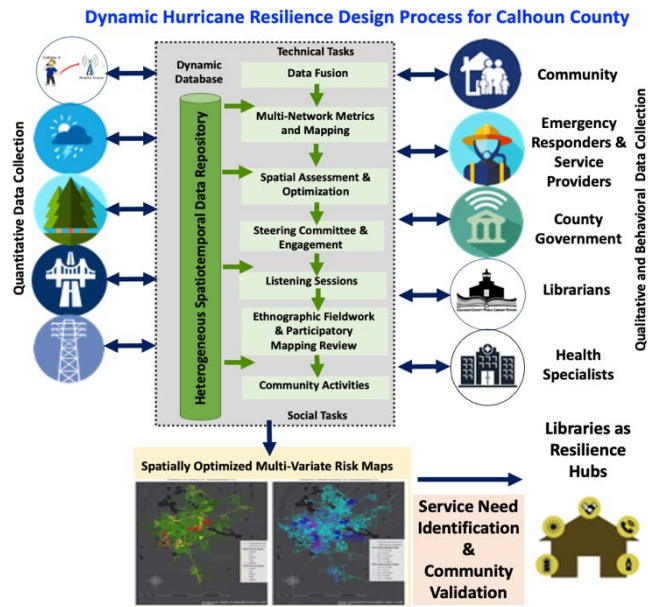


Figure 5. Dynamic Resiliency Hub Library Co-Design Framework

Task 1: Heterogeneous Data Collection and Fusion. Many rural counties such as Calhoun County are facing challenges in collecting, fusing, and analyzing heterogeneous data related to disasters (e.g., closed flooded roadways, power outages, fallen trees, weather reports, public perceptions of emergency events). Little research has focused on integrating these data within and across communities. The main gap in characterizing, modeling, and analyzing the impact of hurricanes is a lack of holistic and multi-methods approaches to consider interdependency and interconnectivity between communities, the environment, and infrastructure. Therefore, a key goal of our project is to utilize the relevant data and identify the hurricane damage by considering the interaction of county ecosystem components through the dynamic information flow in the form of time-dependent data, including: 1) transportation network configuration data; 2) safety data, including high flood and storm surge risk locations, fallen trees, and power poles; 3) location and accessibility attributes for libraries and other key emergency facilities; 4) spatial distributions of populations and other demographic and socioeconomic data; and 5) environmental, and weather-related data, 6) roadway disruptions (e.g., closure, flooding, and debris) data; 7) vegetation data, and 8) real-time cell phone-based population positioning and movement data. We will complement these quantitative analyses with social data to capture librarians', policymakers' and residents' experiences and perspectives on recent disasters and their aftermath. Data on sentiment and perceptions will be collected at the community-level through interactions (e.g., focus groups, interviews) with selected library and county staff, focusing on their emergency plans, operations, and experiences.

Task 2: Developing Multi-Network Resiliency Metrics and Dynamic Multivariate Prioritized Risk Maps. Risks vary across population groups and locations dependent on the available road and power networks. To develop socioeconomic and demographic mathematical metrics to account for infrastructure characteristics, real-time location and movement of people, social factors, land use, and other localized conditions associated with various relief strategies, we will develop will create dynamic multivariate risk maps. These dynamic multivariate

prioritized vulnerability maps require an extensive analysis of the existing system (i.e., demographics, facilities, power and roadway networks), and a real-time investigation of network performance and emergency management plans under hurricane situations. These maps are critical for designing physically and socially resilient libraries and offered services. This metrics will be supported by community outreach to educate residents about the services the library/libraries do and will eventually offer.

Task 3: Dynamically Assessing Spatiotemporal Hurricane Impacts. Multi-layer information and geographic information systems (GIS)-based analysis will highlight variations in exposure risk of different locations and socioeconomic groups to unfavorable health and safety consequences due to potential hurricanes. This series of GIS-based spatial multi-objective optimization models will aim to minimize the restoration time, disruption and suffering involved with critical resource distribution. Spatial optimization models will allow the community to dynamically to plan for and allocate mobile emergency response library hub locations, strategically and hierarchically, based on the information gathered from the creation of the vulnerability maps in Task 2.

Task 4: Assessing Mapping Design Process through Community Perceptions of Vulnerability. Researchers will conduct a participatory mapping project in which they will collect fieldnotes on their experiences and participant observation in the county relevant to disaster preparation and response. Ethnographic fieldwork will focus on identifying knowledge gaps about vulnerable populations and key social context relevant to understanding local preparation and response behaviors. Fieldwork will also track the resiliency hub design process, document challenges that arise, and identify overlooked factors. The integration of human movement data with contextual data from community-based ethnographic perspectives represents a departure in the way that optimization models are typically applied and ultimately utilized in practice. This innovation may further serve to break down barriers between the research and practitioner community, as developing the support infrastructure to facilitate these broad integrations will represent a contribution to both arenas. Researchers will then present maps from Tasks 1-3 to community members during listening sessions (Task 5). Mapping will include data on housing materials, perceived vulnerable populations and hazard-prone areas, resource-sharing networks (e.g., kin, faith-based), and where people go during hurricanes.

Task 5: Community Health and Safety Assessments. Health and safety assessments will engage citizens in informational and therapeutic programs to enhance well-being and document local resiliency needs. In our prior research, we learned that psychological trauma, particularly among children, was a key issue for this community (Mardis et al., 2020). The research team includes behavioral health professionals who will administer an assessment tool to identify possible psychological trauma and measure children's ability to identify and talk about their emotions. Calhoun County Emergency Management personnel will offer citizens on-the-spot assistance in registering for the behavioral health community notification system. These events inform and gather unmet needs from children and parents. Outcomes and data will be shared at steering committee meetings and listening sessions.

Task 6: Steering Committee Meetings. The steering committee includes library, community, and academic leads representing each county district to document community needs and assets.

They will convene regularly to document hub designs, provide feedback on commonalities and convergences in each case, and advise on co-designed library resilience hub sustainability.

Task 7: Listening Sessions. Public listening sessions are opportunities for citizens in each county district to learn about project tasks, progress, and sustainability and, most importantly, provide their insights, experiences, reflections, support, and concerns. This critical feedback will be captured, transcribed, and fed into the resiliency hub designs.

Task 8: Data Integration and Stakeholder Validation. In this multiple case study, we will collect quantitative, then qualitative data to assemble case study analyses by district. When the case studies are complete, we will integrate data across all five cases. Instrumental case studies and integrated data will be used to answer the research questions.

- To answer RQ1, *Who are the key beneficiaries and what do they need*, we will use ethnographic field work, community activities, listening sessions, and steering committee input to validate heterogeneous data multi-network resiliency metrics, dynamic multivariate prioritized risk maps, and dynamic spatiotemporal hurricane impact assessments. These validated maps and data sets will document locations and resilience needs of all Calhoun County citizens and inform library resiliency hub design.
- To answer RQ2, *What is the process of designing a resiliency hub*, civic and academic leads, with the steering committee will review meeting minutes, transcripts, calendar, documents and detail the step-by-step process used in each district's library resiliency hub design.
- To answer RQ3, *What do library resiliency hubs provide and how can they be sustained*, we will compare the case studies for common design elements and variables that influenced differences.

Benefits and Sustainability

In this paper, we detailed a proposed resiliency hub design framework and process that entails the co-production of solutions and involves an inclusive collaboration among researchers, librarians, and community members to address the effects of cascading impacts of natural disasters. The novel co-design process detailed in this paper reflects an in-depth understanding of the complex interactions among libraries, residents, governments, and other agencies by collecting sociotechnical hurricane-related data for Calhoun County, Florida, a region devastated by Hurricane Michael (2018) and hard-hit by Covid-19. These data will inform co-designed resiliency hubs sited in public libraries. This research, though in its initial stages, leverages a unique opportunity for the co-development of integrated library-centered policies and technologies to establish a new paradigm for developing disaster resiliency in rural settings. Public libraries serve a diverse population who will directly benefit from practical support tailored to their needs. The project will inform efficient plans to ensure that high-need groups are not isolated in disasters. The knowledge and insight gained from disseminating the study's results will not only improve our understanding of emergency response operations, but also will contribute to the development of new disaster-related policies and plans for public libraries, with a broader application to rural communities in many settings.

The proposed strategy entails co-production of solutions and involves an inclusive collaboration among researchers, librarians, and community members to address the effects of cascading

impacts of natural disasters. This research leverages a unique opportunity for the co-development of integrated library-centered policies and technologies to establish a new paradigm for developing disaster resiliency in rural settings. Public libraries serve a diverse population who will directly benefit from practical support tailored to their needs. The project will inform efficient plans to ensure that high-need groups are not isolated in disasters. The knowledge and insight gained from the results of this project will not only improve our understanding of emergency response operations but will also contribute to the development of new disaster-related policies and plans for public libraries, with a broader application to rural communities throughout the United States.

Conclusion

While libraries are not often thought in disaster response, they are considered central to community well-being, especially in small and rural communities. Librarians are citizens and stewards of the community; as county officials, they are also dedicated to implementing the practices that local government has developed to strengthen and support citizens. Librarians are trusted resiliency brokers, gathering resources in the public library information hubs and distributing them where they are most needed (Ghorbanzadeh et al., 2020). The efforts' effectiveness depends on the extent to which libraries are seen as part of the disaster response ecosystem. This proposed work is novel in that it elevates an under-recognized, yet trusted, resiliency source (i.e., libraries) and intentionally builds them into a community disaster resilience design. While libraries and librarians are undoubtedly supporting communities throughout the U.S., this proposed work brings together academic research translation experts, librarians, and cognizant county stakeholders to envision resiliency hubs that bridge local disaster response divides.

Resiliency hub designs must be composed of a wide array of interlinked social, economic, informational, and infrastructural data; we propose to convene community leaders, unavailable to work together during disaster response, to co-design, with librarians, academic partners, and citizens, resiliency hubs for each district. The design process outlined in this paper is a novel combination of librarians, local officials, citizens, industry partners, regional leaders, and academic partners to develop a new design approach to intentionally supporting residents through public library resiliency hubs. This project is important because the study unit is the county district, not just the entire county. This granular approach ensures that the proposed resiliency hub design process will consider the needs of diverse subregions within state, and even in other coastal and adjacent communities.

As we determine what the “new normal” for librarianship looks like post-Covid-19, we propose that librarians can only move forward in concert with their communities. By making explicit and formalizing public libraries' roles in community resiliency, librarians will have the tools and local support they need to be positioned in community response to many kinds of serial, layered, and catastrophic adverse events.

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References

- Ajilore, O., & Willingham, C. Z. (2020, September 21). *The path to rural resilience in America*. <https://www.americanprogress.org/issues/economy/reports/2020/09/21/490411/path-rural-resilience-america/>
- American Library Association. (2019, June 14). *Library statistics and figures: Number of public libraries in the United States over time*. <https://libguides.ala.org/librariystatistics/numberoflibrariesvertime>
- Bayraktar, N., & Dal Yilmaz, Ü. (2018). Vulnerability of elderly people in disasters: A systematic review. *Turkish Journal of Geriatrics/Türk Geriatri Dergisi*, 21(3).
- Bishop, B. W., & Veil, S. R. (2013). Public libraries as post-crisis information hubs. *Public Library Quarterly*, 32(1), 33-45.
- Brobst, J. L., Mandel, L. H., & McClure, C. R. (2012). Public libraries and crisis management: roles of public libraries in hurricane/disaster preparedness and response. In C. Hagar (Ed.), *Crisis information management* (pp. 155-173). Chandos Publishing.
- Calhoun County Board of County Commissioners. (2020, September). *Calhoun County long-term recovery plan: A strategy for recovery following Hurricane Michael: Draft*. <https://calhouncountygov.com/uploads/2020/09/draft-calhoun-county-long-term-recovery-plan.pdf>
- Calhoun County Department of Health, & Liberty County Department of Health. (2020). *Community health improvement plan*. Retrieved October 1 from http://calhoun.floridahealth.gov/programs-and-services/community-health-planning-and-statistics/_documents/Calhoun_CHIP.pdf
- Celedón, A., Pequeño, A., Garrido, M., & Patin, B. (2012). *Disaster response in Chile: Public libraries as critical communication and information infrastructure*.
- Colorado Department of Local Affairs. (2019a). *Developing a resiliency framework*. <https://coresiliency.squarespace.com/developing-a-resiliency-framework>
- Colorado Department of Local Affairs. (2019b). *Disaster resiliency framework*. <https://coresiliency.squarespace.com/developing-a-resiliency-framework>
- Creamer, E. G. (2018). *An Introduction to Fully Integrated Mixed Methods Research*. Sage Publications.
- Creswell, J. W. (2006). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. Sage Publications.
- Elliott, D. (2021, August 5). *Gulf coast businesses struggle to stay open as covid-19 outbreaks surge among staff*. <https://www.npr.org/2021/08/05/1025168418/gulf-coast-businesses-struggle-to-stay-open-as-covid-19-outbreaks-surge-among-st>
- Federal Emergency Management Agency [FEMA]. (2021, September 30). *OpenFEMA dataset: Disaster declarations summaries - v2*. <https://www.fema.gov/api/open/v2/DisasterDeclarationsSummaries>
- FEMA. (2021). *Fact sheet: Recovery at a glance - Calhoun County*. <https://www.fema.gov/press-release/20210318/fact-sheet-recovery-glance-calhoun-county-7>
- Florida Division of Emergency Management. (2017, November 8). *2018 statewide emergency shelter plan*. <https://www.floridadisaster.org/globalassets/dem/response/sesp/2018/counties/calhoun-county.pdf>

- Ghorbanzadeh, M., Ozguven, E. E., Tenney, C. S., Leonarczyk, Z., Jones, F. R., & Mardis, M. A. (2020). Natural Disaster Accessibility of Small and Rural Libraries in Northwest Florida. *Public Library Quarterly*, 1-20.
<https://doi.org/doi:10.1080/01616846.2020.1772027>
- Hambly, H., & Rajabiun, R. (2021). Rural broadband: Gaps, maps and challenges. *Telematics and Informatics*, 60, 101565. <https://doi.org/https://doi.org/10.1016/j.tele.2021.101565>
- Howard, V., & Reid, H. (2016). Connecting with community: The importance of community engagement in rural public library systems. *Public Library Quarterly*, 3(3), 188-202.
<https://doi.org/10.1080/01616846.2016.1210443>
- Institute of Education Sciences [IES], & National Science Foundation [NSF]. (2013, August). *Common guidelines for education research and development*.
<https://ies.ed.gov/pdf/CommonGuidelines.pdf>
- Johnson, C. A., & Griffis, M. R. (2013). The effect of public library use on the social capital of rural communities. *Journal of Librarianship and Information Science*, 46(3), 179-190.
<https://doi.org/10.1177/0961000612470278>
- Keller, E. M., & Owens, G. P. (2020). Traditional rural values and posttraumatic stress among rural and urban undergraduates. *PLOS ONE*, 15(8), e0237578.
<https://doi.org/10.1371/journal.pone.0237578>
- Mardis, M. A., Jones, F. R., Pickett, S. M., Gomez, D., Tenney, C. S., Leonarczyk, Z., & Nagy, S. (2020). Librarians as natural disaster stress response facilitators: Building evidence for trauma-informed library education and practice. Association for Library and Information Science Education Annual Conference, virtual.
- Mardis, M. A., Jones, F. R., Tenney, C. S., & Leonarczyk, Z. (2021). Constructing knowledge about public librarians' roles in natural disasters: A heuristic inquiry into community resiliency in Florida's Hurricane Michael. *Library Trends*, 69(4), 768-789.
<https://doi.org/10.1353/lib.2020.0046>
- Meerow, S., Newell, J. P., & Stults, M. (2016). Defining urban resilience: A review. *Landscape and Urban Planning*, 147, 38-49.
- Mehra, B., Bishop, B. W., & Partee, R. P. (2017). Small business perspectives on the role of rural libraries in economic development. *The Library Quarterly*, 87(1), 17-35.
<https://doi.org/10.1086/689312>
- National Science Foundation, & Institute of Education Sciences. (2018, November 28). *Companion guidelines on replication and reproducibility in education research: A supplement to the Common Guidelines for Education Research and Development*.
<https://ies.ed.gov/pdf/CompanionGuidelinesReplicationReproducibility.pdf>
- New York Times. (2021, September 30). Tracking coronavirus in Calhoun County, Florida. *New York Times*, . <https://www.nytimes.com/interactive/2021/us/calhoun-florida-covid-cases.html>
- Sriram, L. M. K., Ulak, M. B., Ozguven, E. E., & Arghandeh, R. (2019). Multi-network vulnerability causal model for infrastructure co-resilience. *IEEE Access*, 7(1), 35344-35358. <https://doi.org/10.1109/ACCESS.2019.2904457>
- Stake, R. E. (2006). *Multiple Case Study Analysis*. The Guildford Press.
- U.S. Census Bureau. (2016, December 28). *Census Bureau projects U.S. and world populations on New Year's Day*. <https://www.census.gov/newsroom/press-releases/2016/cb16-tps158.html>

Ulak, M. B., Sriram, L. M. K., Kocatepe, A., Ozguven, E. E., & Arghandeh, R. (2021). Resilience characterization for multi-layer infrastructure networks. *IEEE Intelligent Transportation Systems Magazine*. <https://doi.org/10.1109/MITS.2021.3049368>

United States Census Bureau. (2018). *Urban and rural*. <https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html>.