

University-Public Partnerships for Disaster Recovery: Promoting Community Resilience Through Research, Teaching, and Engagement

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Abstract

This article describes a state-supported, multiuniversity, interdisciplinary effort to address unmet disaster recovery needs identified by six hard-hit, low-capacity North Carolina communities following Hurricane Matthew. At the request of the director of the North Carolina Division of Emergency Management and the state governor, university officials created a team of faculty, practitioners, and students called the Hurricane Matthew Disaster Recovery and Resilience Initiative (HMDRRI). This 2-year program delivered research, teaching, and engagement activities of the sort that are not typically undertaken by federal or state emergency management agencies, insurance providers, or nonprofit organizations. HMDRRI also offered graduate students in land-use planning, landscape architecture, and architecture opportunities to help provide community assistance under the supervision and mentoring of faculty and practitioners. An overarching goal of the program was to help build greater rural resilience, an outcome that has received inadequate attention from academics and practitioners.

Hurricane Matthew struck the state of North Carolina in October 2016, causing more than \$4.8 billion in losses and killing 25 individuals (Stewart, 2017). The storm was particularly devastating to small and midsize communities along rivers in eastern North Carolina due to its heavy rainfall, which exceeded 18 inches in some areas (Stewart, 2017). A number of preevent conditions in the region exacerbated disaster-related impacts in the small rural towns on the state's coastal plain. These conditions included declining agricultural economies, an outmigration of residents, a high number of low-income individuals and families living in flood-prone areas, and low levels of governmental capacity to manage disaster recovery programs (Jurjonas & Seekamp, 2018).

In an effort to address these concerns, including needs not traditionally handled by disaster recovery programs, the director of the North Carolina Division of Emergency Management and the state governor asked university faculty at the University of North Carolina at Chapel Hill (UNCCH) and North Carolina State University (NCSU) to provide targeted assistance to six hard-hit, low-capacity communities. This partnership emerged from a long-standing relationship between the primary author of this paper (Smith) and the director of the North Carolina Division of Emergency Management. During Hurricanes Fran (1996) and Floyd (1999), Smith served as the assistant director for hazard mitigation in the North Carolina Division of Emergency Management, where he led

the oversight of several risk reduction and disaster recovery programs. He also served as an adviser to then governor James B. Hunt Jr. during this time.

Based on the state's request for assistance, university officials created the Hurricane Matthew Disaster Recovery and Resilience Initiative (HMDRRI), which focused on six communities: Windsor, Princeville, Kinston, Seven Springs, Lumberton, and Fair Bluff, North Carolina. Each community is located in the coastal plain of eastern North Carolina, a region characterized by significant flood hazard risk and low to modest capacity to recover from disasters. A history of flooding has helped to define these communities, given their proximity to rivers (Figure 1).

Each jurisdiction has flooded numerous times, and several were impacted by Hurricanes Fran and Floyd. Hurricane Matthew, like previous disasters that have affected the state, illuminated long-standing preevent conditions that have hindered these communities' capacity to address a multitude of postdisaster challenges. The small to midsize HMDRRI towns and cities, founded in the 1700s and 1800s, are characterized by declining populations, high rates of poverty, and low median household incomes (Table 1).

Overview of the HMDRRI

Following a discussion with the North Carolina Division of Emergency Management and the governor's office about the proposed goals and tasks to be performed, an interdisciplinary

Figure 1. HMDRRI Communities



Note. Provided by the NC State Coastal Dynamics Design Lab

team of faculty, students, and practitioners from UNCCH and NCSU was assembled. The team included housing and land-use planners, architects, and landscape architects. Many of the HMDRRI team members worked in the Hurricane Matthew Disaster Field Office, a facility that served as a base of operations for hundreds of state and Federal Emergency Management Agency (FEMA) officials tasked with disaster recovery. The director of the North Carolina Division of Emergency Management provided office space for HMDRRI faculty, students, and practitioners that allowed them to meet regularly with state and federal officials, including those tasked with disaster recovery policy formulation and grant management (Figure 2).

The 2-year effort, which focused on deep community engagement, evidence-based policy formulation, and student education, was made possible by the financial support of the North Carolina state legislature; the North Carolina Division of Emergency Management; the North Carolina Policy Collaboratory, a program that supports applied research; and the North Carolina Community Foundation, which provides grants to address community needs across the state. The funding supported nine faculty, including two from UNCCH and seven from NCSU; two practitioners; and 19 graduate students. Of the 19 students, 11 were in the Department of City and Regional Planning at UNCCH and eight were in the College of Design at NCSU pursuing degrees in landscape architecture and architecture.

Table 1. Characteristics of HMDRRI Communities

HMDRRI communities	Year founded	Pre-Matthew population (2010)	Post-Matthew population (2018)	Land (in square miles)	Median household income (2020)	Poverty level (2020)
Windsor	1768	3,630	3,339	2.83	\$51,689	21.05%
Princeville	1865	2,082	1,939	1.53	\$38,455	35.76%
Kinston	1791	21,732	20,083	16.90	\$53,945	29.45%
Seven Springs	1894	110	110	0.30	\$34,169	14.29%
Lumberton	1787	21,545	20,840	15.80	\$53,042	33.46%
Fair Bluff	1873	947	889	2.20	\$31,211	21.21%

Figure 2. HMDRRI Students in the Hurricane Matthew Disaster Recovery Field Office



Most UNCCH students were enrolled in a 10-credit-hour graduate certificate program in natural hazards resilience based in the Department of City and Regional Planning. UNCCH faculty modified existing courses prior to and during the HMDRRI operation to include a 1-credit-hour, certificate-required speaker series class in which disaster recovery experts gave guest lectures. The certificate also included a 3-credit-hour housing course that focused on three of the HMDRRI communities. At NCSU, faculty hosted a student competition called DesignWeek in which interdisciplinary student teams from NCSU and UNCCH worked with assigned communities participating in HMDRRI. During the design studio, students were tasked with developing community-based design options and supporting disaster recovery policies. Each team presented its results to invited community officials and a panel of faculty and practitioners who critiqued their project presentations, provided feedback, and awarded prizes to the top projects. One design was subsequently submitted to the American Society of Landscape Architects and received a national student design award.

Following the culmination of HMDRRI, NCSU developed a 13-credit graduate certificate in Disaster Resilient Policy, Engineering, and Design. The certificate, approved in the fall of 2020, is housed in NCSU's Department of Landscape Architecture and Environmental Planning. Students have the option of choosing one of three tracks in the certificate program: policy, led by the university's Department of Public Administration; engineering, led by the Department of Civil, Construction, and Environmental Engineering; or design, led by the Department of Landscape Architecture and Environmental Planning.

In addition to taking required classes and participating in intensive design studios, students were involved in key aspects of HMDRRI. They participated in public meetings and design workshops, conducted land suitability analyses, collected and summarized pertinent data used in local recovery plans, analyzed housing issues, assisted faculty and practitioners with the formulation of proposed state policy, created materials to guide the use of open space left after the acquisition of flood-prone housing, and visualized varied policy and project-based options for communities to consider (Figure 3).

Figure 3. UNCCH Student Meredith Burns Conducting Interview With Fair Bluff Resident During Fair Bluff's Annual Watermelon Festival



The HMDRRI team included two seasoned land-use planning practitioners who possessed extensive experience working with local governments, states, and FEMA on a range of disaster recovery issues. Each practitioner was assigned to work with three communities, and the practitioners' primary responsibilities involved conducting regular meetings with local officials, coordinating public meetings, helping faculty to mentor students, identifying unmet needs, and managing the assistance provided by the HMDRRI team.

Applied Research Undergirding HMDRRI Program Design

The HMDRRI team's approach was informed by concurrent research undertaken by the two authors of this study (Smith, Nguyen, et al., 2018). The parallel study, which was conducted at the request of the Obama White House and funded by the U.S. Department of Homeland Security's Office of University Programs, explored the state of disaster resilient design education at U.S. colleges and universities and produced recommendations based on the findings. While resilient design

education is a rapidly growing field, limited research exists on this topic. Five design-based disciplines were studied, including architecture, building sciences, engineering, landscape architecture, and land-use planning.

Research methods included an internet search of existing resilient design programs, key informant interviews with identified experts, the use of a review committee, and case studies of identified programs. The findings highlighted a number of areas in which existing programs were lacking and identified the importance of improving the commitment of university administrators, developing new models and organizational structures, building interdisciplinary teams, emphasizing field and studio-based projects, creating flexible and responsive curricula, and meeting the needs of stakeholders (Smith, Nguyen, et al., 2018). The activities described next were informed by the findings of the study.

Assistance Provided by the HMDRRI Team

As one of its first tasks, the HMDRRI team met with representatives of the six communities to identify needs that FEMA, state agencies, insurance

providers, and nonprofit organizations were not addressing. The HMDRRI team and community representatives identified several key issues: (a) proposing appropriate uses of land left vacant after the acquisition and demolition (or “buyouts”) of hazard-prone housing, (b) minimizing the loss of tax base due to the impacts of buyout programs, (c) designing housing prototypes to replace housing demolished following buyouts, (d) conducting land suitability analyses to determine areas within the towns’ jurisdictional boundaries (and outside the 100-year floodplain) where replacement housing could be constructed, (e) developing flood retrofitting strategies for historic downtowns located in the floodplain, and (f) writing disaster recovery plans to help communities link identified needs with postdisaster assistance (Table 2).

Housing Relocation (Buyout) Assistance. Housing acquisition programs, commonly called buyouts, involve the acquisition and demolition of homes located in hazardous areas and the conversion of the land to open space in perpetuity. This hazard mitigation (i.e., risk reduction) measure is intended to reduce future property damage and to limit injuries and deaths. It is often challenging to integrate residents’ and local officials’ concerns, including potentially innovative solutions, into highly bureaucratic, narrowly defined buyout programs (Baker et al., 2018; Greer & Brokopp Binder, 2017). All six HMDRRI communities expressed concerns about using the resulting open space and addressing

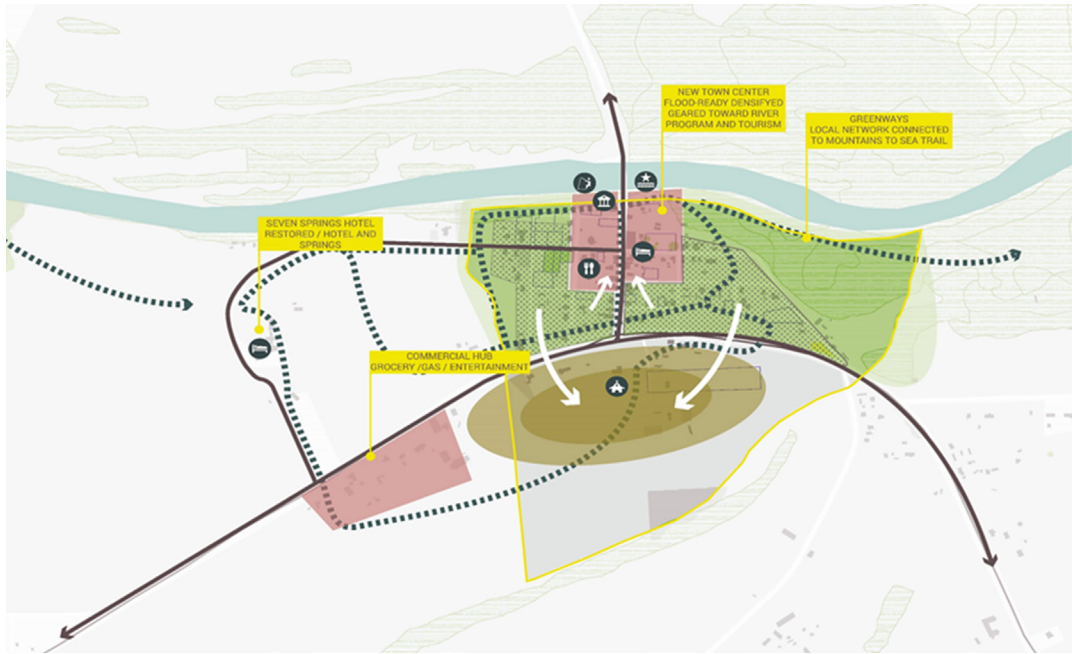
the loss of tax base following the acquisition and demolition of homes. Questions surrounding the eligible uses of postbuyout land, including how to go about creating a public asset as opposed to an administrative burden, pose significant challenges for many communities, particularly smaller locales with fewer resources and staff (Zavar & Hagelman, 2016). In an effort to address these concerns, a team of NCSU landscape architecture faculty and students developed community-specific proposals for the postbuyout land, including greenways, parks, community gardens, memorials, water retention areas, and other ideas based on local conditions, public input, and expert opinions (Figure 4). Students also explored an alternative housing relocation option for homes slated to be acquired and demolished (Figure 5).

The loss of tax base is another problem facing local governments that participate in buyouts. This issue is relevant both in rural communities composed of a small number of overall housing units and in larger municipalities where a significant percentage of the overall housing stock is slated for acquisition (Freudenberg et al., 2016; Lewis, 2012; Maly & Ishikawa, 2013; McCann, 2006; Smith, 2012, p. 65; Smith, 2014, pp. 206–207; Wiley, 2018). Student teams from UNCCH, working with HMDRRI practitioners and local officials, conducted a land suitability analysis in each community to identify replacement housing sites as part of a strategy to offset lost tax revenue associated with buyouts of flood-

Table 2. Assistance Provided by HMDRRI to Each Community

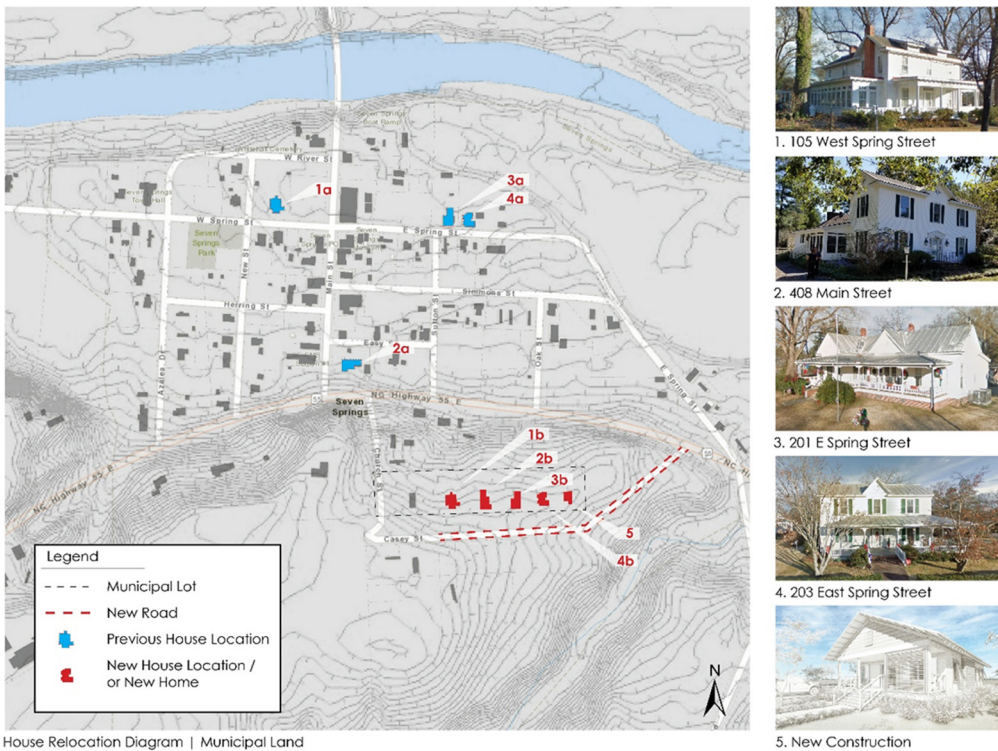
Assistance provided	Windsor	Princeville	Kinston	Seven Springs	Lumberton	Fair Bluff
Postbuyout open space planning	x	x	x	x	x	x
Land suitability analyses	x	x	x	x	x	x
Housing prototypes	x	x	x	x	x	x
Downtown floodproofing studies	x			x		x
Disaster recovery plans		x		x	x	x
Design workshop		x				

Figure 4. Homeplace Open Space Schematic, Seven Springs, North Carolina



Note. Created by the NC State University Coastal Dynamics Design Lab.

Figure 5. Proposed Relocation of Homes Slated for Acquisition and Demolition in Seven Springs, North Carolina



Note. The image on the left depicts the original locations of the structures (blue building footprints) and the proposed new home locations (in red). The photos numbered 1–4 on the right are images of the homes slated for acquisition and demolition, and photo 5 shows an example HMDRRI housing prototype. Created by Nora Schwaller, PhD candidate in the Department of City and Regional Planning at UNCCH.

prone housing. Land outside the floodplain and within town boundaries deemed suitable for development included: (a) land zoned for residential development, (b) parcels suited for single-family housing and larger lots that could support multifamily housing, and (c) property located near supporting infrastructure (i.e., water lines, sewer systems, and roads (Figure 6). Faculty and students from the NCSU School of Architecture developed a series of replacement housing prototypes, including floor plans and building elevations. Housing types were created to reflect the local vernacular and had estimated construction costs similar to the value of the homes slated for acquisition and demolition (Figure 7).

Floodproofing Historic Downtowns.

Windsor, Seven Springs, and Fair Bluff, each of which have historic downtowns located in the floodplain, sought assistance from HMDRRI to assess the impacts of potential floods on downtown buildings and to suggest flood retrofitting strategies that would not mar the historic integrity of existing structures. In an effort to accomplish this goal, the HMDRRI team worked with the Association of State Floodplain Managers (ASFPM; <https://www.floods.org>), FEMA, the state National Flood Insurance Program (NFIP) coordinator, and members of North Carolina's Historic Preservation Office (Figure 8). ASFPM is a professional association composed of government, private-sector, nonprofit, and academic members whose mission is to promote education, policies, and activities that mitigate current and future flood

losses, reduce the costs and human suffering caused by flooding, and protect the natural and beneficial functions of floodplains. One way in which ASFPM provides community assistance is through subcommittees, including one focused on the retrofitting of flood-prone structures. Members of this subcommittee volunteered to assist the HMDRRI team and its communities. FEMA provided staff with expertise in the assessment of damages and associated repair costs. The state's NFIP coordinator, who is responsible for ensuring local compliance with the NFIP, participated in the flood retrofitting study, as did the state historic preservation officer, who coordinates the recordation and protection of historic properties.

The team of experts identified potentially useful flood retrofitting strategies, such as the construction of permanent impermeable barriers (some disguised as planter boxes) and the deployment of temporary flood control structures. In some cases, the group deemed buildings unsuitable for repair and recommended that they be demolished. Student teams created images of what the retrofitted downtowns might look like to help convey design options that town officials could consider and that federal and state agencies could provide funding to implement (Figure 9).

Disaster Recovery Planning. Predisaster recovery planning remains uncommon across the United States, often resulting in the development of postdisaster recovery plans that strive to coordinate the range of assistance that follows an event with identified needs (Berke et al., 2015; Smith, 2012;

Figure 6. Land Suitability Analysis, Town of Fair Bluff



Note. Created by Christian Kamrath, former graduate student in the Department of City and Regional Planning at UNCCH. The location of the proposed 36-unit affordable housing development (in the upper-right corner of the figure) was informed by the results of the land suitability analysis.

Figure 7. Replacement Housing Prototype



Note. The image represents one of several housing options created by NCSU architecture students at the Coastal Dynamics Design Lab.

Figure 8. Downtown Flood Retrofit Team in Windsor, North Carolina, Comparing Notes



Note. Pictured here are the state floodplain administrator, representatives from FEMA, the state historic preservation officer, and a film crew in Windsor, North Carolina. The footage collected has been used to create a documentary titled *Three Towns / Three Rivers* that tracks the recovery of several HMDRRI communities. Note the elevated air conditioning unit in the background, which provides some evidence of the height at which Windsor requires new construction to be elevated in order to comply with their local flood damage prevention ordinance.

Smith & Wenger, 2006; Smith, Martin et al., 2018). Four of the six communities, Princeville, Seven Springs, Lumberton, and Fair Bluff, asked the HMDRRI team to develop postdisaster recovery plans. The plans described each town's unique character, hazard vulnerability, and local needs. Based on this background information, the HMDRRI team, in partnership with residents and local officials, identified a community vision for each town, as well as goals, policies, and projects that spanned housing, public facilities, infrastructure, environment, health, land use, finance and administration, economic development, and workforce development. The team also created a series of recommended actions, associated funding opportunities, and implementation strategies. In addition to helping town officials identify unmet needs, the plans helped to inform the emerging funding strategies of state agencies, the state legislature, and nonprofit organizations. Plan appendices included HMDRRI tasks where applicable, such as downtown flood retrofitting strategies, land suitability analyses, open space strategies, and housing prototypes.

Princeville Design Workshop. The Princeville Design Workshop focused on helping local officials and residents think through varied

Figure 9. Visualization of Downtown Fair Bluff With Flood-Damaged Structure Removed and Replaced With a Public Space



Note. The public space is intended to tie Main Street in the foreground to the Lumber River in the background. Image created by Nora Schwaller, PhD candidate in the Department of City and Regional Planning at UNCCH.

design options for a 52-acre parcel of land adjacent to the town limits. This tract had been purchased by the state for the purpose of relocating some of the town's critical public facilities, housing, and commercial developments to a site outside the 100-year floodplain (Figure 10). The town of Princeville, incorporated in 1865, was the first African American municipality settled by formerly enslaved people after the Civil War (Blue, 2000). Given the historical and cultural significance of the town, the workshop sought to balance risk reduction and increased disaster resilience with deep place attachment among its residents. On the first day of the event, more than 50 state and federal officials gave presentations addressing the overall purpose of the workshop, hazard risk reduction and floodplain management, sociocultural factors, and the status of proposed repairs to the town's levee.

In 1999, Hurricane Floyd's floodwaters had overtopped the levee, inundating the entire jurisdiction with water that reached the rooftops of most homes, including historic houses constructed by early settlers. Unlike many other HMDRRI communities devastated by Hurricane Floyd, the town chose not to pursue the acquisition and demolition of hazard-prone homes. Following Hurricane Matthew, the town decided to pursue a combination of buyouts and elevation of flood-damaged homes. In an effort to address these

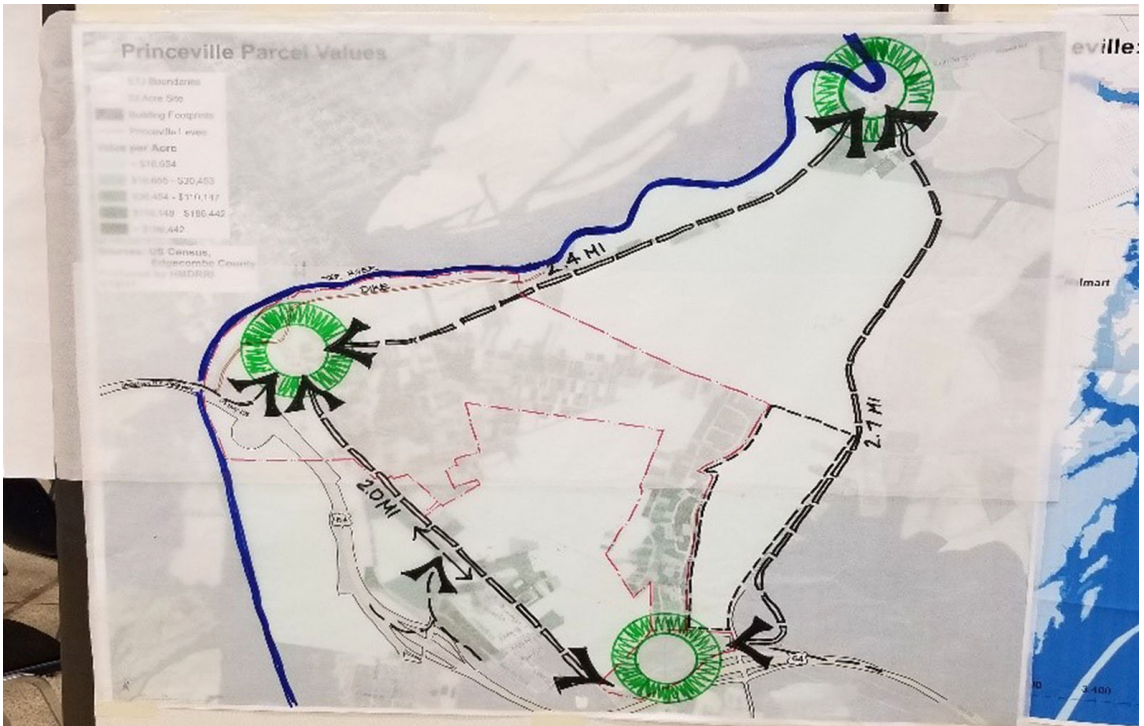
complex challenges, HMDRRI officials invited a multidisciplinary team of architects, landscape architects, land-use planners, and engineers to participate in the workshop. Team members included faculty, students, and practitioners, including a number of nationally recognized African American design professionals (Figure 11).

While the design team focused on gleaning insights from presentations, site visits, and ongoing meetings with Princeville's public officials and citizens, the North Carolina Division of Emergency Management provided invaluable financial and logistical support. Specific tasks included funding the 5-day event; covering travel costs for out-of-state design professionals; managing feeding operations; identifying lodging; purchasing necessary workshop materials; and providing 24-hour IT support, communication enhancements, and security (Figure 12). This unique arrangement allowed the design team to focus on conducting necessary research, creating varied design options, hosting public venues to solicit feedback, and revising their drawings accordingly.

Educating the Next Generation of Practitioners and Scholars

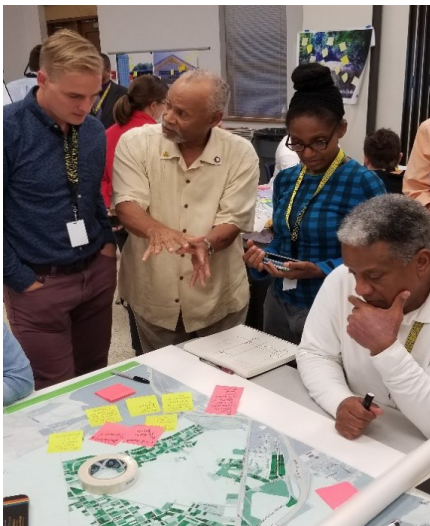
The students hired to assist with the HMDRRI effort included those pursuing the UNCCH graduate certificate and those engaging in NCSU

Figure 10. The Town of Princeville’s Physical Footprint and Key Landmarks



Note. Key landmarks (represented by large circles) in Princeville (denoted by a horseshoe-shaped town boundary) include (from left to right), Freedom Hill (the original settlement site), the 52-acre parcel of land slated for new development, and Shiloh Landing, an area where enslaved people were removed from barges floating on the Tar-Pamlico River to be sold in nearby Tarboro, North Carolina. The graphic highlights the proximity of the three locales. This could be used to inform an economic development strategy tied to tourism, including the construction of a possible visitor’s center on the 52-acre site, which is adjacent to a highway frequented by tourists on the way to a number of beach communities.

Figure 11. Princeville Design Workshop



Note. From left to right: Adam Walters, former NCSU landscape architecture student; Milton Bullock, Princeville town councilman; Yasmin Fozard, executive director of the Institute of Landscape Art and Sustainable Spaces; and Marshall Purnell, NCSU architecture Professor of the Practice.

Figure 12. North Carolina Division of Emergency Management Officials Who Coordinated the Management of and Logistical Support for the Princeville Design Workshop



Note. From left to right: Brian Falconer, logistics section chief; Joe Wright, deputy director; and Steve Powers, area coordinator.

studios focused on disaster recovery topics. Several students have continued to work in this field during their university careers and upon graduation, as highlighted in Table 3.

Issues, Challenges, Policy Lessons, and Recommendations

The activities undertaken by the HMDRRI team represent a unique university-based approach to deep community engagement driven by locally identified needs and supported by state government officials. In this section, we describe how this type of effort could be improved, including how the lessons derived from this process could be used to inform and institutionalize similar programs in the future. Specific recommendations include: (a) developing preevent protocols to improve access to data; (b) creating tailored classes for students involved in postdisaster assistance; (c) engaging with communities over longer time horizons; (d) maximizing the role of universities in disaster recovery, recognizing existing strengths, limitations, and institutional constraints; and (e) building institutional arrangements that harness what we know about disaster recovery, applying it through deep and enduring community engagement, and continuing to learn and translate this knowledge into action.

Develop Preevent Protocols to Improve Access to Local, State, and Federal Data

Much of the work undertaken by the HMDRRI team relied on accessing or creating data to inform design and planning-based tasks. Gaining access to federal and state data proved highly problematic and time-consuming. In many cases, the data was impossible to procure, which has been a long-standing problem among researchers and practitioners involved in disaster recovery efforts. For instance, because the HMDRRI team could not access parcel-level data tied to individuals participating in the buyout, faculty were unable to document the demand for new replacement housing. In turn, the team had trouble estimating the cost of replacement housing construction, determining whether those participating in the buyout would stay in the same community, and evaluating whether the proposed replacement housing prototypes designed by NCSU faculty and students appealed to them. The lack of data further hindered the team's ability to gauge the amount of federal and state funding required to build replacement housing based on an estimated demand for varied housing types among buyout recipients.

The problems associated with data access should be addressed through the creation of clear, actionable preevent data sharing agreements among university faculty and federal, state, and local governments. Developing these agreements before disaster strikes would allow stakeholders to analyze critically important data in a more timely manner. In the case of the HMDRRI work, accessing this data would have enabled faculty, students, and practitioners to create design and policy recommendations that could have helped federal and state agencies. These government groups continue to struggle with the administration of post-Matthew recovery programs more than 4 years after the disaster.

The HMDRRI team also agreed to serve as a key point of contact for FEMA's Community Planning and Capacity Building (CPCB) group, a cadre of federal officials and contractors who help communities identify disaster recovery needs and facilitate the delivery of federal assets to address them. CPCB staff often help communities develop postdisaster recovery strategies and plans, a role that aligned with the efforts undertaken by the HMDRRI team. However, numerous efforts to develop a collaborative strategy with FEMA were largely ineffective due to an apparent misunderstanding of how CPCB staff could best integrate with the HMDRRI program.

The ability for state and local officials to capitalize on CPCB's assistance during postdisaster recovery efforts is another long-standing challenge, which is unfortunate because attention to pre- and postdisaster recovery planning remains insufficient among federal, state, and local government agencies and organizations (Smith, 2012, p. 42; Smith, Martin, et al., 2018, pp. 609–610). Following Hurricane Matthew, challenges included (a) a lack of support for HMDRRI-proposed CPCB activities from the federal coordinating officer (FCO), who is responsible for coordinating the work of federal agencies, and (b) FEMA's focus on postdisaster federal programs, which placed less attention on the role of economic development, land-use planning, design, and the delineation of needs as described by local governments.

The aforementioned problems warrant the development of preevent agreements among universities, states, and the CPCB officials tasked with providing postdisaster assistance as well as the development of an FCO cadre that is better versed in the benefits of university teams providing pre- and postdisaster recovery planning assistance. To avoid coordination problems, CPCB staff should

Table 3. Sample of HMDRRI Students, Their University Affiliations, Work Performed, and Current Position

Students	University affiliation	Research and HMDRRI activities	Ongoing schoolwork or position after graduation
Amanda Martin	UNCCH	Dissertation focused on buyouts in Princeville and Kinston, North Carolina; housing strategy; Princeville workshop	Chief resilience officer, North Carolina Office of Recovery and Resiliency
Ashton Rohmer	UNCCH	Master's project focused on buyouts; recovery planning; land suitability analysis; community meetings	Urban planner, AECOM (consulting firm)
Devon McGee	Duke University	Published master's project paper in Natural Hazards Review focused on buyouts following Hurricane Sandy; land suitability analysis; recovery planning	Coastal management specialist, Michael Baker (consulting firm)
Christian Kamrath	UNCCH	Master's project focused on land suitability analysis in HMDRRI communities; land suitability analysis; recovery planning; community meetings; Princeville workshop	Office of Resilience, Miami-Dade County, Florida
Meredith Burns	UNCCH	Recovery planning; community meetings; Princeville workshop; downtown flood retrofitting	Recovery planner, South Carolina Emergency Management Division
Darren Williams	UNCCH	Master's project focused on economic resilience; Princeville workshop; recovery planning; community meetings	Pursuing PhD at Massachusetts Institute of Technology
Nora Schwaller	UNCCH	Dissertation focused on housing relocation; recovery planning; downtown flood retrofitting	Pursuing PhD at UNCCH
Adam Walters	NCSU	Homeplace; community meetings; recovery planning; Princeville workshop	Senior designer, Site Collaborative
Danielle Chelles	NCSU	Homeplace	Artist/freelance designer
James Popin	NCSU	Homeplace	Architectural designer, Weinstein Friedlein Architects
Lindsey Naylor	NCSU	Homeplace; Princeville workshop	Landscape designer, Design Workshop
Stephanie Heimstead	NCSU	Homeplace; Princeville workshop	Architectural designer, AECOM (consulting firm)
Ezgi Balkanay	NCSU	Homeplace	Pursuing PhD at NCSU

be encouraged to be nimble enough to adapt and provide federal assistance to states, university teams, and others engaged in local recovery efforts without clear preevent agreements, up to and including developing agreements in the aftermath of a disaster. In all cases, agreements should be aligned with established emergency management and planning programs when possible, as they are recognized by those tasked with recovery and provide a greater degree of standing in the aftermath of federally declared disasters (Smith, 2012, pp. 345–367).

Create Classes Tailored for Students Involved in Disaster Recovery Efforts

The difficulty associated with gaining access to postdisaster data is one of many valuable lessons that students learn when working in the postdisaster environment. Students also learn related lessons about the slow, rules-based, bureaucratic nature of disaster recovery; the high levels of conflict across stakeholder groups; the role of power and political access to decision-makers; and the lack of preevent planning for postdisaster recovery, which hampers governance-based approaches that undergird resilient outcomes (Smith, 2012). These lessons are invaluable to students who seek to work in this space; they better prepare students for the realities of disaster recovery and enable them to identify creative solutions to these systemic problems.

Students possessed a wide range of prior work experiences. Some were visibly shaken by the dysfunction they observed in the Hurricane Matthew postdisaster environment, including the conflict-laden nature of public meetings and the reactive policy-making process. The courses described earlier in this article and regular mentoring helped expose students to a base level of disaster management knowledge, including the realities of postdisaster public meetings; the political nature of disaster recovery decision-making; the realization that many communities fail to adequately plan for postdisaster recovery; and the fact that federal agencies, states, and local governments are often ill-equipped to deal with the complexities of this process. Students could be better prepared for the eventuality, prevalence, and severity of potential conflict during disaster recovery through education and training efforts, such as teaching students public engagement techniques, offering courses in alternative dispute resolution, conducting role-playing exercises, and engaging in more interactive, field-based education programs that span longer timeframes than typical semester-based courses.

Explore Longer Time Horizons for Ongoing Community Engagement and Develop University-Public Protocols to Achieve This Goal

Even though the majority of the HMDRRI team worked closely with members of the six communities and the state for 2 years following Hurricane Matthew, it became clear that this was not enough time to link all of the deliverables created by the HMDRRI team to new and emerging administrative institutions and programs generated by state and federal officials. More than 4 years after the storm, many disaster recovery programs were just beginning, including the Hazard Mitigation Grant Program and the Community Development Block Grant Program–Disaster Recovery, which are slated to buyout, elevate, or demolish and rebuild a new structure in situ to current codes and standards.

The HMDRRI team intended to take the steps necessary to create a more thoughtful and comprehensive approach to the acquisition and relocation process than is typically undertaken by state and local governments. In many cases, the buyout process is dominated by a one-dimensional focus on administering the grant rather than working toward a more holistic approach spanning the entire buyout lifecycle (Smith, Saunders, & Vila et al., 2021). HMDRRI team members had planned to interview potential buyout applicants about their desires to return to their community or move elsewhere. The idea was to measure the demand for varied types and locations of replacement housing following the acquisition and demolition of homes in HMDRRI communities, including the desirability of the homes designed by NCSU architecture students and faculty and the attractiveness of areas identified through land suitability analysis techniques. Two years after the storm—and at the conclusion of HMDRRI funding—many residents participating in the buyout program did not know where they stood in the process, and as a result, the state justifiably discouraged the HMDRRI team from interviewing them. Failure to complete interviews limited the HMDRRI team's ability to try to address the intertwined problems of risk reduction, the potential loss of tax base, the long-term economic viability of towns, and the question of what to do with the resulting postbuyout open space.

Four years after Hurricane Matthew, NCSU faculty and students continue to work with targeted communities such as Lumberton and Princeville. In Lumberton, NCSU is helping to develop and implement open space plans by writing guidance documents and hazard mitigation grants to fund

the targeted buyouts of properties that were not acquired initially but are part of proposed greenway system. In Princeville, work has included a class project that constructed a mobile museum and highway signage noting the historical significance of the town. This project also coordinated local planting and neighborhood beautification projects involving citizens, community officials, students, and faculty. NCSU faculty and students are also conducting a comparative study of buyouts in the United States and New Zealand to identify ways to improve what remains a complex and unnecessarily slow process (Saunders & Smith 2020; Smith, Saunders, & Vila et al., 2021; Smith & Saunders in press). As this article was being written, UNCCH faculty and students were in the process of interviewing local officials involved in the buyout process and developing recommended policy options.

The ongoing activities undertaken by former members of the HMDRRI team have evolved organically through relationships developed with community officials and signify university faculty's commitment to providing much-needed assistance. The assistance provided, however, does not represent a codified program among universities and public sector agencies. Nor did the HMDRRI team develop a process to evaluate the program's effectiveness. The remaining recommendations offer several ways to address these issues.

Maximize the Role of Universities in Disaster Recovery, Recognizing Strengths, Limitations, and Institutional Constraints

Universities have an important, albeit often underutilized, set of strengths that are particularly relevant to postdisaster recovery. Universities house expertise that spans land-use planning and design—skills that are often lacking in the emergency management–dominated state and local agencies tasked with recovery (Smith, 2012, pp. 356–359). The types of assistance provided should be tempered by the reality that involving design professionals without a clear understanding of disaster recovery programs or failing to apply sound engagement approaches when developing proposed reconstruction strategies can lead to attractive renderings and plans that are not implementable at the local level (Evans-Cowley & Gough, 2009). Furthermore, it is incumbent on university faculty to adopt sound, ethical research, teaching, and engagement strategies that respect how this work affects those in the throes of a disaster (Gaillard & Peek, 2019).

Community-based research and engagement is becoming more prevalent among faculty across U.S. colleges and universities, including those with an explicit focus on disaster resilience (Smith Nguyen, et al., 2018). While some types of postdisaster research have been supported through quick response grants funded by the National Science Foundation and the University of Colorado Boulder's Natural Hazards Center, a similar funding stream does not exist to support the rapid identification and deployment of university-led teams focused on engagement over long timescales (Smith, 2008; Smith 2012, p. 105). HMDRRI was fortunate to have access to substantial federal and state funding to create an administrative framework used to identify, create, and deploy interdisciplinary teams. The efficacy of the team's efforts was bolstered by a close working relationship with the North Carolina Division of Emergency Management, which facilitated the provision of office space, access to governmental officials, and additional resources needed to conduct identified actions. Finally, both NCSU and UNCCH, including administrators and faculty, consciously decided to make a multiyear commitment to the effort, which required allowing faculty to amend their teaching, research, and engagement activities to align with HMDRRI. This innovative program, however, represents a one-time approach that has not been codified by state emergency management officials or university faculty.

While postdisaster conditions provide rich learning opportunities, the timing of a disaster cannot be planned. In an effort to take advantage of real-time learning laboratories that are created in the postdisaster environment, university programs should create resilient design curricula that are responsive to opportunities that arise, especially in situations in which resilient design teaching, research, and practice can provide tangible benefits to communities, governments, nonprofits, and others. Furthermore, university departments should establish resilient design strike teams capable of rapidly responding to postdisaster situations and needs as well as flexible funding sources and curricula that can be used to pay for expenses—such as travel, student and faculty time commitments, and community meetings—when situational opportunities arise. In order to prepare for such events, university departments, with the support of their respective deans and other administrators, should establish different types of courses. Examples may include 1-credit, 1-day, 5-day, and mini-courses, or departments may offer

internship credits that can allow faculty to quickly develop courses in the aftermath of a disaster. To facilitate this, administrators should allow faculty to teach these courses at flexible times, including between semesters, and for faculty to receive course teaching credit for doing so.

Long-term community engagement by faculty can prove difficult. In many cases, university faculty (especially junior members) are already overloaded with required teaching loads, student commitments, and involvement in multiple departmental committees. Senior faculty members often have a preidentified research agenda that may or may not focus on disaster recovery or engagement. Further hindering faculty's ability to make long-term commitments are existing university reward systems that emphasize the production of peer-reviewed journal articles and require teaching loads tied to departmentally defined classes rather than a commitment to community engagement or the teaching of elective classes that are not part of the core curriculum (Smith, Nguyen et al., 2018).

Build Institutional Arrangements That Translate Knowledge Into Action

One way to confront these challenges is to develop predisaster cadres of faculty (including interdisciplinary teams across departments) that are willing and able to provide the types of assistance offered by HMDRRI on relatively short notice, thereby ensuring a breadth of available options when a disaster strikes. Development of faculty groups may necessitate recruiting junior faculty, including those who may not realize that disaster research and engagement provides a conduit to studying a broad array of issues. This would also require developing preevent agreements and contracts with state and federal agencies involved in disaster recovery; these agreements would spell out the ability of university faculty, students, and engagement experts to offer the types of assistance requested and create a clear process of program evaluation and improvement based on a review of the work. The elements described in this recommendation could be achieved by modifying preexisting disaster contracts that state and federal agencies routinely use to fund an array of disaster recovery activities provided by consultants. Another option involves including university faculty in interstate mutual aid agreements codified through the Emergency Management Assistance Compact, a contract between states that allows resources and technical experts to be shared in the event of a federally-declared disaster.

Assisting communities on short notice over long timescales requires that university administrators commit to giving more than lip service to faculty who propose to undertake such efforts. Facilitating greater faculty involvement would require modifying the reward structure (i.e., tenure) to place greater value on this type of work (Smith, Nguyen, et al., 2018). The transfer of knowledge in disaster recovery can be bolstered by advances in applied research findings derived from long-term observations of the recovery process. The information gleaned from these efforts should be better injected into policy and programs and shared with practitioners and students who will ultimately serve as the next generation of researchers and practitioners.

Conclusions

Lessons drawn from HMDRRI include: (a) the need to develop strategies that tackle unmet needs not addressed by stakeholders traditionally tasked with hazard mitigation and disaster recovery efforts; (b) the importance of building governance strategies that include nontraditional partners such as university faculty and students; and (c) the need to create evidence-based policy and design solutions that are visually depicted, thereby better conveying their physical manifestations to broad audiences, including residents, government officials, and others providing assistance. A key framing issue worth remembering is the need to confront the myriad challenges facing small towns, including targeted pre- and postevent strategies aimed at advancing rural resilience.

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